REPORT OF FINDINGS
OF
INDEPENDENT REVIEW OF
KEY TECHNICAL, INTERFACE AND
CONSTRUCTION CONCERNS

NINE MILE POINT NUCLEAR STATION — UNIT 2
NIAGARA MOHAWK POWER CORPORATION

VOLUME I

Prepared by

STONE & WEBSTER ENGINEERING CORPORATION
NEW YORK OFFICE

J.O. NO. 12177.73

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Review Project Engineer Albert A. Patterson Date 5-13-83

A.A. Patterson

STONE & WEBSTER

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1.0 INTRODUCTION AND OBJECTIVES

A task force was formed to provide an independent design review of specific technical areas of engineering, design, and construction activities on the Nine Mile Point Nuclear Station - Unit 2 (NMP2). The review was authorized by Niagara Mohawk Power Corporation (NMPC) in its Letter No. 5668 dated February 1, 1983.

The review was performed by an independent Stone & Webster Engineering Corporation (SWEC) task force comprised of engineers not connected with the NMP2 Project. They used the latest revisions of all the applicable project documents describing the systems, equipment, structures, and procedural and construction concerns in the scope of work.

The lead engineers on the task force all have had supervisory experience or have served in lead engineer capacities on several nuclear projects. They are technically qualified in all phases of engineering and design in their specific discipline.

The review, conducted over 12 weeks, covered significant portions of two important plant safety-related systems categorized by 62 specific tasks: the service water system and the onsite emergency ac power system. In addition, the flow of design information and the process of incorporating changes into the engineering, design, and construction of plant systems and structures were reviewed. The review team represented each major technical discipline (power, electrical, control systems, engineering mechanics, and structural) as well as construction. Supported by seven support engineers during the peak review period, the review team applied approximately 3,700 man-hours to review more than 450 documents, in addition to reviewing applicable sections of the Final Safety Analysis Report (FSAR).

The report consists of two volumes. This volume includes the introduction and objectives, overall conclusions both on a specific task basis and a discipline basis, scope of work, review method used, and detailed descriptions of each task and related findings. All the potential discrepancy reports and construction findings are included in the appendix of this volume. All the procedures used to perform the review are included in the second volume.

The systems selected have a high degree of importance to plant safety and are composed of diverse discipline tasks. Included are a wide range of activities that SWEC executes to engineer, design, purchase, and define construction requirements. These systems were selected on the basis that the engineering was close to completion and has undergone a representative change process.

These systems were also used to provide data for evaluating the interdiscipline communication process and making judgments on the constructibility of designs.

These systems were expected to provide an adequate sample of NMP2 Project engineering, design, and construction activities in order to provide findings representative of a more extensive review.

The three specific areas that this review encompassed were:

- Technical - plant systems

  - Service water system
  - Onsite emergency ac power system

- Interdiscipline communication

- Constructibility of the designs

Each of the two plant systems were reviewed to ensure conformance to applicable design criteria and FSAR commitments, and the ability to perform its intended function. Selected components were reviewed for their compliance with the project equipment qualification program. Each system was reviewed for compliance with the applicable post-TMI requirements defined in NUREG-0737 and for single failures, including a review of the Failure Modes and Effects Analyses (FMEA).

Interdiscipline communication considered the proper flow of engineering information from inception to final design and that the proper communication and data flow exist between all engineering disciplines, design functions, vendors, and the construction site. In addition, the change control process was reviewed to confirm that all engineering changes were incorporated into the project documents as required.

Documents and procedures were reviewed for constructibility in accordance with the following criteria:

- Minimize the effects from support interferences

- Documents define constructible designs

- Documents are clear and complete

The constructibility review also considered the implementation of the suggested actions contained in the Task Force Report on Review of Piping Erection Problems, issued March 19, 1981 (referred to as the ITT Grinnell Report).

Open Item Reports (OIRs) were issued if an apparent inconsistency was found; that is a failure to meet a stated commitment and/or that the system or procedure would not perform the required function. If an OIR remained unresolved, it was then issued as a Potential Discrepancy (PD). Twenty-seven Potential Discrepancy Reports were issued. These reports summarized the basic review findings in specific terms. The development of recommended corrective actions was not included within the scope of this review.

2.0 CONCLUSIONS

2.1 GENERAL

The review resulted in numerous findings of different relative importance. This section describes the conclusions drawn from the findings contained in Section 5 of this report.

The two plant systems reviewed will operate in accordance with their requirements as defined in the FSAR; however, some noncompliance with Design Criteria and FSAR commitments was found. Detailed conclusion statements for each system and for each discipline are listed in this section.

A review of interdiscipline communication concerns relating to the flow of design information between all disciplines, including vendors and construction groups, indicates the project generally is following their administrative procedures and that adequate communication exists. There are conclusion statements in this section that outline several specific concerns.

The review of constructibility concerns indicates that the construction schedule can be maintained, although there are several specific areas that need improvement to further ensure meeting the schedule. These concerns are outlined in this section.

2.2 SERVICE WATER SYSTEM - GENERAL

Based on the review results for the safety-related modes of service water system operation, it can be concluded that the system has been adequately designed to service the plant cooling requirements.

The piping and pipe support design of the service water system appears to be adequate for the required service. However, for some pipe stress and support designs, further documentation may be required to demonstrate compliance with all FSAR commitments.

A general revision of the service water system hydraulic calculations is currently being conducted to account for small bore piping design and other changes to the system service in recent years. This analysis is proceeding in a reasonable manner. The results should be carefully monitored for possible impact on plant design.

2.3 ONSITE EMERGENCY AC POWER SYSTEM - GENERAL

The review of the onsite emergency ac power system has indicated that it will perform the intended function as described in the FSAR. However, the margin available under certain operating modes, e.g., auxiliary boiler transformer supplying the emergency bus, is low. Some deviations from Design Criteria and FSAR commitments were found, and these need to be resolved.

2.4 POWER

2.4.1

Except for a minor discrepancy in cooling load versus committed service water flow for the diesel generator control rooms (see Section 5.1.2.1), service water flow rates committed to in the FSAR are adequate to meet the specified cooling requirements of the essential components listed in Table 9.2-1.

2.4.2

The service water system design temperature and pressure are adequate.

2.4.3

There is adequate NPSH and pump submergence for all credible modes of service water system operation.

2.4.4

The design to prevent freezing at the offshore and onshore intakes is adequate.

2.4.5

The design to utilize one of the two redundant intake structures to discharge service water if the normal discharge path is unavailable for service is adequate.

2.4.6

Biological fouling of the service water system by Asiatic clams is not a concern for the NMP2 site.

2.4.7

The TMI requirements that relate to cooling provided by the service water system are being met.

2.4.8

Valves omitted in the service water system failure modes and effects analysis must be included for completeness to comply with NRC requirements. However, the effects of including and assuming single failures of the omitted valves is not expected to lead to complete service water system failure.

2.4.9

Adequate ventilation has been provided in the service water pump bays; however, a backup calculation is needed to complete the paper trail.

2.4.10

Engineering Change Notices (ECNs) are being effectively incorporated into the service water system flow diagrams.

2.4.11

Except for minor discrepancies, ventilation supplied in support of the onsite emergency power system appears to be adequate.

2.4.12

The calculations for the standby and HPCS diesel generator fuel oil storage and oil transfer pump capacity do not currently demonstrate compliance with the requirements of ANSI Standard N195-1976. To meet the FSAR commitments in this regard, the calculations must be revised.

2.4.13

Specification No. NMP2-E031A, Diesel Generator, requires an updating of its data sheets to reflect actual interface data for air startup and cooling water.

2.4.14

Single failures identified in the FMEA analyses for systems supporting onsite emergency ac power systems are being adequately addressed by the project.

2.5 ELECTRICAL

2.5.1

Electrical calculations in certain areas did not comply with the FSAR commitments and Design Criteria requirements.

2.5.2

A calculation to support the minimum cable size selected for short-circuit duty in Electrical Design Criteria EDC-4 does not exist.

2.5.3

The main one-line drawings were consistent with the FSAR commitments. Portions of the emergency 4.16-kV bus one-line drawings were inconsistent with the FSAR commitments and ESKs.

2.5.4

The electrical specifications are in general compliance with FSAR requirements and calculation results.

2.6 CONTROL SYSTEMS

2.6.1

The logic system and electrical elementary design are in general agreement with the FSAR operational requirements. However, based on the number of minor discrepancies identified, additional checking should be performed to provide assurance that the electrical construction drawings have not incorporated these inconsistencies.

2.6.2

The main control board design will not meet certain guidelines of NUREG-0700 concerning Human Factors Review; modifications may be required. In FSAR Section 1.10, the NMP2 project has committed to a final control room design review based on guidelines of NUREG-0700 during 1983 or 1984.

2.6.3

Special service control valves are being purchased based on unverified results. Vendor calculations are required to ensure proper function within system requirements.

2.6.4

Although one potential discrepancy was identified, the instrument design drawings were generally in accordance with acceptable design practices and reflected the proper flow of engineering information.

2.6.5

Additional verification is required to ensure that instrumentation parameters are compatible for equipment within the same measurement loop.

2.7 ENGINEERING MECHANICS

2.7.1

Service water piping appears to be adequately designed and maximum stresses are within allowable stresses as specified in the FSAR and ASME III Code. However, some additional documentation is required in order to demonstrate that all necessary FSAR commitments have been considered.

2.7.2

The pipe support design appears to satisfy its intended function, although not all design loads were current. In some variable spring hanger designs, documentation was unavailable to confirm whether the FSAR commitment to design for dynamic movements is met. A review is required to verify that the variable spring hangers can accommodate dynamic movements.

2.7.3

The service water pumps, thermal relief valves, and 4,160-V metal-clad switchgear are qualified to perform their safety-related function during a postulated seismic event.

2.7.4

Calculations that provide the design input loads to the suppression pool hydrodynamic ARS generation are satisfactory.

2.8 STRUCTURAL

2.8.1

With the exception of the screenwell building discharge bay walls, the review of structures was limited mainly to secondary structures such as embedment plates, cable tray supports, and conduit supports. The review results were satisfactory in the areas reviewed.

2.8.2

The determination of the allowable loads on standard embedment plates to include the flexibility criteria of NRC IE Bulletin 79-02 has not yet been completed, but it appears that an appropriate analytical method is being used. These data will be used in a future Structural Verification Program in which all of the applied loads from pipe supports, cable tray and conduit supports, and seismic duct supports on every embedment plate will be compiled. All of the embedment plates then will be checked for their ability to resist the applied loads.

The design methods used for the cable tray supports and conduit supports were found to be correct, but the impact of the new seismic amplified response spectra on the designs must be assessed. New seismic amplified response spectra and profiles were issued for the primary containment and the reactor building in December 1982. Still to be assessed is the possible impact of the new response profiles on the structures.

2.8.3

The design of the discharge bay walls in the screenwell building was reviewed and found to provide adequate strength to resist the applied loads.

2.9 EQUIPMENT QUALIFICATION

The Equipment Qualification Program has the mechanics to provide adequate support of FSAR Section 3.11 commitments; however, procedures for the implementation of the program are lacking in both the project and Equipment Qualification Section areas. Documents that will provide the necessary controls and directions for the implementation of the program are in review and approval cycles and must be issued for use as soon as possible. Adherence to these new documents and procedures will be necessary to ensure complete support of the FSAR Section 3.11 commitments.

2.10 INTERDISCIPLINE COMMUNICATION

The interdiscipline communication review has indicated that, in general, the project is following acceptable administrative procedures and that adequate communication exists between various project disciplines. The interdiscipline communication findings listed in Section 5.7 will not have any adverse impact on the design phase and subsequent construction effort.

2.11 CONSTRUCTIBILITY

2.11.1 ITT Grinnell Report

The recommendations of the March 1981 report for improving the ITT Grinnell effort have been implemented. There is room for continued improvement and the need to begin concentrating on system completion.

2.11.2 Supports Interferences

There is no generic problem causing project-wide supports interferences. The many reported interferences are not atypical given the project's size and complexity. Limitations imposed by project documents on construction resolution of Category I or seismic support interferences, particularly conduit supports, has contributed to the number of reported interferences. In addition, rework of electrical conduit to clear interferences with supports may be 30 percent for scheduled conduit and more for unscheduled conduit.

The overall installation schedule should not be affected provided contractors and site engineering acknowledge the scope of expected interferences and work together for a timely resolution of them. Any additional flexibility given to the construction forces to resolve interferences themselves, without engineering involvement, would help in achieving the overall construction schedule.

The constructibility of the systems supported by embedment plates, such as piping, cable trays, conduits, and seismic ductwork could be affected by the results of the future Structural Verification Program. The results of the program could possibly show an overstress condition in existing plates, leading to required support changes. It is important that the timing of the program be such that any required support changes can be made without impacting the construction schedule.

2.11.3 Installation Practicality

The engineering products are by and large constructible and generally provide for a practical installation.

The relatively few first-issue documents remaining to be issued and those requiring revision to bring them to 100 percent complete, e.g., Category I/seismic conduit drawings (EE), and tubing drawings (EK) in the reactor building and diesel generator area, could benefit from additional checking and/or construction (SWEC or contractor) review.

Greater installation tolerances across all disciplines would generally enhance the practicality of installation, provided contractors exhibit a willingness to utilize them only when a practical installation cannot be achieved as given on the drawing.

2.11.4 Clarity and Completeness of Drawings

As to clarity, no generic problems affecting remaining documents appear to exist. Constant attention to the clarity of vendor drawings and later revisions of engineering drawings is required.

As to completeness, the large number of E&DCRs against engineering drawings has rendered many drawings incomplete. While the construction forces may be fully aware of the changes affecting the drawings they are using, changes should be incorporated as soon as possible, and clean drawings should be reissued to minimize the "paper trail" in those areas where work is still in process.

Also, small bore drawings (particularly DPs in the reactor building) need to provide dimensions for locating hangers from building lines and to account for dimensions that do not close or provide construction with sufficient flexibility to install the small bore piping and tubing to suit field conditions while maintaining the basic routing given by the drawing.

2.11.5 General

The constructibility review was somewhat different from the engineering approach, as no statistical data or past detailed reports were reviewed and as such, any observations, findings, or suggested actions listed are more subjective than quantitative. Review of certain engineering documents and interviews with individuals close to the project indicated that no individual task, series of tasks, or industry generic problems can be identified as being insurmountable, or give cause that the construction schedule cannot be achieved. There are considerable areas of concern, such as future regulatory agency actions, engineering to be completed, unfinished procurement activities, and improvement in contractor efficiency and production. However, with all the mechanisms available, a dedication to efficient work, and quick responses to problems, the schedule can be met.

3.0 SCOPE OF WORK

3.1 POWER

3.1.1 Service Water System

3.1.1.1 Task P-SWP-1 Verification of Service Water Flow Rates

The original scope involved reviewing selected final hydraulic calculations; however, all of those calculations are currently being revised. Therefore, the review was redirected to assess the methodology being used in the current revision. The hydraulic model (flow network) was reviewed against the flow diagrams to confirm definition of the links and node points. Selected input data calculations were reviewed for methodology and input values. The hydraulic computer code was checked for qualification and for comparison with actual network flows. Results of one of the original hydraulic calculations were checked for adequacy of line sizing and flow velocities.

3.1.1.2 Task P-SWP-2 Verification of Compliance with TMI Requirements of NUREG-0737

There are two TMI requirements that relate to cooling provided by the service water system: 1) a requirement to supply reactor coolant system (RCS) recirculation pump seal cooling after a loss of offsite power and 2) a requirement to provide air-conditioning to the control room after a LOCA (Note--service water provides a heat sink to the chilled water system).

Flow diagrams and logic diagrams were reviewed to confirm that adequate piping and valving was provided to meet these requirements. Specifications and correspondence with GE were reviewed to confirm that service water flow rates were adequate to meet these requirements. The calculation sizing the service water chiller condenser recirculation pumps was reviewed.

3.1.1.3 Task P-SWP-3 Adequate Ventilation of Service Water Pump Area

Calculations and specifications were reviewed to confirm adequate cooling coil sizing, air flow, and service water flow to maintain design temperatures in the service water pump bays.

3.1.1.4 Task P-SWP-4 Verification of Service Water System Flow Diagrams

The service water system flow diagrams were reviewed against all SWP engineering change notices (ECNs) to ensure that changes were being incorporated correctly and according to project procedure.

3.1.1.5 Task P-SWP-5 Verification of Service Water Pump NPSH

Calculations, specifications, and flow diagrams were reviewed to confirm adequacy of available service water system pump NPSH. These calculations covered considerations of head loss in the intake structure and intake

bays, submergence requirements for vortexing, and pressure drop in the pump suction piping for various modes of system operation.

3.1.1.6 Task P-SWP-6 Single-Failure Analysis

The fault tree and failure modes and effects analysis (FMEA) for the service water system were reviewed for single failures. The fault tree structure and development were reviewed against the flow diagrams, and a review of the fault tree and the FMEA for completeness was conducted.

3.1.1.7 Task P-SWP-7 Adequacy of Design to Prevent Freezing at the Service Water Intake

Calculations, flow diagrams, and logic diagrams were reviewed to confirm the adequacy of the design to prevent freezing at the service water intake. The review included the design for heating the offshore bar racks to prevent adherence of frazil ice, and the line sizing and flow required for the screenwell tempering line. Logic diagrams were checked for proper monitoring and alarms related to these two functions.

3.1.1.8 Task P-SWP-8 Verification of the Capability of the Intake to Provide an Alternate Discharge Path for Service Water

Since the service water discharge tunnel and diffuser are not Category I structures, the plant design includes the capability to use one of the two redundant intakes as a discharge if the normal discharge pathway is unavailable. Calculations and flow diagrams were reviewed to confirm adequate flow and service water pump operation under this condition.

3.1.1.9 Task P-SWP-9 Control of Biological Growth

NRC I&E Bulletin 81-03 identified the potential for flow blockage in service water systems due to extensive plugging by Asiatic clams. The FSAR and other documentation were reviewed to ensure that adequate precautions have been taken to address the NRC's concern.

3.1.1.10 Task P-SWP-10 Verify Selected Heat Load Calculations and Adequate Cooling Water for Specified Heat Loads

Specifications, correspondence, and vendor drawings were reviewed against FSAR commitments to confirm that adequate service water flow has been provided to essential components. This supplemented the detailed review of the unit cooler designs and heat load calculations conducted in Tasks P-EPS-1, P-EPS-2, and P-SWP-3.

3.1.1.11 Task P-SWP-11 Verify Adequacy of Service Water System Design Pressure and Temperature

The calculation that determined the service water system design pressure and temperature was reviewed against current specifications and drawings to confirm that the system design is adequate.

3.1.2 Onsite Emergency AC Power System - (EPS)

3.1.2.1 Task P-EPS-1 Adequate Ventilation for Standby and HPCS Diesel Generators

Calculations and specifications were reviewed to confirm adequate cooling coil sizing, air flow, and service water flow to maintain design temperatures in the standby and HPCS diesel generator areas and the generator control room areas.

3.1.2.2 Task P-EPS-2 Adequate Ventilation for Emergency Switchgear Area

Calculations and specifications were reviewed to determine that adequate air and water flow and cooling capacity were provided to maintain the design temperature in the emergency switchgear areas, including battery rooms. The review also considered ventilation requirements to prevent hydrogen buildup in the battery rooms.

3.1.2.3 P-EPS-3 Adequate Fuel Oil and Pumping Capacity for Standby and HPCS Diesel Generators

Calculations, specifications, and flow diagrams were reviewed to confirm adequate fuel oil and pumping capacity for the standby and HPCS diesel generators. This included sizing of the oil storage tanks, the transfer pumps from the storage tanks to the day tanks, and the oil transfer line size from the day tanks to the diesel generators.

3.1.2.4 Task P-EPS-4 Review of Standby Diesel Generator Specification

A review of the standby diesel generator specification was performed for interface inputs for fuel oil, air startup, and cooling water requirements.

3.1.2.5 Task P-EPS-5 Single-Failure Analysis - Onsite Emergency AC Power System

Nine failure modes and effects analyses (FMEAs) for systems supporting onsite emergency ac power were reviewed for single failures. Where single failures were identified in the FMEAs, additional review of proposed resolution and confirmation of followup action were included in the review. An indepth review of the fault tree for standby diesel generator fuel was made against the flow diagrams and ESKs to ensure adequate fault tree development for mechanical and electrical components.

3.2 ELECTRICAL

3.2.1 Service Water System

3.2.1.1 Task E-SWP-1 Review of Voltage Profiles at Service Water Pump Motor Terminals

The voltage profile calculation was reviewed to verify that acceptable voltages were maintained at the service water pump motor terminals during full load, light load, and motor start conditions.

3.2.1.2 Task E-SWP-2 Review of Cable Sizing Calculation for the Service Water Pump Motor

The 5-kV cable sizing calculation for the service water pump motor was reviewed to verify that the FSAR and Design Criteria requirements were being met, and the latest available motor data was used.

3.2.1.3 Task E-EPS-3 Review of the Service Water Pump Motor Specification

The service water pump motor specification was reviewed to verify that the FSAR commitments and calculation results were included in the specification. The vendor qualification report was reviewed to verify compliance with the specification requirements.

3.2.2 Onsite Emergency AC Power System

3.2.2.1 Task E-EPS-1 Review of Reserve Station Service Transformer Sizing Calculation

The reserve station service transformer sizing calculation was reviewed to verify that the FSAR commitments were being met and the latest available motor and load data were used.

3.2.2.2 Task E-EPS-2 Review of Standby Diesel-Generator 2EGS*EG1 Sizing Calculation

The standby diesel generator sizing calculation was reviewed to verify that the FSAR commitments were being met and the latest available motor and load data were used.

3.2.2.3 Task E-EPS-3 Review of the Onsite Emergency AC Power System Short-Circuit Calculation

The short-circuit calculation was reviewed to verify that the 250-MVA switchgear purchased for buses 2ENS*SWG101 and 2ENS*SWG103 was adequate to meet the short-circuit requirements.

3.2.2.4 Task E-EPS-4 Review of the Voltage Profiles for the Onsite Emergency AC Power System

The voltage profile study calculation was reviewed to verify that acceptable voltages were maintained at Class 1E motor terminals during light

load, full load, and motor start conditions with the 115-kV switchyard operating between 95 percent and 105 percent voltage limits.

3.2.2.5 Task E-EPS-5 Review of the Voltage Profiles for the Onsite Emergency AC Power System During a Degraded Grid Condition

The voltage profile study calculation was reviewed to verify the lowest voltage value determined at which the 115-kV switchyard can operate to maintain acceptable voltages at Class 1E motor terminals.

3.2.2.6 Task E-EPS-6 Review of the 5-kV Feeder Cable Sizing Calculation

The 5-kV cable sizing calculation for certain selected loads was reviewed to verify compliance with the FSAR and Design Criteria requirements.

3.2.2.7 Task E-EPS-7 Review of the 600-V Cable Sizing Calculation

The 600-V cable sizing calculation for certain selected loads was reviewed to verify compliance with the FSAR and Design Criteria requirements.

3.2.2.8 Task E-EPS-8 Review of 4.16-kV Switchgear Specification

The 4.16-kV switchgear specification applicable to bus 2ENS*SWG101 was reviewed to verify that FSAR commitments and station service calculation results were included in the specification. The vendor qualification report was reviewed for compliance with the specification requirements.

3.2.2.9 Task E-EPS-9 Review of Standby Diesel Generator Specification

The standby diesel generator specification was reviewed to verify that FSAR commitments and sizing calculation results were included in the specification.

3.2.2.10 Task E-EPS-10 Review of 600-V Power Cable Specification

The 600-V power cable specification was reviewed to verify compliance with the FSAR commitments. The vendor test data and qualification report was reviewed to ensure that the specification requirements were met.

At the April 5, 1983, progress report conference, NMPC added to the original scope of work a review of the adequacy of the data available in-house for insulation resistance testing of a multiconductor cable. The results of this review will be issued as an appendix to this report.

3.2.2.11 Task E-EPS-11 Review of Selected Safety-Related Tray Layout Drawings

Selected safety-related tray layout drawings were reviewed to verify compliance with the FSAR and Design Criteria commitments for separation.

3.2.2.12 <u>Task E-EPS-12 Review of the One-Line Drawing for the 4160-V Emergency Switchgear 2ENS*SWG101</u>

The 4160-V emergency switchgear 2ENS*SWG101 one-line drawing was reviewed to verify that the FSAR commitments for relay protection of standby generator, motors, and load center feeders were incorporated in the one-line drawing.

3.2.2.13 <u>Task E-EPS-13 Review of Main One-Line Drawings</u>

The main one-line drawings EE-1A and EE-1B were reviewed to verify that the FSAR commitments for relay protection of main generator, main transformer, reserve transformer, auxiliary boiler transformer, and normal transformer were incorporated in one-line drawings.

3.3 CONTROL SYSTEMS

3.3.1 Service Water System

3.3.1.1 <u>Task C-SWP-1 Instrument Loop Diagram Verification</u>

The instrument loop diagrams were reviewed for compliance with FSAR commitments and conformance to system design documents such as flow diagrams and ECNs.

3.3.1.2 <u>Task C-SWP-2 Safety and Relief Valves</u>

The safety and relief valve specification was reviewed to verify compliance with the FSAR commitments and utilization of proper system design parameters in the selection and sizing of the valves. This included reviewing vendor sizing calculations for the service water valves.

3.3.1.3 <u>Task C-SWP-3 Logic System Verification</u>

The logic system descriptions and diagrams were reviewed to confirm system operation for automatic and manual control as required during a LOCA and/or loss of offsite power. The FSAR commitments for functional and instrumentation requirements were used as the base document.

3.3.1.4 <u>Task C-SWP-4 Elementary Design Verification</u>

The elementary diagrams were reviewed for compliance with instrumentation and control device redundancy, separation, and different modes of operation as specified by the system logic diagrams and description.

3.3.1.5 <u>Task C-SWP-5 Display and Instrument Selection</u>

Sections of the main control boards related to service water were reviewed for compliance with instrumentation required by the FSAR, including post-TMI requirements of NUREG-0737 and Regulatory Guides 1.47 and 1.97. The display and instrumentation as specified in the FSAR were reviewed with regard to their availability and proper integration of the instrument loop signals with the corresponding components. This included review of the appropriate data sheets for readouts, transmitters, and

associated elements. The qualification test reports for the Rosemount transmitters were reviewed for compliance with specification requirements.

3.3.1.6 Task C-SWP-6 Instrument Design Drawing Verification

The instrument piping drawings and details associated with the service water system were reviewed for compliance with the flow diagrams, loop diagrams, instrument schedule, and proper piping arrangement.

3.3.1.7 Task C-SWP-7 Special Services Control Valves

The special services control valve specification was reviewed to verify compliance with the FSAR commitments and utilization of proper system design parameters in selection and sizing of the valves. Included was the review of vendor sizing calculations for the service water valves.

3.3.1.8 Task C-SWP-8 Instrument and Alarm Setpoints

Setpoint calculations have not been performed yet by the Nine Mile Point Nuclear Station - Unit 2 Project; therefore, this task was not accomplished.

3.3.2 Onsite Emergency AC Power System

3.3.2.1 Task C-EPS-1 Standby Diesel Generator Loading Sequence Logic

The standby diesel generator load sequence logic description and logic diagrams for Divisions I and II were reviewed for compliance with the system functional requirements as described in the FSAR.

3.3.2.2 Task C-EPS-1 Standby Diesel Generator Undervoltage Load-Sequencing Elementary Diagrams

The elementary diagrams were reviewed for compliance with FSAR commitments and logic system design requirements.

3.3.2.3 Task C-EPS-3 Display and Instrument Selection

The electrical panels in the control room were reviewed for compliance with instrumentation required by the FSAR, including post-TMI requirements of NUREG-0737 and Regulatory Guides 1.47 and 1.97. The instrumentation and controls portion of the diesel generator specification was reviewed for compliance with the system requirements.

3.4 ENGINEERING MECHANICS

3.4.1 Service Water System

3.4.1.1 Task N-SWP-01 Review of Design Criteria for Pipe Stress Analysis

The design criteria of the Piping Engineering and Design Specification were reviewed for compliance with applicable FSAR licensing commitments and ASME III design criteria.

3.4.1.2 Task N-SWP-02 Review of Service Water Pipe Stress Calculations

Selected pipe stress packages for piping runs from the service water pump bay to the RHS heat exchanger were reviewed for implementation of FSAR commitments, the latest revision of design input, modeling technique, design loading cases, and maximum stresses. As the piping in the vicinity of the diesel generator cooler is in the process of design, they were not included in the review.

3.4.1.3 Task N-SWP-03 Review Hydrodynamic Loads on Suppression Pool Boundaries

The design information provided to the Structural discipline for hydrodynamic ARS generation was reviewed. Loadings on the suppression pool structure due to SRV discharge, condensation oscillation, and chugging were included in this review.

3.4.1.4 Task N-SWP-04 Review of Equipment Qualification for Seismic and Hydrodynamic Loads - Service Water Piping

Seismic and hydrodynamic equipment qualification of selected safety-related equipment was reviewed for compliance with FSAR commitments. Two types of equipment, service water pumps and safety and relief valves, were included in this review.

3.4.1.5 Task N-SWP-05 Design Input Controls - Pipe Stress Analysis

Project procedures related to the design input control of pipe stress analysis were reviewed. These project procedures were SW-PP40, Administrative Procedure for Pipe Stress, and NMP2-40-07, Data Required for Pipe Stress Analysis and Pipe Support Design.

3.4.1.6 Task N-SWP-06 Review of Major Equipment Supports

The support design of selected safety-related equipment was reviewed for compliance with FSAR commitments. The equipment was designed in accordance with the provisions of ASME III, Subsection NF. The support design of the service water pump was reviewed.

3.4.1.7 Task N-SWP-07 Review Design Criteria for Pipe Support Design

The design criteria of the specification for Design and Fabrication of Power Plant Piping Supports were reviewed for compliance with applicable FSAR licensing commitments.

3.4.1.8 Task N-SWP-08 Review of Selected Pipe Support Design

Selected pipe support calculations were reviewed for implementation of FSAR commitments, correct application of support design loads, loading orientation, load combinations, and pipe support location.

3.4.2 Onsite Emergency AC Power System

3.4.2.1 Task N-EPS-01 Review of Equipment Qualification for Seismic Load - Onsite Emergency AC Power System (EPS)

The seismic qualification of 4,160-V metal-clad switchgear was reviewed for compliance with FSAR commitments.

3.5 STRUCTURAL

3.5.1 Task S-STR-1 Standard Embedment Plates

The methods used to determine the allowable loads on standard embedment plates from pipe supports, cable tray and conduit supports, and duct supports were reviewed. The analyses were reviewed for compliance with the flexibility criteria of NRC IE Bulletin 79-02 with the attachments at any point on the plate.

3.5.2 Task S-STR-2 Cable Tray Support Systems

The analysis and design of Category I cable tray support systems were reviewed for compliance with the FSAR commitments. The review included the application of seismic and hydrodynamic loads, the dynamic analysis method used, and the design of the support members.

3.5.3 Task S-STR-3 Conduit Support Systems

The analysis and design of Category I conduit support systems were reviewed for compliance with the FSAR commitments. The review included the application of seismic and hydrodynamic loads, the dynamic analysis method used, and the design of the support members.

3.5.4 Task S-STR-4 Baseplates with Drilled-in Anchors for Conduit Supports

The design of baseplates with drilled-in anchors was reviewed for compliance with the flexibility criteria of NRC IE Bulletin 79-02.

3.5.5 Task S-STR-5 Screenwell Building Discharge Bay Walls

The wall design in the discharge bay of the screenwell building was reviewed for compliance with the FSAR commitments. The strength of the walls was reviewed for their ability to resist the applied loads, including hydrostatic loads from normal operation with failed diffuser.

3.6 EQUIPMENT QUALIFICATION

3.6.1

In addition to each discipline's review of equipment within its scope of work, the project's Equipment Qualification Program was reviewed. The review was performed to determine if the FSAR commitments conform to current NRC requirements and if the environmental, seismic, hydrodynamic, and operation criteria support the FSAR commitments. A review of the

project procedure for the qualification of equipment was performed to verify that adequate direction is provided for identification, evaluation, classification, documentation, statusing of equipment, and if required, the resolution of concerns. The review included the qualification of both electrical and mechanical equipment.

3.7 INTERDISCIPLINE COMMUNICATION

The flow of design information among engineering disciplines, design functions, and vendors was reviewed. Selected design changes were reviewed for consistency between documents to ensure that the information was incorporated by all affected disciplines.

3.8 CONSTRUCTIBILITY

The scope of the constructibility review consisted of reviewing four tasks which were selected in agreement with Niagara Mohawk Power Corporation as the subjects of most concern. These tasks were as follows:

3.8.1 Followup on March 1981 ITT Grinnell Report

This task included determination of what recommendations, if any, remain to be implemented with the piping contractor, ITT Grinnell.

3.8.2 Supports Interferences

This task included a review of selected areas of previously identified interference problems between supports for large bore pipe/equipment, small bore pipe, conduit, tubing, and cable tray to determine potential generic problems for remaining work areas.

3.8.3 Installation Practicality

This task was directed towards Engineering products (specifications, drawings, and changes thereto) to determine the extent to which these products represent constructible design and to identify any potential generic problems that may pertain to engineering products yet to be issued for construction.

3.8.4 Clarity and Completeness of Engineering Products Issued for Construction Use (Drawing Quality)

This task included a review of specific problems raised by Construction (contractors) and the determination of potential generic problems that may pertain to products yet to be issued for construction.

4.0 METHODOLOGY

The FSAR and the Design Criteria were used to identify commitments to be used for review of the selected task. The drawings, calculations, specifications, etc, associated with the task were reviewed for their compliance with the commitments, correctness of design method used, and flow of information transfer between disciplines. Open Item Reports (OIR) were written to identify noncompliance with the licensing commitments. If an OIR could not be closed after discussion with the NMP2 Project and NMPC, a Potential Discrepancy Report (PD) was written (see Figure 4-0). All necessary forms described in Review Project Procedure RPP-1 were filled out to complete the task (see Volume II).

4.1 POWER

In each case, FSAR commitments and other licensing requirements in the NRC Regulatory Guides and NUREG documents were used as a basis for the review.

Calculations were reviewed against current drawings, specifications, and vendor documents to confirm that input information and assumptions were current and consistent with the characteristics of purchased equipment.

Where necessary, independent review calculations were performed to ensure the adequacy of the system or components to perform its intended function.

Implementation of calculated results and input assumptions were also checked against logic drawings, motor load lists, and other documents to confirm successful transfer of information to and from other disciplines.

Flow diagrams were reviewed against Engineering Change Notices (ECNs), fault tree diagrams, and Failure Modes and Effects Analyses. Specifications were reviewed against FSAR commitments to confirm incorporation of calculated results.

When required, clarifying discussions were held with NMP2 project personnel.

4.2 ELECTRICAL

Calculations were reviewed to verify compliance with FSAR commitments and Design Criteria requirements. Calculation inputs were checked to verify that the latest available data were used. Where necessary, alternate calculations were performed to verify sizes of the cables selected by the project.

Specifications were reviewed to verify that the calculation results, FSAR commitments, and the latest project drawings were incorporated in the specification requirements. The vendor's test data for the equipment, where available, were reviewed to verify that the specification requirements have been met. The vendor equipment qualification reports were reviewed to verify compliance with the specification environmental parameters.

One-line drawings were reviewed to verify that the calculation results and FSAR commitments had been met. The motor nameplate horsepower shown on the one-line drawings was compared with the data in the Electrical Motor and Load Equipment List-PES400 report.

The raceway layout drawings were reviewed to verify that the FSAR commitment for separation was being met.

As required, discussions were held with Lead Electrical Engineer or his designee to obtain additional information or clarification on the document being reviewed.

4.3 CONTROL SYSTEMS

The engineering drawings were reviewed in a sequential manner where the review document in one task would provide input to the next. In all cases, the review included the FSAR commitments to NRC requirements such as regulatory guidelines and NUREGs.

The instrument loop diagrams were compared to the Instrument Schedule, PES-212, and the flow diagrams to verify completeness, location, redundancy, and information transfer. The logic descriptions and diagrams were compared against the loop diagrams, system descriptions, and FSAR operational and instrumentation requirements. The logic diagrams were then utilized as the base document in determining the correctness of the electrical elementary drawings (ESKs). These ESKs were also checked for compliance with the FSAR control and annunciator commitments.

Valve sizing calculations, where available, were reviewed to verify incorporation of the latest system parameters and the ability to perform the required function. The specifications were reviewed for use of the calculation results and incorporation of code requirements.

Where instruments of different specifications were part of the same loop, the data sheets were compared for signal, range, and readout compatibility.

The instrument piping drawings were reviewed against the loop diagrams, specifications, flow diagrams, and instrument schedule for completeness and proper installation.

Selected vendor environmental test procedures and reports were reviewed to determine qualification of the equipment to the normal and accident environment specified in the equipment specification.

Appropriate NMP2 project personnel provided clarification when requested.

4.4 ENGINEERING MECHANICS

Design requirements were determined based on a review of design criteria. The FSAR was reviewed to summarize the licensing commitments regarding ASME III Code design criteria, Regulatory Guides, analytical methods and computer codes. Design Specifications were reviewed for compliance to these FSAR commitments.

In general, for calculations, design input information such as design loads, design conditions, related drawings, and FSAR commitments, was reviewed. For computerized analyses, the modeling technique, loading combinations, and computer input and results were reviewed. In the case of seismic qualification of equipment, the review included the qualification criteria, procedures, and vendor equipment qualification report.

For the hydrodynamic load task, results of the General Electric SRV hydrodynamic analyses were used as the basis for input to the SWEC calculations.

Discussions were held with appropriate NMP2 project personnel for clarification, where necessary.

4.5 STRUCTURAL

Representative calculations for the structures to be reviewed were randomly selected. The FSAR commitments pertaining to the calculation to be reviewed were determined. The FSAR will usually specify the governing codes and standards with which the calculation must comply. Specific requirements in the Structural Design Criteria pertaining to the calculation were also identified.

No alternate calculations were done. All reviews were of the project calculations themselves. Calculation input was reviewed for compliance with licensing commitments and the design criteria. The assumed structural configuration in the calculation was reviewed for conformance with the project drawings.

For manual calculations, the body of the calculation was reviewed. For computerized calculations, the review was for analytical approach, modeling technique, and computer code input.

When required for the review, discussions were held with the lead and principal structural engineers on the project to obtain the necessary background information.

4.6 EQUIPMENT QUALIFICATION

A review of the FSAR was performed to verify that the plant has been properly classified and to verify that commitments are in conformance with the latest NRC requirements for equipment qualification. The project procedure for the control of equipment requiring qualification and the Equipment Qualification Section Operating Procedure Manual were reviewed to verify if adequate direction is provided in order to support the FSAR commitments. Discussions were held with the equipment qualification section lead and support engineers, equipment qualification coordinator, the assistant project engineer, and the assistant to the project engineer responsible for equipment qualification.

4.7 INTERDISCIPLINE COMMUNICATION

The documents for the two systems selected for technical review were used as a basis for determining adequacy of communication between all project

disciplines, vendors, and Construction. For the service water system, it was determined that the ECNs were routed through all affected disciplines and that change information was incorporated in the procurement and construction documents. The electrical motor and load equipment list (PES 400 report) was also used selectively to check whether vendor/specification data were incorporated in it. Selected General Electric main control board drawings were reviewed to verify that information transfer occurred between the Control Systems and Electrical disciplines.

4.8 CONSTRUCTIBILITY

A constructibility review was performed for each of the following areas: 1) March 1981 ITT Grinnell Report, 2) supports interferences, 3) installation practicality, and 4) drawing quality. Each review was accomplished through direct communication with the site (contractors and SWEC) and CHOC project personnel, by checking the content of selected engineering products, identifying and documenting apparent problems by means of a common presentation format, and evaluating the identified problems in terms of their potential for delaying the remaining construction activities.

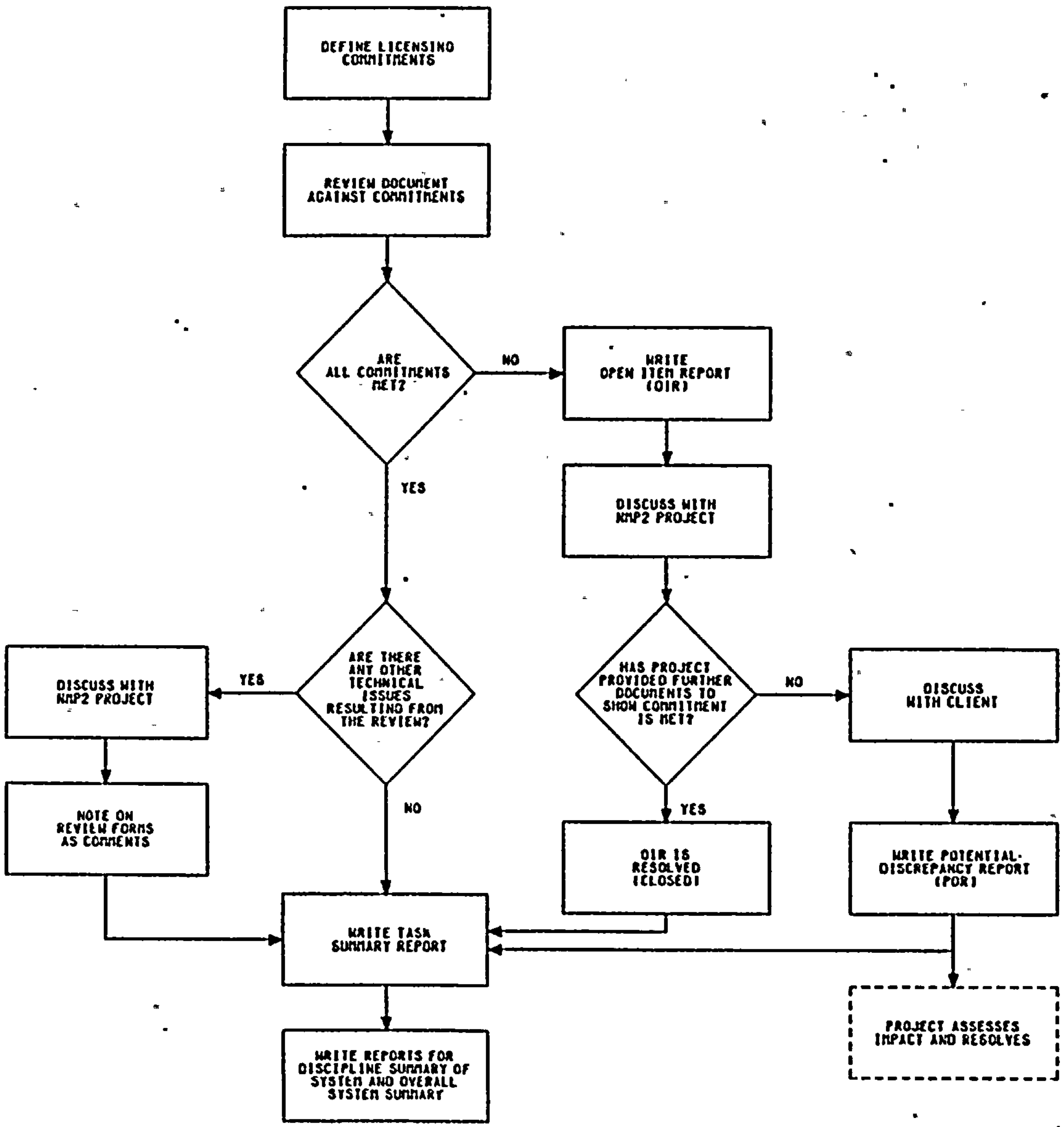

FIGURE 4-8

LOGIC FOR ANALYZING HOW COMMITMENTS ARE MET

STONE & WEBSTER

INDEPENDENT DESIGN REVIEW
COMMITMENT ANALYSIS LOGIC

NINE MILE POINT NUCLEAR STATION-UNIT 2

NIAGARA MOHAWK POWER CORPORATION

STONE & WEBSTER ENGINEERING CORPORATION

5.0 DETAILED RESULTS

5.1 POWER

5.1.1 Service Water System

5.1.1.1 Task P-SWP-1 Verification of Service Water Flow Rates

Review of the methodology and input data for the service water system hydraulic calculations shows the approach and input data to be acceptable. Checking of the flow network model (Attachment 1 to Calculation No. A10.1N-083) against Division I of the safety-related portion of the service water flow diagrams (FSK-9-10 series) showed agreement except for two areas where node points were lumped together for modeling purposes (acceptable), and piping changes associated with the standby diesel generator area. In the latter case the network included piping changes from ECN-SWP-48, which had not yet been incorporated in the flow diagrams.

Review of approximately 50 valve and fitting loss coefficients in Calculation No. A10.1N-083 showed acceptable results. Since the postulated system flows for the various modes of operation in the current reanalysis were comparable to previously analyzed cases, Calculation No. A10.1N-043 was reviewed with regard to header sizing and reasonableness of system flow velocities. This review also showed acceptable results.

5.1.1.2 Task P-SWP-2 Verification of Compliance With TMI Requirements of NUREG 0737

Adequate piping, controls, and service water flow have been provided to meet TMI requirements to provide reactor recirculation pump seal cooling and to maintain post-LOCA control room habitability.

Review of Calculation No. HVK4, which sizes the service water recirculation pump (2SWP*P2A and B) for the chiller condensers, showed that the pumps were undersized, however, this problem is currently being corrected by the purchase of new pumps.

5.1.1.3 Task P-SWP-3 Adequate Ventilation of Service Water Pump Area

Heat loads in the service water pump bay as determined in Calculation No. HVY-21 are satisfactory. No project calculations were identified for the sizing of unit coolers (2HVY*UC2A, B, C, and D) and axial fans (2HVY*FN1A, B, C, and D) for the unit coolers in this area. However, it was determined by a review calculation that unit coolers purchased in accordance with Specification No. P412M and axial fans purchased in accordance with Specification No. P413R have cooling and air flow capacities to remove enough heat from the pump bays to maintain the design temperature in these areas. Some discrepancies exist in fan performance data between Specification Nos. P413R and P412M. Specification No. P412M should be modified to agree with Specification No. P413R.

5.1.1.4 Task P-SWP-4 Verification of Service Water System Flow Diagrams

Fifty-four Engineering Change Notices (ECNs) have been issued for the service water system. Twenty-four ECNs are outstanding. Thirty of these have been incorporated in the system design, and of those incorporated, 14 affect a total of 32 service water system FSKs. A review of these 14 ECNs against the 32 affected FSKs has shown successful incorporation of changes, except for two instances where corrections were found to be in progress.

5.1.1.5 Task P-SWP-5 Verification of Service Water Pump NPSH

The service water system pump NPSH required is 27 ft water, and the suction piping is very short with few losses. Therefore, as long as there is water in the intake bay above the top of the suction pipe to the pump, sufficient NPSH will be available. As a result, the review concentrated on determining that sufficient submergence was provided to preclude vortex formation and subsequent air entrainment into the system.

The only case where vortexing was determined to be a problem was the case of minimum postulated lake elevation (236.3 ft) combined with a loss of the normal discharge tunnel and diffuser. Interpretation of Regulatory Guide 1.135 indicates that this is not a credible combination of events. Therefore, adequate submergence is provided to prevent vortexing under all feasible operating conditions.

5.1.1.6 Task P-SWP-6 Single-Failure Analysis

Review of the service water system fault tree diagram (98 sheets) and the Failure Modes and Effects Analysis (110 pages) showed no single failures that could prevent post-LOCA/LOOP operation of the service water system. Review of the FMEA against the flow diagrams (48 sheets) for completeness showed that approximately 40 relief valves, 2 SOVs and 12 AOVs were omitted from the analysis. Two MOVs that were included as mechanical failures were not developed electrically. The effects of including and assuming single failure of the omitted valves would result in local failures of some cooling services, but would not be expected to lead to service water system failure in general. These valves, however, must be added to the analysis for completeness.

5.1.1.7 Task P-SWP-7 Adequacy of Design to Prevent Freezing at the Service Water Intake

Review of calculations to determine the heating requirements for the offshore bar racks in the service water intake to prevent adherence of frazil ice showed that the design was adequate. Review of line sizing calculations showed adequate sizing of the tempering line to prevent freezing in the onshore intake.

5.1.1.8 Task P-SWP-8 Verification of the Capability of the Intake to Provide an Alternate Discharge Path for Service Water

Review of Calculation No. H6E-172 to determine that the use of one of the two intake tunnels as a discharge on loss of the normal service water

discharge tunnel showed this operating mode to be acceptable. Review of logic diagrams showed adequate controls and alarms to actuate this mode of operation. A structural review of the wall separating the discharge and intake bay showed the wall to be capable of withstanding the adverse differential head of 49 ft under the worst conditions.

5.1.1.9 Task P-SWP-9 Control of Biological Growth

Review of the plant design for control of biological growth included discussions regarding conditions at FitzPatrick and NMP1. Neither of these plants has chlorination or other biofouling control systems on the service water system, and neither plant has reported any biofouling problems. NRC I&E Bulletin 81-03 on Asiatic clams was responded to in a letter (9M2-10,629 dated June 24, 1981) which indicated that the clams do not currently exist in the lake, but committed to provide monitoring of system pressure drops as a future precaution against the rapidly spreading species. An operating procedure to implement this commitment should be developed by NMPC.

5.1.1.10 Task P-SWP-10 Verify Selected Heat Load Calculations and Adequate Cooling Water For Specified Heat Loads

Review of four specifications and five vendor drawings showing cooling water requirements against FSAR commitments to provide cooling water flow showed agreement between required and committed flows. For results of detailed review of unit cooler designs and heat load calculations, see Sections 5.1.1.3, 5.1.2.1, and 5.1.2.2.

5.1.1.11 Task P-SWP-11 Verify Adequacy of Service Water System Design Pressure and Temperature

The review of current specifications and drawings against Calculation No. A10.1N-9A showed that system design temperature and pressure are adequate.

5.1.2 Onsite Emergency AC Power System

5.1.2.1 Task P-EPS-1 Adequate Ventilation for Standby and HPCS Diesel Generators

The review of calculations and specifications showed that adequate ventilation has been provided to maintain the design temperature of 120°F in the standby and HPCS diesel generator rooms. However, the project has had recent correspondence with GE (GE Letter No. NMP2-4901 dated March 22, 1983, and SWEC Response Letter No. 9M2-13974 dated March 28, 1983) questioning the GE qualification of the HPCS diesel for the 120°F design temperature.

The review of calculations and specifications related to the cooling load, unit cooler, and fan sizing in the standby and HPCS diesel generator control rooms resulted in PD 017 regarding unit coolers 2HVP*UC1A, 2HVP*UC1B, and 2HVP*UC2. In this instance the higher heat load due to the increased horsepower of the purchased fans exceeds the margins assumed in the calculation. It may be possible to meet the increased

cooling requirements by adjusting the fan pitch and increasing the service water flow from 11 to 12 gpm.

5.1.2.2 Task P-EPS-2 Adequate Ventilation for Emergency Switchgear Area

The review of Calculation No. HVC-40 and Specification No. NMP2-P412M showed that FSAR commitments have been met and that adequate cooling capacity has been provided to maintain the design temperature in the emergency switchgear area. The calculated ventilation requirements for the battery rooms are also adequate to maintain design temperature and to prevent hydrogen buildup. However, a review of Specification No. NMP2-P413R resulted in PD 024 regarding battery room exhaust fans 2HVS*FN4A and B. The purchased capacity of these fans is more than twice the required capacity, and the potential system imbalance could impact several areas.

5.1.2.3 Task P-EPS-3 Adequate Fuel Oil and Pumping Capacity For Standby and HPCS Diesel Generators

The review of Calculation No. EGF-16, which sized the fuel oil storage tanks for the standby diesel generators, resulted in PD 013 regarding fuel oil tanks 2EGF*TK1A and B. This potential discrepancy relates to a requirement for an "explicit" allowance for fuel consumption during periodic testing when sizing the storage tank. The tank sizing calculation was based on a continuous load requirement of 4400 kW, which agrees with the FSAR commitments in Section 9.5.4.1. However, this aspect of the tank sizing will be affected by the resolution of PD 004 discussed in Section 5.2.2.2 of this report.

The same margin requirement applies to the HPCS diesel fuel oil storage tank sized in Calculation No. EGF-17. However, there appears to be ample margin in the current tank capacity for this purpose, but the calculation should be revised to demonstrate compliance with the FSAR requirement.

The review of Calculation No. EGF-14, which sized the fuel oil transfer pumps, resulted in PD 011 regarding pumps 2EGF*P1A, B, C, D, 2A, and 2B. Additional pressure drops need to be considered in sizing these pumps.

The review of Calculation No. EGF-18, which sizes the fuel oil transfer line between the day tank and the standby diesel generators, assumed the maximum fuel oil level in the day tank instead of the minimum level in calculating the gravity-driven flow. However, a review calculation showed that the line sizing was adequate.

5.1.2.4 Task P-EPS-4 Review of Standby Diesel Generator Specifications

The review of Specification No. NMP2-E031A, Standby Diesel Generator, against flow diagrams and FSAR commitments showed that adequate service water flow is provided to meet cooling requirements; however, the data sheets in the specification need revision. Interface requirements regarding fuel oil are discussed in Section 5.1.2.3 above. The review of interfaces to the diesel generator air startup system showed that the flow diagrams, FSAR commitments, and vendor drawings for the air receiver

tanks were in agreement; however, data sheets in the specification need to be revised.

5.1.2.5 <u>Task P-ESP-5 Single-Failure Analysis</u>

The review of approximately 300 pages of FMEA output on nine systems supporting onsite emergency ac power identified single failures in the control bulding and diesel generator building ventilation systems. The single failure in the diesel generator ventilation system was resolved by ECN-HVP-12, and the single failures in the control building ventilation system are currently being addressed as evidenced by notes of conference of several recent meetings. No other single failures were identified.

The review of the fault tree diagram for the standby diesel generator fuel against the flow diagrams and several elementary diagrams showed adequate treatment of all mechanical components, and the review also showed that all electrical components checked were correctly incorporated.

5.2 ELECTRICAL

5.2.1 Service Water System

5.2.1.1 <u>Task E-SWP-1 Review of Voltage Profiles at Service Water Pump Motor Terminals</u>

The voltage profile review performed under Task E-EPS-4 indicated that the service water pump motor requirements will be met. Acceptable voltages will be maintained at the service water pump motor terminals during light load, full load, and motor start conditions with the 115-kV switchyard operating between 95 percent and 105 percent of the rated voltage.

5.2.1.2 <u>Task E-SWP-2 Review of Cable Sizing Calculation for the Service Water Pump Motor</u>

The service water pump motor cable sizing calculation was reviewed. The motor full load current used in the calculation did not agree with the vendor motor data, but the difference was small and did not affect the cable size selected. The project is presently revising the duct bank loading calculation. Results indicate the need to increase the service water pump motor cable size from 250 KCM to 350 KCM.

5.2.1.3 <u>Task E-EPS-3 Review of the Service Water Pump Motor Specification</u>

The review indicated that the FSAR and calculation requirements were included in the specification. In addition, the service water pump motor qualification report was reviewed. Based upon this review, the motor will have a less than 40-year qualified life when operated at full load and specified ambient condition. It should be noted that the specification has not explicitly stated that the motor shall have a 40-year service life.

5.2.2 Onsite Emergency AC Power System

5.2.2.1 Task E-EPS-1 Review of Reserve Station Service Transformer Sizing Calculation

The review of the reserve station service transformer sizing calculation has identified that the FSAR commitment of one reserve transformer being capable of bringing the plant up to 25 percent power cannot be met. When one reserve transformer is available, power can be supplied to either, Division I or Division II system; however, both divisions of service water pumps (four pumps minimum) are required during 25 percent power operation.

The review of this calculation has also identified that, due to increase in 600-V loads, the spare capacity available in the transformer purchased will be less than that presently indicated in the calculation. Adequate capacity is still available to supply all presently identified loads. Refer to PDs 001 and 003 for detailed discussion.

5.2.2.2 Task E-EPS-2 Review of Standby Diesel-Generator 2EGS*EG1 Sizing Calculation

As the standby diesel-generator sizing Calculation No. EC-32, Revision 2, was under project review, FSAR Tables 8.3.1 and 8.3.5 were used to determine the diesel-generator loading requirement. The worst-case load in Table 8.3.5 is shown to be 4,679-kW, which is higher than the 4,400-kW continuous rating of the diesel-generator. The FSAR commitment requires that the continuous rating of the diesel generator be equal to or greater than the worst-case load requirement. Therefore, the diesel generator selected is not consistent with the FSAR Table 8.3.5.

A project review of the diesel-generator loading calculation is underway, and preliminary results indicate that the actual worst-case load is less than the continuous rating of the diesel generator.

An FSAR change is required. Refer to Potential Discrepancy No. 004 for detailed discussion.

5.2.2.3 Task E-EPS 3 Review of the Onsite Emergency AC Power System Short Circuit Calculation

The short-circuit calculation for the emergency buses 2ENS*SWG101 and 2ENS*SWG103 was reviewed. The short-circuit rating of 250 MVA for the emergency bus breakers is adequate when the bus is either supplied from the reserve station service transformer or the auxiliary boiler transformer. However, when the emergency bus is supplied from the auxiliary boiler transformer, the 250 MVA breaker has very small margin available.

The NMP2 Project is presently revising this short-circuit calculation to incorporate the new system short-circuit data received from the Client.

5.2.2.4 Task E-EPS-4 Review of the Voltage Profiles for the Onsite Emergency AC Power System

The voltage profiles at Class 1E motor terminals during light load, full load, and motor start condition with the 115-kV switchyard supplying power to the emergency buses were reviewed.

When the emergency bus is supplied from the reserve station service transformer, acceptable voltages can be maintained at Class 1E motor terminals with the 115-kV switchyard operating between 88 percent and 105 percent of the rated voltage.

When the emergency bus is supplied from the auxiliary boiler transformer, acceptable voltages can be maintained at Class 1E motor terminals with the 115-kV switchyard operating between 95 percent and 105 percent of the rated voltage.

The NMP2 Project is presently revising these voltage profile calculations to incorporate the new system short-circuit data received from the Client.

5.2.2.5 Task E-EPS-5 Review of the Voltage Profiles for the Onsite Emergency AC Power System During a Degraded Grid Condition

It can be seen from subparagraph 5.2.2.4 that a minimum voltage of 95 percent will be required in the 115-kV switchard to maintain acceptable voltages at Class 1E motor terminals when the auxiliary boiler transformer is supplying power to the emergency bus. Therefore, during a degraded grid condition, the offsite power to the emergency bus will have to be cut off when the 115-kV switchyard voltage is below 95 percent. This will prevent the degraded grid from adversely affecting the operation of the onsite emergency ac power system.

SWEC Letter No. 9M2-4546 dated October 21, 1977, discusses the effects of a degraded grid condition on the emergency buses. This letter has considered the case of a reserve station service transformer supplying the emergency bus. The limiting case of an auxiliary boiler transformer supplying the emergency bus is not discussed in the letter.

5.2.2.6 Tasks E-EPS-6 and E-EPS-7 Review of the 5-kV and 600-V Cable Sizing Calculations

The review of the 5-kV and 600-V cable sizing calculation for selected loads has identified that the following FSAR and the Design Criteria EDC-4 requirements were not complied with in the applicable calculations:

a. Use of 100 percent locked rotor current for motor-operated valve (MOV) cable sizing. The calculation has used 55 percent of locked rotor current for MOV cable sizing.

b. For MCCs having long-length feeders, the voltage drop limitation of 4 V was exceeded.

c. The correct backup fault clearing time does not seem to have been used in calculating the minimum cable size required for short-circuit duty. Our independent calculation check indicated that cable sizes larger than those listed in Table Q were required if the backup fault clearing time and fault current parameters of Table Q were used. This calculation check was required as the project calculation supporting the minimum sizes did not exist.

In addition, the formula listed in the Design Criteria EDC-4 for short-circuit current to be used for calculating the minimum cable size was incorrect. This formula did not include system ac fault current component and did not find the total fault current by square root of the sum of squares method. Refer to PDs 005, 008, 014, and 023 for detailed discussions.

5.2.2.7 Task E-EPS-8 Review of 4.16-kV Switchgear Specification

The 4.16-kV switchgear Specification No. E015F applicable to bus 2ENS*SWG101 was reviewed. The station service calculation results and FSAR commitments were incorporated into the specification. The vendor qualification report was reviewed. This report has used the environmental data specified in the specification to meet the qualification requirements. The vendor has identified certain components which have a less than 40-year qualified life. The qualified life for certain components is established in terms of number of cycles of operation.

The vendor has not yet performed the production tests as required by the specification.

5.2.2.8 Task E-EPS-9 Review of Standby Diesel Generator Specifiation

The review of the standby diesel-generator Specification No. E031A had indicated that the vendor does not have the latest loading requirement of the FSAR Table 8.3.5. The specification also has not included the environmental qualification parameters for the diesel-generator. The qualification of the diesel-generator should be confirmed for the latest loading and environmental parameter requirements.

5.2.2.9 Task E-EPS-10 Review of 600-V Power Cable Specification

The review indicated that the FSAR commitments were included in the specification. In addition, the qualification report environmental profile used by the vendor enveloped the specification requirement. However, in certain instances, the margin available in the environmental qualification parameter (such as a temperature of 346°F versus 340°F required for a period of 3 hours after LOCA) is low. The vendor also has not addressed the synergistic effect of thermal and radiation parameters on aging of the insulation and jacket material.

The production test data for a multiconductor cable were reviewed. The test data (except insulation resistance test data) submitted by the vendor meet the specification requirements. The insulation resistance

test data will be reviewed as a separate activity for this task, and the results will be provided as an appendix to this report.

5.2.2.10 Task E-EPS-11 Review of Selected Safety-Related Tray Layout Drawings

Cable tray layout drawings for the control building and the electrical tunnels were reviewed for separation requirements. Drawings reviewed met the separation criteria. This review has indicated that "Green" and "Yellow" color codes are used for "Division" as well as "Channel" type raceway identification. This may present raceway identification problems in the field.

The project has advised that "Green" or "Yellow" color coded "Division" and "Channel" oriented raceways do not share the same support, i.e., Division I (Green) and Channel 1A (Green) raceways are not installed on the same support. Adherence to this requirement should be verified by a field check of selected raceway installation.

5.2.2.11 Task E-EPS-12 Review of One-Line Drawing for 4,160-V Emergency Switchgear 2ENS*SWG101

The review of one-line Drawing No. EE-1Q-6 has identified inconsistencies between FSAR commitments, ESKs and the one-line drawing. These are documented in PDs 019 and 021.

5.2.2.12 Task E-EPS-13 Review of Main One-Line Drawings

The main one-line Drawings Nos. EE-1A and EE-1B were reviewed to verify FSAR commitments for relays to be used for protection of the main generator, main transformer, reserve station service transformer, auxiliary boiler transformer, and the normal station service transformer. The one-line drawings have incorporated the FSAR requirements satisfactorily.

5.3 CONTROL SYSTEMS

5.3.1 Service Water System

5.3.1.1 Task C-SWP-1 Instrument Loop Diagram Verification

The review of the instrument loop diagrams identified 23 inconsistencies in relation to compliance with the system flow diagrams. These consisted of differences in line numbers and size, document references, color coding, valve position, and data omissions. In addition, the modification required by ECN SWP-033 was not incorporated. Except for these inconsistencies, no potential discrepancies were identified.

5.3.1.2 Task C-SWP-2 Safety and Relief Valves

The vendor valve sizing calculations for the Category I safety and relief valves were reviewed for compliance with system design criteria. Incorporation of the ASME code requirements within the Purchase Specification No. C051A was verified. Except for minor data inconsistencies within these documents, no potential discrepancies were identified.

5.3.1.3 Task C-SWP-3 Logic System Verification

In reviewing the logic system description and diagrams for compliance with FSAR functional and instrumentation requirements, there were no potential discrepancies identified. However, there were 13 inconsistencies in the logic system descriptions and 8 in the diagrams, including the following:

Descriptions

a. Control switch operation disagrees with ESK
b. Computer and alarm points omitted
c. Valve operation description omitted
d. Incorrect designations

Diagrams

a. Computer monitoring inconsistent with description
b. Logic gate incorrect
c. Equipment location incorrect
d. Status light omitted

5.3.1.4 Task C-SWP-4 Elementary Design Verification

The review of the 61 elementary diagrams resulted in 32 inconsistencies which included:

a. Relay contact designations omitted
b. Relay contact closure operation incorrect
c. Incorrect contact and alarm designation
d. Incorrect document reference
e. Limit switch development incorrect
f. Circuit inconsistent with logic requirements

In addition, 19 pushbutton switches shown as "PB Service Water Div. I Manually Inoperable" located on the Category I portion of Panel 601 in an unisolated Category I circuit are identified as a QA Category II switch. This has resulted in PD 018.

5.3.1.5 Task C-SWP-5 Display and Instrumentation Selection

Instrumentation requirements as specified in the FSAR were reviewed to ensure availability as well as the compatibility with the equipment design, instrument measurement loop, and environmental qualification. The specification data sheets for 2SWP*FE533 and 2SWP*FT533 indicates an inconsistency in measurement ranges.

Flow element 2SWP*FE533 has been sized to pass a maximum flow of 20,000 gpm with a 150-in. wc, whereas the associated transmitter has a calibrated range of 0 to 27,000 gpm for a 0 to 150 in. wc differential.

Flow transmitter 2SWP*FT567 has a specified flow range of 0 to 27,000 gpm (150-in. wc) from a flow element sized to pass 22,000 gpm at a 150-in. wc

differential. The actual flow will not meet FSAR commitments of 0 to 27,000 gpm.

The ratio at normal flow to maximum flow for 2SWP*FE523, 2SWP*FE534, and 2SWP*FE567 is 10 percent, 25 percent, and 19 percent, respectively. This results in a normal condition at the extreme low end of the scale with severe restrictions in readability. This has resulted in PD 009.

ECN SWP-29 dated May 18, 1982, added requirements for 2SWP*FT200A-F and 2SWP*FT201A and B. Report No. PES-212, Control Systems Instrument Schedule, shows the equipment was being purchased as part of Specification No. C071M. Specification No. C071M, through Addendum 1 to Revision 1, dated November 8, 1982, has not incorporated this equipment. This has resulted in PD 010.

In reviewing the applicable instrumentation in relation to the main control board, it was found that indicators 2SWP*FI533 and 2SWP*FI523 on Panel No. 2CEC*PNL601 are mounted in mirror image to their redundant indicators 2SWP*FI567 and 2SWP*FI534. In accordance with the guidelines of NUREG 0700, mirror image violates the principle of "positive transfer of training" and should be avoided. This has resulted in PD 002.

5.3.1.6 Task C-SWP-6 Instrument Design Drawing Verification

The instrument details and piping drawings were reviewed for proper inclusion and interpretation of engineering input including licensing commitments. Instrument piping Drawing No. EK-19B showed the high and low side of differential pressure transmitters PDIS-70A (trash rack differential pressure) and PDIS-71A (traveling screen differential pressure), both interconnected to the high side piping. This has resulted in PD 031.

5.3.1.7 Task C-SWP-7 Special Services Control Valves

In reviewing the specification (C051M) for the special services control valves it was found that for valves 2SWP*TV35A and 2SWP*TV35B there were no calculations to verify the parameters shown on the technical data sheets. The resultant C_v is based on preliminary vendor information without calculation submitted for review and approval. The valve requirements and input parameters do not agree with existing project system calculations.

5.3.1.8 Task C-SWP-8 Instrument and Alarm Setpoints

Setpoint calculations have not yet been performed by the project; therefore, review to design and licensing commitments could not be performed.

5.3.2 Onsite Emergency AC Power System

5.3.2.1 <u>Task C-EPS-1 Standby Diesel Generator Loading Sequence Logic Task C-EPS-2 Standby Diesel Generator Undervoltage Load Sequencing Elementary Diagrams</u>

The review of the Divisions I and II standby diesel generator load sequencing requirements resulted in identifying 26 inconsistencies between the logic descriptions, logic diagrams, elementary diagrams, and the FSAR. These included:

a. Status lights omitted from logic description
b. Annunciators omitted from logic diagrams
c. Monitored parameters omitted from logic description
d. Transfer switch interlock omitted from logic diagram
e. Relay contact numbers and position differ between elementary diagrams
f. List of annunciator displays disagree between logic description and elementary diagrams.

5.3.2.2 <u>Task C-EPS-3 Display and Instrument Selection</u>

Instrumentation requirements were reviewed in accordance with the FSAR commitments and diesel generator Specification No. E031A. This resulted in identifying areas of the main control board which do not comply with FSAR commitments of Sections 8.3.1 and 1.10, Item I.D.1. This includes omission of alarms and noncompliance to the guidelines of NUREG 0700, "Guidelines of Control Room Design Review." These were documented in PD 025. Additionally, the specified range for the fuel oil transfer pump flow (low) of 20 gpm does not meet the FSAR commitment of 0 to 30 gpm (see PD 022).

5.4 ENGINEERING MECHANICS

5.4.1 Service Water Piping

5.4.1.1 <u>Task N-SWP-1 Review of Design Criteria For Pipe Stress Analysis</u>

The design criteria of Specification No. P301A, Piping Engineering and Design, were reviewed for compliance with FSAR commitments. Selected commitments were reviewed. They include loading conditions, seismic design criteria of ASME III code, modal response combination of Regulatory Guide 1.92, and piping damping factors of Regulatory Guide 1.61. They are correctly addressed. The use of equivalent static load factor of 1.5 is satisfactory as compared with a factor of 1.3 specified in FSAR. However, the FSAR commitment of Regulatory Guide 1.122 on ARS enveloping and peak spreading is not addressed. It is recommended to incorporate it in the next addendum of the subject specification, as this commitment has been implemented in pipe stress analysis.

5.4.1.2 <u>N-SWP-02 Review of Service Water Pipe Stress Analysis</u>

Three pipe stress analyses were reviewed. They are AX-19L for the piping connecting to RHS service water suction nozzle, AX-19F for piping located

between secondary containment and pipe tunnel, and AX-19AF for piping connecting to service water pump discharge nozzle. As a result of these pipe stress analyses review, five Potential Discrepancies were identified.

5.4.1.2.1

The review of pipe stress package AX-19L, Revision 3, resulted in PD 006, which regards seismic analysis. The piping of this pipe stress analysis package is an ASME III Safety Class 3 piping as specified in FSAR Section 3.9.3.1.2A. It is designed to withstand levels of loading imposed by the OBE and SSE. In this calculation, the loading cases of OBE seismic anchor movement (OBEA) and SSE inertia (SSEI) are not included. With the absence of the OBEA load, the Equation 10 (plant normal and upset condition) of ASME III, ND-3652.3 is not properly addressed. In addition, with the absence of SSEI, the Equation 9 (plant faulted condition) of ASME III, ND-3652.2 is not properly addressed. Additional documentation is required to justify the use of certain loading conditions, or consideration that they are negligible.

5.4.1.2.2

The review of pipe stress package AX-19L, Revision 3, resulted in PD 007, which regards water hammer analysis. This section of service water piping should be designed for water hammer load. The water hammer forcing functions were available in Calculation No. 12177-NP(C)-PX-01920, Revision 0, but was not included in this pipe stress analysis. This water hammer load is required for Equation 9 (plant emergency and faulted conditions) of ASME III, ND-3652.2 in accordance with FSAR Section 3.9.3.1.2A.

The project is aware of this concern and has scheduled to reanalyze this pipe stress package to include the water hammer loads.

5.4.1.2.3

The review of stress package AX-19F, Revision 3, resulted in PD 015, which regards the dynamic model. This dynamic model has a cutoff frequency of 23.8 Hz at its 50th mode. This cutoff frequency does not reach the peak response frequency of SRV hydrodynamic amplified response spectrum (ARS) curves (approximately 50 Hz). Without the contributions from ARS peak response, these analyses may not give a satisfactory dynamic response.

However, it may be shown that the number of vibration modes used for this dynamic model was sufficient using the procedure outlined in Standard Review Plan Section 3.7.3. If the inclusion of additional modes does not result in more than a 10 percent increase in response, the original model would be considered acceptable.

5.4.1.2.4

The review of pipe stress package AX-19F, Revision 3, also resulted in PD No. 16, which regards seismic ARS envelopes. The input seismic ARS

curves are from PX Calculation No. 12177-PX-01937, Revision 0, which provides seismic ARS envelopes at reactor building elevations 213.75 ft and 197 ft. This PX calculation does not include the seismic ARS for the tunnel in which part of the piping is located. The use of these ARS envelopes does not completely satisfy the commitment of FSAR Section 3.7.3.9A.

5.4.1.2.5

The review of ARS Calculation No. 12177-PX-01907, Revision 0, results in Potential Discrepancy 32, which regards ARS peak spreading. FSAR Section 1.8 commits to comply with Regulatory Guide 1.122 in the development of floor design response spectra for seismic design of floor-supported equipment or components. SWEC computer code PSPECTRA (described in FSAR Section 3.7.3.8.3A) is designed to implement the peak spreading criteria of this Regulatory Guide, as well as for envelope generation.

ARS Calculation No. 12177-PX-01907 for enveloping seismic ARS curves uses an older computer code CURVE 2 (ME-117) and there is no other design calculation referenced. It is not clear how the requirement of Regulatory Guide 1.122 is addressed. Pipe stress packages, such as AX-19L, which use the results of this calculation as their design input should also be reevaluated.

5.4.1.3 <u>Task N-SWP-03 Review of Hydrodynamic Loads on Suppression Pool Boundaries</u>

Four calculations were reviewed for the hydrodynamic loads on suppression pool structure. These loads are provided to the Structural Division for hydrodynamic ARS generation.

Calculation No. 12177.08-PX-60020 provides the design data used to design quenchers and to generate SRV discharge load into the suppression pool. The design data includes information such as SWEC piping drawings, friction factor, valve opening time, etc. The review finds this calculation satisfactory.

The review find the three other Calculation Nos. 12177.08-PX-60044, PX-60058, and PX-60053 also satisfactory. They provide the hydrodynamic loads on suppression pool structure due to condensation oscillation and chugging effect.

5.4.1.4 <u>Task N-SWP-04 Review of Equipment Qualifications for Seismic and Hydrodynamic Loads - Service Water Piping</u>

The service water pump and thermal relief valves were selected and reviewed for the equipment qualification for seismic and/or suppression pool hydrodynamic loads.

The seismic qualification criteria of service water pump Specification No. NMP2-P222X were reviewed for compliance with FSAR commitments. These criteria are used as the basis for the review of Seismic-Stress Analysis

Report (ME-534). The result indicates that the service water pumps are qualified to perform safety-related functions during and after a postulated seismic event.

For thermal relief valves, four documents were reviewed. They are the safety and relief valves Specification No. NMP2-C051A, vendor seismic report (EC-522), vendor specification for design analysis (EC-672), and vendor Operability Test Report 3864. The review finds the thermal relief valves are adequately qualified for the combined effect of seismic and hydrodynamic loads.

5.4.1.5 Task N-SWP-05 Review of Design Input Controls - Pipe Stress Analysis

Project Procedures SW-PP40, The Administrative Procedure for Pipe Stress, and NMP2-40-07, Data Required for Pipe Stress Analysis and Pipe Support Design, were reviewed. These two procedures provide the design control of information required for pipe stress analysis. The interdiscipline interfaces are clearly specified. The review finds procedures adequate for their intended purpose.

5.4.1.6 Task N-SWP-06 Review of Major Equipment Supports

Calculation No. 12177-MS-1275, the anchor bolt analysis for service water pumps, was reviewed. The review items include material properties, design loads, and anchor bolt loads. The design is found to meet the requirements of ASME Section III, subsection NF.

5.4.1.7 Task N-SWP-07 Review of Design Criteria for Pipe Support Design

The design criteria of Specification No. P301N, Design and Fabrication of Power Plant Piping Support, were reviewed for compliance with FSAR commitments. The review items include the loading conditions and allowable stress for Class 2 and 3 pipe support and pipe integral attachment.

The review resulted in two findings. The first one is that FSAR Table No. 3.9A-4 should be revised to use OBET in the combination for Load Condition 3. The second finding is that the piping support design Specification No. P301N should be revised to read DL+SRSS(OBEI, OCCE) for plant emergency load combination.

5.4.1.8 Task N-SWP-08 Review of Selected Pipe Support Design

A selected number of pipe supports with various support functions were reviewed for design input, loading combinations, and support function and location. The selection included suppressors, variable spring hangers, anchors, struts, and rigid restraints. This review has found that the latest support design loads have not been incorporated in all support designs. In addition, two PDs have been identified as follows.

5.4.1.8.1

The review of pipe support Calculation No. 12177-Z19-0122 has resulted in PD 026. FSAR Section 3.9.3.4.1A states that spring hangers are designed

for a down-travel and up-travel in excess of the specified thermal movement to account for dynamic movements. In this calculation, the pipe movements due to dynamic loads (seismic and hydrodynamic) were not considered when checking the working range of the variable spring hangers. This concern applies to all springs in the pipe stress packages AX-19L and 19F under review.

5.4.1.8.2

The review of pipe support Calculation No. 12177-Z19-0338 has resulted in Potential Discrepancy 33. Extra pipe support loads due to geological movements in addition to other loadings are provided in pipe stress Calculation No. 12177-NP(c)-AX-19F, Revision 3, dated October 28, 1982. This revision of pipe support loads is not used in the support design calculation, but an earlier revision without such loads due to geological movements is used. In addition, the current revision of pipe support loads has higher thermal load than the ones used in the design. This pipe support design and its structural attachment loads may have to be revised.

5.4.2 Onsite Emergency AC Power System (EPS)

5.4.2.1 Task N-EPS-01 Review of Equipment Qualification for Seismic Load

The seismic qualification of 4,160-V metal-clad switchgear was reviewed. Purchasing Specification No. NMP2-E015F, 4,160-V Metal-Clad Switchgear, and Vendor Certified Seismic Report were reviewed. The result indicates that the switchgear is qualified to perform its safety-related functions during a postulated seismic event.

5.5 STRUCTURAL

5.5.1 Task S-STR-1 Standard Embedment Plates

The intent of the original scope was to review selected calculations for numerical accuracy but the calculations to determine the allowable loads on standard embedment plates using headed anchor studs are currently being superseded. The new calculations have not been completed and are not checked. Therefore, the review was redirected to assess the methodology being used in the new calculations. The objective of these calculations is to determine the allowable loads with the attachments at any point on the plate and to include the flexibility criteria of NRC I&E Bulletin 79-02. Review of the calculations indicates that the analytical method used is appropriate.

The FSAR states that pipe supports using baseplates and concrete expansion anchor bolts are designed using the flexibility criteria of NRC I&E Bulletin 79-02. Although not specifically mentioned in the FSAR, embedded plates using headed anchor studs will behave exactly the same as baseplates with concrete expansion anchor bolts, and therefore both systems should be analyzed in the same way.

A finite element nonlinear analysis is used to calculate the stud loads and the plate stresses. The STARDYNE/SPRING computer program is used and

the interface between the concrete and the baseplate is modeled as a non-linear spring. The stiffness of the attachment is included in the base-plate model.

One of the parameters upon which the allowable loads on the embedment plates depend is the allowable ultimate pullout loads on the studs. There could be a possible future licensing question with the method used to calculate the allowable ultimate loads on the studs.

The Nine Mile 2 Project is committed to design concrete structures in accordance with the requirements of ACI 318, except as modified in the FSAR. ACI 318, however, does not give any specific requirements for the calculation of the allowable ultimate pullout loads on embedded studs. These values were taken from the publication Design Data 10, Embedment Properties of Headed Studs, TRW Nelson Division, hereafter referred to as the Nelson Stud Catalog.

ACI 349, Appendix B, does specify requirements for the calculation of allowable ultimate stud loads, and using the methods of ACI 349 results in lower allowable loads than those given in the Nelson Stud Catalog. The Nine Mile 2 Project is not committed to ACI 349, and Appendix B has not yet been accepted by the NRC in Regulatory Guide 1.142, Revision 1, dated October 1981. However, the discussion in Regulatory Guide 1.142 does state that the staff intends to endorse Appendix B in a regulatory guide being developed to address component support anchors. It does appear that in the future the NRC could require that allowable embedded stud loads shall be calculated using the methods of ACI 349, Appendix B.

5.5.2 Task S-STR-2 Cable Tray Support Systems

The intent of the original scope was to review selected calculations for numerical accuracy. However, the seismic verification program for the plant has not been completed, and the effect of the new seismic response spectra on existing cable tray and conduit support designs has not been fully assessed. Therefore, the review was redirected to emphasize the methology used in the calculations. The results were reviewed to see if they were reasonable for the old seismic response spectra.

The FSAR states that Category I cable tray support systems are analyzed using a modal analysis/response spectra method including seismic and/or hydrodynamic loads, and that the dynamic responses to the dynamic loads such as LOCA, SRV, and OBE/SSE are combined by the square root of the sum of the squares (SRSS) method.

Review of the calculations indicates that the mathematical modeling of the cable tray support systems and the dynamic analysis method is correct. The STRUDL computer program is used to do the frequency/response analysis.

The design of the cable tray support system members complies with the requirements of the AISC Specification for the design, fabrication, and erection of structural steel for buildings, which is an FSAR commitment.

5.5.3 Task S-STR-3 Conduct Support Systems

The FSAR states that cable and supports with safety function are designed to withstand the effects of seismic and/or hydrodynamic loads, and that the dynamic responses to the dynamic loads such as LOCA, SRV, and OBE/SSE are combined by the square root of the sum of the squares (SRSS) method.

The method normally employed in the dynamic analysis of conduit support is to apply the peak value of the appropriate amplified response spectrum in the resonant range as an equivalent static load. When, in the opinion of the project, a less conservative but more correct set of dynamic loads is desired, a dynamic analysis is done on the conduit support in the same manner as is done for the cable tray supports.

Review of the calculations indicates that both of the above methods of dynamic analysis have been used correctly. The design of the conduit support members complies with the requirements of the AISC Specification for the design, fabrication, and erection of structural steel for buildings, which is an FSAR commitment.

5.5.4 Task S-STR-4 Baseplates with Drilled-in Anchors for Conduit Supports

The FSAR states that pipe supports using baseplates and concrete expansion anchor bolts are designed using the flexibility criteria of NRC I&E Bulletin 79-02. Although not specifically mentioned in the FSAR, conduit supports using baseplates and concrete expansion anchor bolts are also designed using the flexibility criteria of NRC I&E Bulletin 79-02.

A review of the calculations indicates that the design method used is the one described in CHOC-EMTR-605 dated July 8, 1981. Within the baseplate size and thickness limitation specified, CHOC-EMTR-605 meets the flexibility criteria of NRC I&E Bulletin 79-02. The design method for the baseplates is therefore considered satisfactory.

5.5.5 Task S-STR-5 Screenwell Building Discharge Bay Walls

The licensing commitment for the design of the Seismic Category I portions of the screenwell building is given in Section 3.8.4 of the FSAR and the required strength for load combinations is given in Table 3.8-11 of the FSAR.

Review of the calculations indicates that the wall dimensions used are in accordance with the drawings and that the applied load combinations are satisfactorily incorporated in the design.

The walls are designed by an elastic analysis for out of plane loading using flat plate equations for two-way action and beam theory for one-way action. Elastic analysis using beam theory is used for in-plane seismic loading.

The wall design complies with ACI 318, American Concrete Institute Building Code Requirements for Reinforced Concrete, which is an FSAR commitment.

5.6 EQUIPMENT QUALIFICATION

Project Procedure (PP) 76, Control of Equipment Requiring Qualification, and the Equipment Qualification Section (EQS) Operating Procedures Manual identify the Project Equipment System (PES) document (particularly PES 800) as the base document to be used for the preparation of the Equipment Qualification Document (EQD) that will support the commitments of FSAR Section 3.11, Environmental Design of Mechanical and Electrical Equipment. The PES document is the "Master List" of equipment requiring qualification. No procedures presently exists providng direction to the project on the implementation of the PES system; however, such a procedure is under preparation and should be issued shortly.

The project procedure that provided for the transmittal of documents between disciplines involved in the qualification program (PP 17) has been cancelled. The EQS presently references this procedure as the controlling document for the "Flow of Documents Between Projects and Equipment Qualification Section (see Procedure EQ-5-1-0 dated August 2, 1982). Currently, no other procedure exists to provide for the document transmittal in either the NMP2 Project Procedures or the EQS Operating Procedures. Project Procedure PP 81, Revision 1, Supplier Document Handling System (SDHS) and PP 87, Revision 0, Review of Supplier Equipment Qualification Documentation, are being prepared and at present are out for comment. PP 81 will replace Project Procedure PP 17 and PP 87 will be an extension of PP 81, specifically for the handling and review of vendor-supplied qualification documentation. These procedures, when implemented, will provide the necessary controls needed for the project handling of vendor qualification documentation. These procedures need to be incorporated into the EQS Operating Procedures Manual to ensure that the handling of these documents is consistent between the EQS and NMP2.

The EQS Operating Procedures Manual identifies the procedures by which the EQS functions. Not all procedures identified in the table of contents exist at this time (i.e., EQ-6-0-0 and associated procedures). EQS procedure EQ-7-1-0, Required Equipment Qualification Section Working File dated August 2, 1982, requires the EQS reviewers to prepare an Environmental Qualification Summary Sheet. This summary sheet is to be incorporated into the EQD, thereby becoming a supporting document for FSAR Section 3.11 commitments. No written procedure is provided at this time for the completion of this form.

The EQS is presently reviewing available vendor qualification submittals against the environmental requirements imposed upon the vendor by the specifications. Project Specification No. NMP2-EDLS, Environmental Design Limits Specification, will provide a controlled document that lists the indoor environmental conditions resulting from normal, abnormal, and accident events. The specification is presently only in the preliminary stage but is expected to be released in the near future. This document will cause a revision to specifications and to the status of equipment listed in the PES document when released. This specification will also become the basis for the comparison of the vendor qualification data against plant-specific conditions.

FSAR Section 3.11 commits to the qualification of mechanical equipment. Presently, no NRC requirements exist for the qualification of mechanical equipment; however, based on NRC requests to CE&I's Perry Project and from LILCO's Shoreham Project, the Client has asked the NMP2 Project for recommendations for the qualification of mechanical equipment (reference R. P. Byrnes' memorandum dated July 27, 1982, to P. A. Wild, Attachment G to SWEC Letter No. T-59,571 dated April 29, 1983). The referenced memorandum also identifies the NMP2 Project Procedures for the qualification of mechanical equipment. These are the only procedures that exist to date for mechanical equipment. The procedures, if implemented formally, would provide a response similar to that provided for the Shoreham Project. Based on the Perry Project, the Shoreham Project, and the Hanford 2 Project, the NRC will require a mechanical equipment qualification program submittal before approving fuel load.

The equipment qualification program being performed by the NMP2 Project does not include NSSS-supplied equipment. This equipment is being reviewed by GE. Project Guideline (PG) 55, Tracking Qualification Status of GE-Supplied Equipment, dated February 14, 1983, provides for project control of the GE effort.

5.7 INTERDISCIPLINE COMMUNICATION

Inadequate interdiscipline communication has been found in the following areas.

5.7.1

The existing system for the use of standard embedment plates is that the discipline using the plate compares its loads with the allowable loads issued by the structural project group (note that the allowable loads presently in use do not include the flexibility criteria of NRC I&E Bulletin 79-02). If the applied loads are less than the allowables, the structural project group is not notified of the value of the loads on the plate. The weakness of this procedure is that the Structural Group cannot readily tabulate the applied loads on any particular embedment plate. This situation can be corrected when an adequate structural verification program is implemented on the project.

5.7.2

Poor interdiscipline communication between power and structural disciplines was observed in the design of the wall between the intake and the discharge bays in the screenwell building for normal operation with failed diffuser. The required differential head of water on this wall is 49 feet. The wall was designed for a differential head of 40 feet. There is enough conservatism in the design so that the wall is still adequate to resist a head of 49 feet. This calculation should be revised to reflect the correct differential head.

5.7.3

The implementation of ECN No. SWP-040 on the ESKs and the one-line drawing was reviewed. It was observed that the ESK-5SWP07 has incorporated

ECN No. SWP-040 but one-line Drawing No. EE-IQ-6 had incorporated it incorrectly. This item was included in PD 019.

5.7.4

The implementation of the load sequencer undervoltage relay tripping scheme in the ESKs and the one-line drawing was reviewed. Inconsistencies were observed between one-line Drawing No. EE-IQ-6 and ESK-5ENS21. It appeared that the ESK is correct and that one-line Drawing No. EE-IQ-6 will have to be revised to be consistent with the ESK. This item was included in PD 019.

5.7.5

The setpoints established for 2EGA*PS7A and 2EGA*PS10A differ in LSK-12-4A and electrical Specification No. E031A.

5.7.6

The electrical section of the FSAR required annunciators that were not incorporated by the Controls Discipline in the appropriate annunciator panel (see Section 5.3.2.2).

5.7.7

The loop diagrams No. SWP-209 and SWP-511 have added the flow indicators 2SWP-FI209 and 2SWP-FI511. However, the flow diagrams FSK-9-10 series have not added this indicators.

5.8 CONSTRUCTIBILITY

5.8.1 Followup on Task Force March 1981 Report on ITT Grinnell Piping Erection Activities

A review of the March 1981 report on ITT Grinnell piping erection activities was performed, and all suggested actions contained in the report have been addressed or implemented. There are two subjects, however, worth noting.

ITT Grinnell should continue their efforts to provide qualified nonmanual personnel in the areas of supervision, planning, site engineering, and quality control. Although one of the task force's recommendations included loan of personnel to supplement ITT Grinnell's staff, this should be considered as an interim arrangement.

The present emphasis of installing bulk quantities is a normal and necessary mode of operation at this stage of the project. However, it is also prudent not to set aside, overlook, or postpone too long the completion of systems. The field site is aware of this, and steps are being taken to organize the team to support work tracking and system completion for turnover.

5.8.2 Supports Interferences

Generally, even with tolerances established for location of items, there are numerous occasions where tolerances have to be exceeded. This means that an E&DCR is issued identifying the problem and the resolution to allow additional tolerance or redesign the interfering member to maintain the position of the subsequent installation (usually hanger(s) for piping or cable tray). There do not appear to be any serious problems to date with interference of pipe to pipe, pipe to cable tray or HVAC duct, or cable tray with HVAC duct. The major interferences within these three disciplines are due to the hangers of one discipline interfering with another discipline, hanger-to-conduit interference, and occasionally a hanger-to-hanger interference. Permanent plant installation interference with temporary construction features is not considered in this review.

The established method of resolving interference problems is with E&DCRs and ACNs. The range of time required for resolution depends on the emphasis given to the particular problem along with the degree of complications and can vary from several hours (rarity) to several months.

The techniques used in the industry today to attempt to avoid interferences, i.e., manual cross-checking of drawings, composite drawings, and modeling, appear to work with the amount of information available at a given time. The problem is not so much the large items, which are easier to illustrate, but the magnitude and density of smaller components of systems such as hangers and conduit. As these items do not appear on composites or models to be seen, they inherently are suspects for more interference problems. The problem grows worse as the density of work increases in a given area. This necessitates a walkdown and partial to complete layout prior to installation. Lighting and communications conduits, where installed early or before areas are occupied by the pipefitters, are experiencing a high relocation rate, reportedly 60 to 65 percent.

Other items relating to supports and interferences are:

- The drilled-in-anchor program is experiencing delays for requests to cut reinforcing steel. Providing the installer with sufficient flexibility to move the support as required to miss the steel would reduce these delays.

- Restriction of maximum 3 ft 0 in. unsupported length of cable is not appropriate in all cases. A relaxation to 5 or 10 feet as situations dictate would greatly reduce the number of E&DCRs and, presumably, unsats. A number of areas in the control building and elsewhere (south electric tunnel to auxiliary bay) may not be arranged such that a 3-ft maximum limitation can be achieved.

- The SEG Engineers authorized to sign ACNs need to be located with construction supervision to promote a team effort for more timely resolution of interferences. (It is reasonable to consider that contractor's engineers might be authorized to sign ACNs).

- Small bore baseplates (drilled-in plates) are so massive their size is often not appreciated when supports for small bore (including conduit) are spotted on the drawings.

- Accessibility for tube steel to tube steel welds on some hangers being installed after pipe is erected might benefit from further checking, particularly for wraparound welds supporting pipe lines of 12 in. diameter and below.

- Composite checking in Category II areas on a selected basis might be explored to avoid interdiscipline interference.

For additional information on specific supports, see Appendix Constructibility Task No. 3.

5.8.3 Installation Practicality

A review of the service water EP drawings was made to determine whether the drawings provided adequate information to fabricate and to install said piping, valves, expansion joints, strainers, etc. This included service water piping in the pump bay, turbine building, reactor building, and emergency diesel generator building.

As depicted on the drawings, the density of pipelines is not such that it imposes a burden on interpretation of routing, flow direction, line designation, XYZ coordinates, and valve orientation. Although not considered as composite drawings, there is evidence that indicates a good amount of effort was put into avoiding interferences of pipe routing with items such as hatches, stairways, ladders, chases, elevators, doors, platforms, concrete walls, and structural steel columns and beams. What was not shown was interfacing with HVAC ducts, electrical raceways, other piping systems, and hanger locations.

As stand-alone drawings, they appeared to provide sufficient data and clarity to fabricate and erect the piping with few or no problems. A cautionary remark is that the revisions of the drawings reviewed were Issues 4, 5, 6, or later, and it is possible that first-release drawings may have lacked some specific desired information.

The asterisk mark (*) is used throughout on the EP drawings, but no definition or reference is given to explain its function. The explanation should appear as a note on at least the lead drawing of a series of drawings. (We understand that the asterisk is to signify items that are safety related).

In general, there were only a few items identified as being too impractical to install as described in Appendix A, Constructibility Task No. 3. Most of the comments or complaints on difficulty of installation were generic in nature as would befit any large, complex project, particularly a project under the auspice or scrutiny of a regulatory agency such as the NRC.

Comments discussed were related to:

- Tolerances - The tolerances issued by Engineering for Construction to follow are for a reason, especially where items such as connection points are preengineered to particular dimensions. To favor Construction with larger tolerances runs the risk of interfering with other discipline activity or the chance that a system as-built would not be acceptable without some alteration. Due to tolerances, the major contractors have instituted a program whereby walkdown(s) and Level I surveys by surveying personnel are necessary prior to installation and in some cases prior to fabrication of items, e.g., hangers. While tolerances are necessarily tight to avoid conflicts between contractors, agreement between contractors' construction and engineering to provide more flexible tolerances to be used only when installation in accordance with the drawing cannot be achieved would considerably reduce the number of interferences requiring resolution by E&DCR.

- For Category I/seismic electrical conduit installation, greater flexibility to move conduit and supports while maintaining the basic concept of the support system should be considered. Also, conduit installations might be "generally" enhanced by:

  Approving the use of two or possibly three shim plates under direct attached conduit to allow clearance for pullboxes and baseplates, as well as satisfying criteria for supports proximity to conduit bends, i.e., extend the present limit of 5/8-in. maximum shimming dimension.

  Encourage contractor to request direct attachment in lieu of designed supports where the contractor believes it would benefit his effort and provide timely response to such requests.

  Continue to provide flexibility in requirements similar to allowing 4 ft support either side of a 90 deg elbow in lieu of the original 1 ft requirement.

  Allow rotation of simple tube steel post supports to suit as-bent conduit, e.g., floor post support on west end of south electric tunnel (extend to all areas the allowance to rotate supports provided by Note 4 on Drawing No. EE-460AG in the primary containment).

- The industry has become so procedure-oriented that good judgment practices for field installation have been ruled out unless somehow this judgment is confided or imparted to the engineers and accepted as part of the resolution to a problem.

- The necessary verification of items of work has created a paper mill to which all hands are tied and has had quite an effect on performance or efficiency of individuals.

- General access to most of the buildings is good; however, some areas such as tunnels and passageways are very congested and quite restrictive, making it difficult for orderly installation.

- The installation problems at Nine Mile 2 are no more serious than for other nuclear power plants.

5.8.4 Clarity and Completeness of Engineering Products

At the outset it must be stated that documents in existence today, e.g., drawings, are in most cases revised versions of those originally issued for construction. As such, the clarity and completeness of engineering documents does not appear to be the problem that existed in the past. This is not to say that no problem exists, rather a less severe one, and attention should be given to those first-issue documents ready for release now or in the future.

From interviews with various construction personnel at the site and CHOC, the legibility of documents was an occasional item of complaint rather than a significant problem. The occasional lack of legibility apparently is due to original drawings being worked on repeatedly. Consequently, the reproductions lose quality so as to be illegible at times. Also, occasionally there would be some double-image prints that were the fault of the reproduction process or equipment. The strongest complaint regarding legibility was that some vendor reproducibles and prints were of poor quality. The reason for this was not explored, but this has been a complaint for many years on many jobs. It is an area that needs constant attention by the initial recipients, usually Engineering, to press vendors for better quality prints and reproducibles.

Aside from legibility, the complaints regarding overall clarity and completeness of engineering products consisted of the following:

- Due to many factors associated with interpretation or changes in engineering data, the volume of E&DCRs and ACNs has become a constant source of annoyance. The basic concept of the E&DCRs to provide information or resolutions to problems in an expeditious manner has grown into a paper monster challenging the ability of all users to use and maintain these documents in an orderly manner subject to audits. In extreme cases there are reportedly up to approximately 40 E&DCRs and ACNs attached to a drawing. It is apparent that Project Procedure PP-16, which states that drawings must be revised after five E&DCRs accumulate, is not being followed in all cases. In some cases the field thinks the E&DCR system is being abused since a followup E&DCR can modify or augment a previous one. Each E&DCR should stand alone.

- The isometrics produced by ITT Grinnell in Kernersville, NC, do not include shop weld identification in all cases. These shop welds apparently are required to be identified on the isometric or they are not acceptable as part of the planner package. This being the case, those isometrics which are incomplete must

be updated by ITT Grinnell field personnel in order to be usable. Criticism was also leveled at Kernersville for not devoting enough review time on their isometrics, as approximately 25 percent require E&DCRs to update them for construction use. The field also believes that a Bill of Materials should be included on the isometrics by the preparer, including the small bore isometrics initiated by CHOC. The clarity of BZ drawings did not come under fire as anticipated. Comments such as "size or length of welds are sometimes needed" do not appear to constitute a major problem. It is our understanding that CHOC Management has implemented a revised checklist for design that has improved the clarity of information on the BZ drawings.

- It appears to be a consensus at the jobsite that the termination tickets, for the purposes of terminating, are useless. Terminations are being made utilizing the latest issue of the wiring diagrams. After terminations are made, the issue number of the wiring diagram is transferred to the termination ticket for record purposes. The termination ticket is then used by Quality Control for their verification and official record(s).

- The data required for locating small bore pipe, instrument tubing, and supports of preengineered systems are an issue of significant proportions. Typically, work point reference dimensions with respect to the building are only given at each end of the piping on a DP drawing. In order to locate any other point in the piping, whether it be for a support location or change-of-direction coordinate, a trigonometric calculation must be performed for the surveyors to make a proper layout. Presently these calculations are being performed by the field. It has been discovered in a sufficient number of cases that the dimensions and angles given for pipe routing do not always lead from one working point to the other and contain inaccuracies in excess of 1 in. to several feet. It is the field's opinion that it would be preferable for CHOC to provide the support and change-of-direction coordinates when design is being accomplished along with the end-of-pipe location.

- There is a feeling in the field that the Line Designation Table is a document issued for information only and as such is not being updated as often as it should be. Both SWEC and ITT Grinnell use this document in the field. It should be issued as a controlled document and revised as necessary. The present issue in the field is dated May 24, 1982.

- The specification for the sheet metal contractor was explored and several areas of concern were noted. Reportedly, the specification does not make clear the documentation (data sheets, certification papers) the contractor is required to supply nor are they clear on procedure submittals as to simple submittal for "information," for "review" or for "approval." The specification also lacks information in the area of equipment to be

procured by the contractor. The dampers reportedly are referenced to a catalogue number with no other requirements stated and in reality the requirements, though not specified, are extremely detailed, causing confusion and delays in drawing approvals and release for fabrication. There is also some area of concern by the field on responsibilities of the contractor as to:

a) Approval requirements for the contractor's nonseismic support design, i.e., approval of generic design or approval of each design.

b) Submittal of as-builts to indicate location of nonseismic supports.

5.9 STATISTICAL RESULTS

The review of the service water system and the onsite emergency ac power system required the use of a broad cross-section of document types prepared by both SWEC and equipment vendors. Each of these documents or portions thereof were compared to the appropriate base document and/or the FSAR commitments. In some cases the review document of one task became the base document of a subsequent task. Table 5.9-1 is a matrix of the documents reviewed versus the quantity of inconsistencies by type.

TABLE 5.9-1

Document	Quantity Reviewed	Minor Errors and Inconsistencies	Potential Discrepancies
Specifications	9	7	5
Calculations	62	34	24
Tray Layout Drawing	19		-
One-Line Drawings	3	2	2
Elect Motor and Load EQM List	FSAR Table 8.3.1	28	-
Logic Diagrams	26	7	-
Logic Description	2	21	-
Instrument Drawings	25	7	1
Loop Diagrams	84	23	-
Embedment Drawings	1	-	-
Conduit Drawings	4	-	-
Concrete Drawings	10	-	-
Elementary Diagrams	64	51	3
FMEA	10	64	-
FSK Sheets	52	3	-
Piping Drawings	14	-	-
Piping Support Drawings	9	-	-
Project Procedures	2	-	-
Pipe Support Location Drawings	14	-	-

POTENTIAL DISCREPANCY (P.D.) LOG

P.D. NO.	OIR NO.	DISCIPLINE	SYSTEM	TITLE OF P.D.	TASK NO.
001	001	Electrical	Onsite Emergency A-C Power	Reserve Station Service Transfer Sizing Calculation	E-EPS-1
002	002	Controls	Service Water	Control Board Design - Human Engineering Discrepancy	C-SWP-5
003	003	Electrical	Onsite Emergency A-C Power	Reserve Station Service Transfer Sizing Calculation	E-EPS-1
004	004	Electrical	Onsite Emergency A-C Power	Standby Diesel-Generator 2EGS*EG1 Sizing Calculation	E-EPS-2
005	005	Electrical	Onsite Emergency A-C Power	600V AC Power Cable Sizing Calc	E-EPS-7
006	006	Engineering Mechanics	Service Water Piping	Seismic Analysis/Service Water Piping Stress Calc AX-19L	N-SWP-02
007	007	Engineering Mechanics	Service Water Piping	Water Hammer Analysis/Service Water Pipe Stress Calc AX-19L	N-SWP-02
008	008	Electrical	Onsite Emergency A-C Power	600V AC Power Cable Sizing Calc	E-EPS-7
009	009	Controls	Service Water	Instrument Loop Measurement Range	C-SWP-5
010	010	Controls	Service Water	Transmitter Specification	C-SWP-5
011	011	Power	Onsite Emergency A-C Power	Onsite Emergency Power	P-EPS-3-
013	013	Power	Onsite Emergency A-C Power	Fuel Oil Storage Tank Capacity Standby Diesel Generator	P-EPS-3-[illegible]
014	014	Electrical	Onsite Emergency A-C Power	5 KV Power Cable Sizing	E-EPS-6
015	015	Engineering Mechanics	Service Water Piping	Dynamic Model of SRV Hydrodynamic Loading Calculation AX-19F	N-SWP-02

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POTENTIAL DISCREPANCY (P.D.) LOG

P.D. NO.	OIR NO.	DISCIPLINE	SYSTEM	TITLE OF P.D.	TASK NO.
016	016	Engineering Mechanics	Service Water Piping	Seismic ARS Envelopes for Service Water Calc AX-19F	N-SWP-02
017	017	Power	Onsite Emergency A-C Power	Adequate Ventilation for Diesel Generator Control Rooms	P-EPS-1
018	018	Controls	Service Water	Indicator Switches on Panel 601	C-SWP-4
019	019	Electrical	Onsite Emergency A-C Power	One Line Dwg. Review	E-EPS-12
021	021	Electrical	Onsite Emergency A-C Power	Review of the One-Line Dwg. 12177-EE-1Q-6	E-EPS-12
022	022	Controls	Standby Power	Flow Element Sizing	C-EPS-3
023	023	Electrical	Onsite Emergency A-C Power	600V Cable Sizing Calculation	E-EPS-7
024	024	Power	Onsite Emergency A-C Power	Adequate Ventilation for the Emergency Switchgear Area	P-EPS-2
025	025	Controls	Onsite Emergency A-C Power	Electrical Control Board Review	C-EPS-3
026	026	Engineering Mechanics	Service Water	Variable Spring Hanger Design	N-SWP-08
031	031	Controls	Service Water	Instrument Piping	C-SWP-6
032	032	Engineering Mechanics	Service Water Ppg	ARS Peak Spreading	N-SWP-02
033	033	Engineering Mechanics	Service Water Line	Pipe Support Design for Geological Movements	N-SWP-08

CONSTRUCTIBILITY REVIEW FINDING LOG

Task No. 1 - ITT Grinnell Report

Task No. 2 - Supports Interferences

Task No. 3 - Installation Practicality

Task No. 4 - Clarity and Completeness of Drawings

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 001

System Onsite Emergency A-C Power System

Discipline Subject Reserve Station Service Transfer Sizing Calculation

Task No. E-EPS-1

Open Item Report No. 001

DESCRIPTION:

FSAR Section 8.2, Criterion #1 requires that each reserve station service transformer be capable of bringing the plant up to 25 percent power during start-up. The service water system requires that four pumps be running for 25 percent power operation. With only one reserve station service transformer available, the electrical distribution system can provide power to safety divisions I or II and division III. There are three service water pumps in each of the safety division I and II. Therefore, during above mentioned condition, the electrical distribution system can supply power to only three service water pumps and not four pumps as required by the subject calculation.

Note: During normal plant start-up both reserve station service transformers are available and can provide power to both safety divisions; Criterion 2, FSAR Section 8.2.

Originator D Patel Date 5-6-83

Review Project Engineer Albert A. Patterson Date 5-6-83

Engineer Management Sponsor V. A. Hoffman Date 5-6-83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 002

System Service Water

Discipline Subject Control Board Design - Human Engineering Discrepancy

Task No. C-SWP-5

Open Item Report No. 002

DESCRIPTION:

Indicators 2SWP*FI533 and FI523 mounted in mirror image to redundant Indicators 2SWP*FI567 and FI534.

Originator W. Lar[illegible] Date: 5/9/83

Review Project Engineer Albert A. Patteso Date: 5/9/83

Engineer Management Sponsor V. A. Hoffman Date: 5/9/83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 003

System Onsite Emergency A-C Power System

Discipline Subject Reserve Station Service Transfer Sizing Calculation

Task No. E-EPS-1

Open Item Report No. 003

DESCRIPTION:

The calculation EC-3 requires that each reserve station transformer be capable of bringing the plant to 25 percent power, provide spare capacity for future load growth, and also supply LOCA loads.

The calculation check was made to verify that the reserve station service transformer has sufficient capacity to meet the above requirements (with the latest available motor and load data). As a result of a significant increase in the 600V load requirement the demand on the reserve station service transformer will be 79MVA. The reserve station service transformer (2RTX-XSR1A) is rated at 42/56/70MVA. Therefore, the load on the transformer exceeds its capacity.

Note: The spare capacity requirement (15 percent + 12MVA) assumed in the calculation should be reviewed in view of the current status of the plant design. If reduction in the spare capacity requirement of 9MVA is acceptable then the plant loads will be within the capacity of the transformer purchased.

Originator DPatel Date: 5-6-83

Review Project Engineer Albert A. Patterson Date: 5-6-83

Engineer Management Sponsor V. A. Hoffman Date: 5-6-83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 004

System Onsite Emergency A-C Power System

Discipline Subject Standby Diesel-Generator 2EGS*EG1 Sizing Calculation

Task No. E-EPS-2

Open Item Report No. 004

DESCRIPTION:

The FSAR commitment (Page 8.3.14) states that "each standby diesel-generator's continuous rating is determined based on its worst-case starting and continuous load duty under the following conditions":

a. Simultaneous loss of offsite power and LOCA.
b. Loss of offsite power and subsequent LOCA.
c. LOCA with subsequent loss of offsite power.
d. Simultaneous loss of offiste power and unit trip.

As per FSAR Table 8.3.5, simultaneous loss of offsite power and LOCA condition imposes a worst-case load of 4679KW (2 hrs. and 6 sec. $<$t). The continuous rating of diesel engine is 4400KW (FSAR Fig. 8.3.2). The 2000 hour rating of the diesel engine is 4750KW. Therefore, the continuous rating of the diesel engine does not meet the FSAR commitment.

Note: 1. It should be noted that at the operating license stage, Regulatory Guide 1.9, Rev. 2, permits the use of a short-time rating of the diesel-generator unit to meet the worst-case continuous load requirement.

2. The calculation EC-32, Rev. 2 (under review) indicates that the worst-case load on the diesel-generator is 4339KW which is less than 4400KW continuous rating of the diesel-generator.

Originator B Patel Date: 5-6-83

Review Project Engineer Steven A. Patters... Date: 5-6-83

Engineer Management Sponsor V.A. Hoffman Date: 5-6-83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 005

System Onsite Emergency A-C Power System

Discipline Subject 600V AC Power Cable Sizing Calculation

Task No. E-EPS-7

Open Item Report No. 005

DESCRIPTION:

FSAR Section 8.3.1.1.4 on Cable Ampacities and Derating states (on Page 8.3-36):

> "For safety-related motor operated valves (MOV), the cables are sized to carry the manfacturer's specified locked rotor current continuously."

In calculation titled 600V AC Cable Sizing, 12177-EC-59-1, safety-related MOV cables are sized at 55% of locked rotor current with the current not exceeding 300% of full load current.

Note: SWEC Electrical Technical Guideline ETG-V-2-3, dated January 10, 1975 allows the use of the procedure used in the above calculation (EC-59-1).

Originator D Patel Date: 5-6-83

Review Project Engineer Albert A. Patterson Date: 5-6-83

Engineer Management Sponsor V. A. Hoffman Date: 5-6-83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 006

System Service Water Piping

Discipline Subject Seismic Analysis in Service Water Pipe Stress Calculation 12177-AX-19L

Task No. N-SWP-02

Open Item Report No. 006

DESCRIPTION:

See Attachment P.D. #006

Originator T. Wen — Date 5-6-83

Review Project Engineer A. A. Patterson — Date 5-6-83

Engineer Management Sponsor V. A. Hoffman — Date 5-6-83

ATTACHMENT P.D. #006

This calculation 12177-NP(C)-AX-19L-1 is the pipe stress analysis for piping from RHS Heat Exchanger Service Water Suction Connection to the first pipe anchor. This is an ASME III Safety Class 3 piping as specified in FSAR Section 3.9.3.1.2A. It is designed to withstand levels of loading imposed by the OBE and SSE. In this pipe stress calculation, the loading cases of OBE seismic anchor movement (OBEA) and SSE inertia (SSEI) are not included. With the absence of the OBEA load, the Equation 10 (plant normal and upset condition) of ASME III, ND-3652.3 is not properly addressed. In addition, with the absence of SSEI the Equation 9 (plant faulted condition) of ASME III, ND-3652.2 is not properly addressed. Additional documentation is required to justify the use of certain loading conditions, or consideration that they are negligible.

(A) It was determined that OBEA may be negligible because of the following reasons:

1. Effect on Pipe Stress

All supports except the anchor at elevation 251'-4" (which is attached to Radwaste Tunnel) lie in the Secondary Containment ranging in elevation from elev. 181' to elev. 240'. Since the elevation involved is at or below grade level, OBEA displacements are considered negligible as indicated below:

Bldg.	Elev. (ft)	Absolute Displacement Dx	Dy	Dz	Ref. Calc.
Secondary Containment	238	0.047	0.007	0.046	12177-EM3.29
Radwaste Tunnel	250	0.003	0.0002	0.011	12177-EM3.88

Equation 10 stress due to thermal expansion is only 6740 psi and is low as compared with the allowable stress of 36,000 psi.

2. Effect on Pipe Support

OBEA loads are included in the support summary by applying a load factor of 0.1 to OBEI. This load factor is specified as a footnote in the pipe support load transmittal (Attachment 2) which is an attachment of the subject pipe stress calculation.

(B) SSEI

It was determined by the NMP2 project stress engineer that the SSE ARS curves are about 25% higher than those for the OBE. However, since the Plant Faulted Condition allowable stress is twice the Plant Normal/Upset Condition allowable stress, the stress level is estimated to be within the allowable stress for the faulted condition. For the design of pipe supports, a load factor of 1.44 was applied to the condition of OBEI + Suppression Pool Emergency Dynamic Loads to account for Faulted Condition Loads (SSE Load + Suppression Pool Faulted Dynamic Load + Water Hammer Load).

(C) The pipe stress calculation must be revised to sufficiently address the required OBEA and SSEI loads. Remaining service water system pipe stress packages must be reviewed to ensure that these loads are sufficiently addressed.

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 007

System Service Water Piping

Discipline Subject Water Hammer Analysis in Service Water Pipe Stress Calculation 12177-AX-19L

Task No. N-SWP-02

Open Item Report No. 007

DESCRIPTION:

This section of service water piping should be designed for water hammer load. The water hammer forcing functions are generated in calculation 12177-NP(C)-PX-01920, Rev. 0, but it is not included in this pipe stress analysis. This water hammer load is required for Equation 9 (plant emergency and faulted conditions) of ASME III, ND-3652.2 as per FSAR Section 3.9.3.1.2A.

The stress engineer determined that water hammer load has negligible effect on the stress analysis in a statement in the assumption in 12177-NP(C)-AX-19L-1, Rev. 1. However, this assumption was not re-stated in Rev. 3.

An evaluation was made using an externally applied static force on the piping and the maximum stress due to water hammer load was only 2216 psi. Water hammer loads in this analysis are due to a 4 pump trip due to LOCA and loss of offsite power (Loop)

For pipe support design, the occasional loads due to Plant Faulted Condition are covered by a load factor of 1.44 times the load due to Plant Emergency Condition.

This stress calculatiom must be revised to address water hammer loads. Remaining service water system pipe stress packages must be reviewed to ensure that water hammer loads are addressed.

Originator T. Wer Date 5-6-83

Review Project Engineer A.A. Patters Date 5-6-83

Engineer Management Sponsor V.A. Hoffman Date 5-6-83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 008

System Onsite Emergency Power System

Discipline Subject 600V AC Power Cable Sizing Calculation

Task No. E-EPS-7

Open Item Report No. 008

DESCRIPTION:

See Attachment P.D. #008

Originator D Patel Date 5-6-83

Review Project Engineer A. L. Patterson Date 5-6-83

Engineer Management Sponsor V. A. Hoffman Date 5-6-83

ATTACHMENT P.D. #008

FSAR Section 8.2.2 on Degraded Voltage Condition states on Page 8.2-24:

"The ~~maximum permissible~~ voltage drop...; for the motor control centers, this is broken up as 4V between the load center and the motor control center (MCC) and 8V between the MCC and the motors."

In calculation titled 600V AC Cable Sizing, 12177-EC-59-1, and according to cable schedule for 2EHS*MCC101 the voltage drop between load center and MCC will exceed the permissible 4V drop.

From cable schedule:

Cable size is 5-250KCM

Estimated cable length 599 ft.

Maximum cable length allowed according to EC-59-1: 2.5 x 83 = 207.5 ft.

Therefore the feeder voltage drop will exceed permissible 4V drop.

Note:

1. The voltage drop can be calculated on the basis of actual load plus spare capacity allowance for future load growth on the MCC. The voltage drop calculation has used 600 amp rating of the MCC as load current.

2. For MCC feeders having long cable lengths, the voltage drop from 600V load centers to the MCC and from the MCC to motors could be redistributed within the framework of the total voltage drop limitation of 12V.

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 009

System Service Water

Discipline Subject Instrument Loop Measurement Range

Task No. C-SWP-5

Open Item Report No. 009

DESCRIPTION:

Significance of Concern:

a) Transmitter calibrated range exceeds max flow through flow element.

b) Flow sensed by FE-567 cannot meet FSAR commitment (Table 7.3-11) of 0-27000 gpm.

c) FE-523, -534, -567 normal flow at low range of scale.

See Attachment P.D. #009

Originator M. Levine Date 5/9/83

Review Project Engineer Albert A. Patterson Date 5/9/83

Engineer Management Sponsor V.A. Hoffman Date 5/9/83

ATTACHMENT P.D. #009

1) The FSAR commitment (Section 9.2.5.2.1) specified that 25000 gpm of the service water be used as makeup to the circulating water system and the remaining portion conveyed to the screenwell discharge bay.

Section 3E of the Service Water System Description identifies instrument loops 2SWP*FE533, *FT533 and 2SWP*FE534, *FT534, train B and A respectively as providing the input signal to the control room indicators 2SWP*FI533 (SWP Loop B Hdr Flow to CWS) and 2SWP*FI534 (SWP Loop A Hdr Flow to CWS).

Per calculation 12177-A10.1N-11, Rev. 1 dated 7/20/81, train A will pass a maximum of 15550 gpm and train B will pass 21150 gpm maximum. For the Loop B flow, the flow element and assorted transmitter data sheets of Specification C011N and C071M show the following data:

C011N	2SWP*FE533	C071M	2SWP*FT533
Meter Differential	150"H_2O	Differential	0-150"H_2O
Min. Flow	0 gpm	Calibrated Range	0-27000 gpm
Normal Flow	9500 gpm		
Max. Flow	20,000 gpm		

An inconsistency exists between the flow element passing a maximum flow of 20,000 gpm with a 150" wc and the transmitter calibrated range of 0-27000 gpm with the same 150" wc differential.

2) Similarly 2SWP*FT567, (service water loop A flow lake), has a specified calibrated range of 0-27000 (150" wc) from a flow element (2SWP*FE567) sized to pass 22000gpm at a 150" wc differential. Therefore the actual measured flow will not meet the commitment of FSAR Table 7.3-11 for an instrument range of 0-27000 gpm.

In both cases the specified range of the transmitter will exceed that of the flow element.

3) The ratio at normal flow to maximum flow for 2SWP*FE-523, FE-534 and FE-567 is 10%, 25% and 19% respectively. This results in a normal condition at the extreme low end of the scale with a severe restriction in readability.

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 010

System Service Water

Discipline Subject Transmitter Specification

Task No. C-SWP-5

Open Item Report No. 010

DESCRIPTION:

2SWP*FT200A-F have not been included in Specification C071M through Addendum 1, Rev. 1, 11/18/82.

2SWP*FT201A, B have not been included in Specification C071M through Addendum 1, Rev. 1, 11/18/82.

Originator M. Levine Date 5/9/83

Review Project Engineer Albert A. Patterson Date 5/9/83

Engineer Management Sponsor W. A. Hoffman Date 5/9/83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 011

System Onsite Emergency AC Power System

Discipline Subject Standby Diesel Generator Fuel Oil Transfer Pump Sizing

Task No. P-EPS-3-1

Open Item Report No. 011

DESCRIPTION:

FSAR Section 9.5.4.1 states that the fuel oil storage system will conform to ANSI Standard N-195-1976. Section 6.3 of the ANSI Standard requires a strainer at the discharge of each fuel pump. Calculation 12177-EGF-14, Rev. 0 does not account for the strainer in sizing the fuel oil pumps (2EGF*P1A,B,C,D,2A,2B).

According to 12177-FSK-8-9A and B, the calculation should also include an additional valve and flow element, and flow in the recirculation line.

This calculation is labelled "confirmation required" because piping length was estimated. When calculation is confirmed with actual piping design the above mentioned items should be included.

Originator H.R. Greenberg Date 5/10/83

Review Project Engineer Albert A. Patterson Date 5/11/83

Engineer Management Sponsor V. A. Hoffman Date 5/11/83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 013

System Onsite Emergency AC Power System

Discipline Subject Fuel Oil Storage Tank Capacity for Standby Diesel Generator (2EGF*TK1A, 1B)

Task No. P-EPS-3-2

Open Item Report No. 013

DESCRIPTION:

FSAR Section 9.5.4.1 states that the fuel oil storage system will conform to ANSI Standard N195-1976. Section 5.4 of the ANSI Standard requires an "explicit" allowance for fuel consumption during periodic testing. Calculation 12177-EGF-16, Rev. 0 which calculates the required fuel storage capacity for the standby diesel generator tanks 2EGF*TK1A and B does not include such a margin.

Originator H. R. Greenberg Date 5/10/83

Review Project Engineer Albert A. Patterson Date 5/11/83

Engineer Management Sponsor V. A. Hoffman Date 5/11/83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 014

System Onsite Emergency A-C Power System

Discipline Subject 5 KV Power Cable Sizing

Task No. E-EPS-6

Open Item Report No. 014

DESCRIPTION:

See Attachment P.D. #014

Originator D Patel Date 5-6-83

Review Project Engineer Albert A. Patterson Date 5-6-83

Engineer Management Sponsor V.A. Hoffman Date 5-6-83

ATTACHMENT P.D. #014

The review of the 5-kV Power Cable Sizing Calculation No. EC-38 dated March 31, 1978, has resulted in the following observations:

1. The Document No. EDC-4 dated April 18, 1978, titled "Criteria for Sizing Power, Control and DC Cables," states that the minimum cable size required to meet the short-circuit duty be calculated as follows:

$$\left[\frac{I}{A}\right]^2 t = 0.0297 \text{ Log} \left[\frac{T_2+234.5}{T_1+234.5}\right] \quad \ldots\ldots 1$$

Where t = Fault Clearing time
A = Conductor Area
I = RMS Current during entire interval of current flow

And I is defined in EDC-4 as

$$I = \sqrt{\frac{\int_0^t I_{max}^2 e^{-\frac{2t}{\tau}} dt}{t}} \quad \ldots\ldots 2$$

Where I_{max} = Fault current at t=0

τ = $\frac{L}{R}$ ratio of the system

However, the RMS value of the short circuit current consists of the decaying dc component (Idc) and the ac symmetrical component (Iac). The equation 2 represents the decaying dc component (Idc) only.

The total short-circuit current is calculated by the following equation:

$$Isc(RMS) = \sqrt{I_{ac}^2 + I_{dc}^2} \quad \ldots\ldots 3$$

It can be seen from the above that EDC-4 has used only dc component and not the total value of short-circuit current for minimum cable sizing calculation.

2. The FSAR Section 8.3.1.1.8 on "Electric Circuit Protection" states that "The time overcurrent relays on the bus incoming line provide protection against bus faults and backup protection to individual feeder circuits from the bus."

Also the EDC-4, page 19, states that "It is also desirable to have the cable withstand the short-circuit for the backup trip time of the fault clearing device."

We cannot confirm the minimum cable size #2/0 listed on Table Q of EDC-4 using the fault current of 46,080 amperes and backup fault clearing time of 0.41 sec (24.6 cycles).

However, a subsequent calculation (dated April 1, 1983) provided by the project has calculated a minimum cable size of #2/0 using Isc of 21,164 amperes and a primary fault clearing time of 5 cycles. As discussed in Item No. 1 above, the fault current (Isc) used by the project is only the dc component (Idc). Also the use of a primary fault clearing time of 5 cycles is not consistent with SWEC Electrical Division Technical Guideline ETG-IV-4-1. This guideline recommends that a primary fault clearing time of 8 cycles be used.

Note:

1. A calculation check was made to determine the minimum cable size required to meet the short-circuit requirements for the 5-kV safety-related system. This calculation check indicates that a minimum cable size of #3/0 (32,100 amp fault current, 8 cycle primary fault clearing time and 250°C final conductor temperature) is required which is larger than #2/0 required by the calculation.

2. The use of total fault current in accordance with Equation No. 3 and primary fault clearing time of 8 cycles may impact the minimum cable size required to meet the short-circuit duty for the 5-kV and 15-kV non-safety related systems.

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 015

System Service Water Piping

Discipline Subject The Dynamic Model of SRV Hydrodynamic Loading for Calculation 12177-AX-19F

Task No. N-SWP-02

Open Item Report No. 015

DESCRIPTION:

See Attachment P.D. #015

Originator T. Wen Date 5-6-83

Review Project Engineer A.A. Patter... Date 5-6-83

Engineer Management Sponsor V.A. Hoffman Date 5-6-83

ATTACHMENT P.D. #015

For pipe stress calculation 12177-NP(C)-AX-19F, Rev. 3, the dynamic model has a cutoff frequency of 23.8 H_z at its 50th mode. This cutoff frequency does not reach the peak response frequency of SRV hydrodynamic ARS curves (approximately 50 H_z). Without the contributions from ARS peak response, these analyses may not give a satisfactory dynamic response.

However, it may be shown that the number of vibration modes used for this dynamic model was sufficient by using the procedure outlined in Standard Review Plan Section 3.7.3. If the inclusion of additional modes does not result in more than a 10% increase in response, the original model would be considered acceptable.

SRV peak accelerations are only about one tenth (1/10) of seismic peak accelerations. These two (2) load cases are combined by Square Root of Sum of the Squares Method (SRSS). This will cause the SRV to contribute less than 1% to the total load. The existing calculation shows that the ASME III, Equation 9 stresses are as follows:

10,010 psi for Normal and Upset (18,000 psi allowable)
11,515 psi for Emergency (27,000 psi allowable)
12,477 psi for Faulted (36,000 psi allowable)

The inclusion of additional modes may have a negligible effect on the pipe stress and pipe support loads. However, the pipe stress calculation 12177-NP(C)-AX-19F, Rev. 3 must be revised to conform with Standard Review Plan, Section 3.7.3. Remaining service water pipe stress packages must be reviewed to ensure that no similar concerns exist.

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 016

System Service Water Piping

Discipline Subject Seismic ARS Envelopes for Pipe Stress Calculation 12177-AX-19F

Task No. N-SWP-02

Open Item Report No. 016

DESCRIPTION:

See Attachment P.D. #016

Originator T. Wev — Date 5-6-83

Review Project Engineer A. A. Patters — Date 5-6-83

Engineer Management Sponsor V. A. Hoffman — Date 5-6-83

ATTACHMENT P.D. #016

For pipe stress calculation 12177-NP(C)-AX-19F, Rev. 3, the input seismic amplified response spectrum (ARS) curves are from calculation 12177-PX-01937, Rev. 0 which provides seismic ARS envelopes at Reactor Building elevations 213.75' and 197'. This PX calculation does not include the seismic ARS for the tunnel in which part of the piping is located. The use of these ARS envelopes do not completely satisfy the commitment of FSAR Section 3.7.3.9A.

Seismic ARS curves for the tunnel at elevation 250' are enveloped by the seismic ARS curves for the Secondary Containment at elevations 213.75' and 197', except north-south direction between 3.44 Hz to 8.33 Hz affecting two vibration modes (see pages 2, 3 and 4). One mode falls between 3.44 Hz to 5.5 Hz with the acceleration difference not exceeding 0.02G and the other mode between 5.6 Hz to 8.33 Hz with acceleration difference not exceeding 0.4G. When all the responses are combined, the resultant is estimated to have a minimal increase in pipe stress and pipe support load. The existing calculation shows that the ASME III, Equation 9 stresses are as follows:

10,010 psi for Normal/Upset (18,000 psi allowable)
11,515 psi for Emergency (27,000 psi allowable)
12,477 psi for Faulted (36,000 psi allowable)

The stress calculation will be revised to satisfy FSAR Section 3.7.3.9A. Remaining service water pipe stress packages must be reviewed to ensure that no similar concerns exist.

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CALCULATION SHEET

▲ 5010.65

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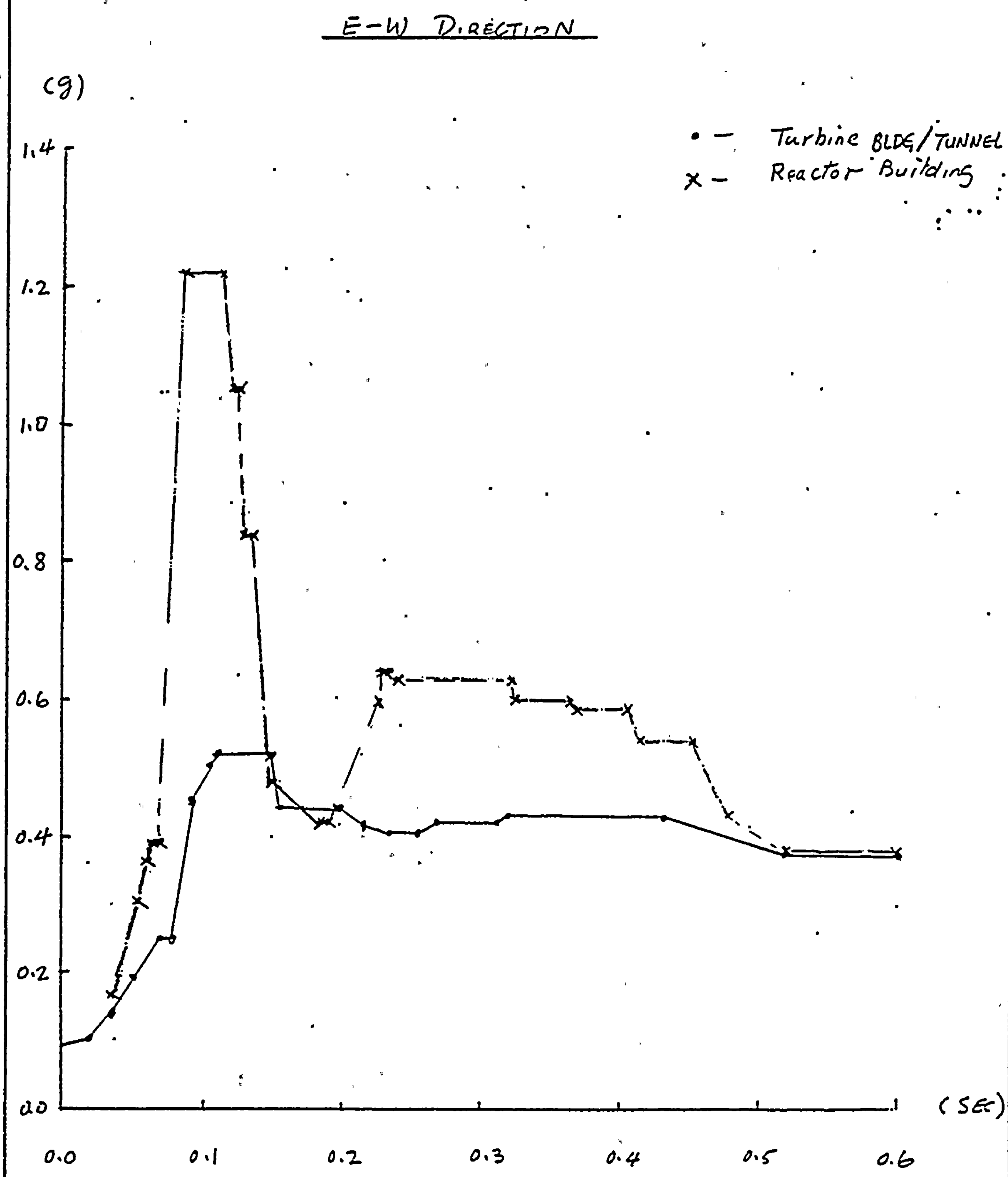
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	



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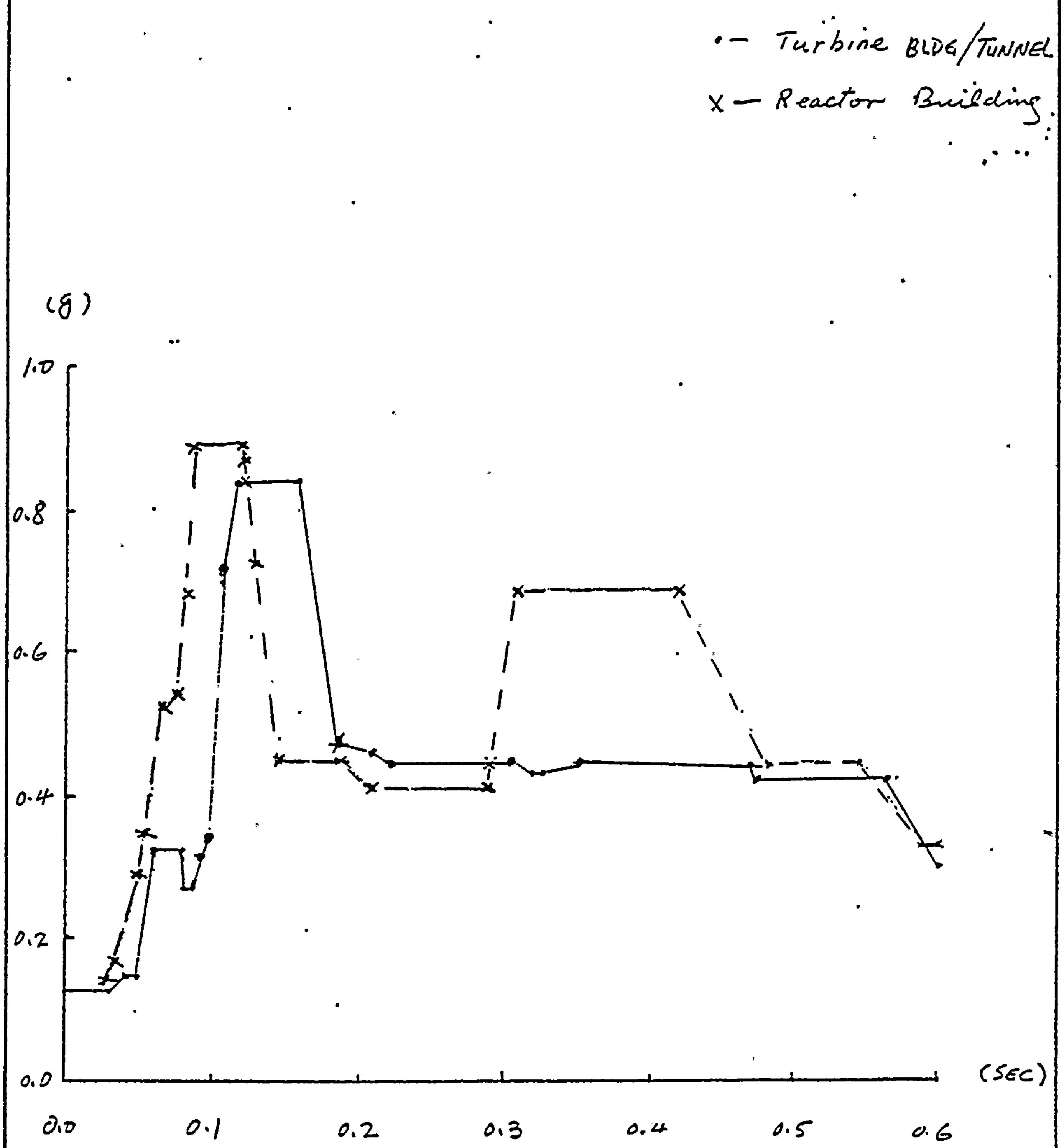

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CALCULATION SHEET

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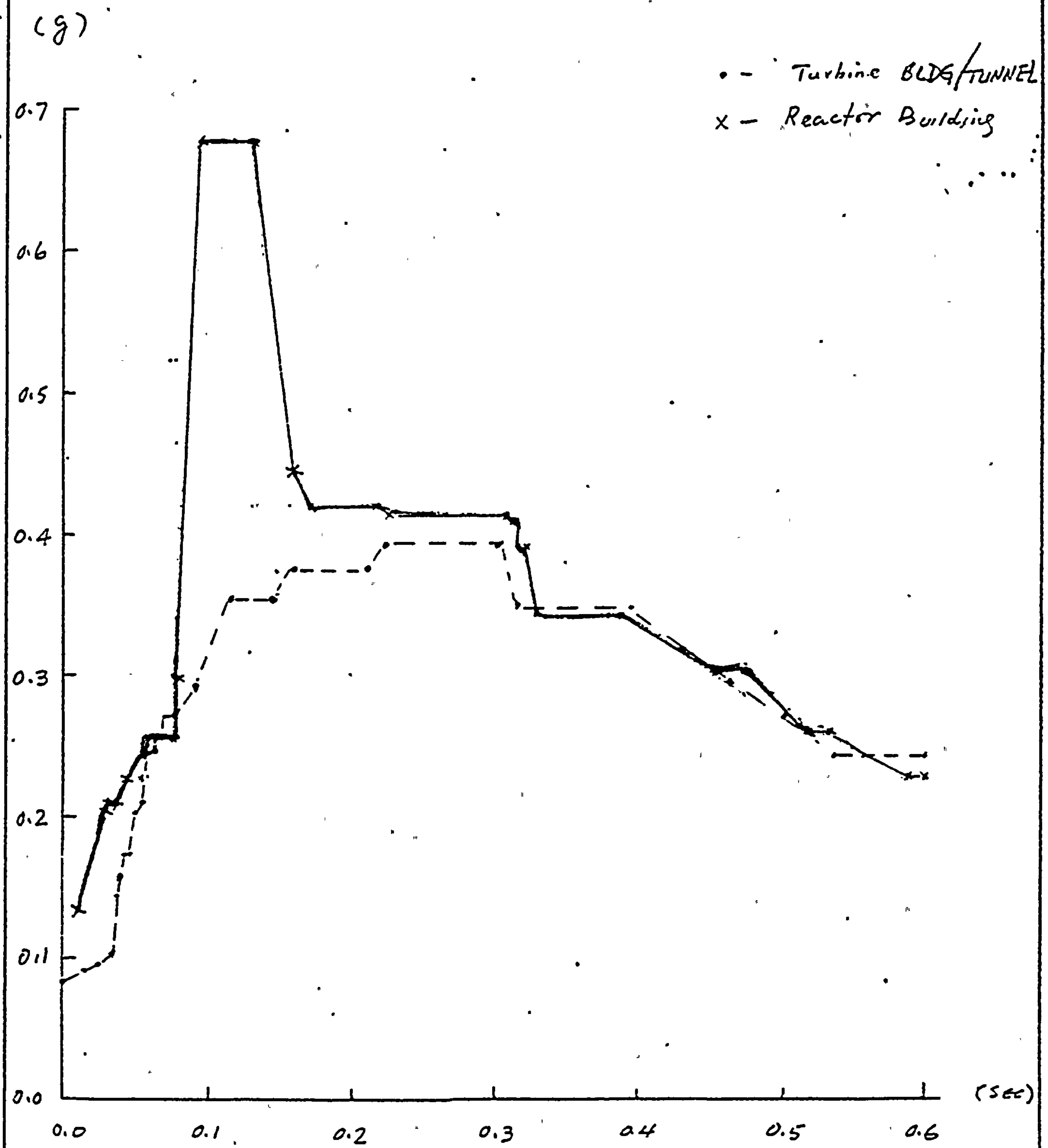

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POTENTIAL DISCREPANCY (P:D.) REPORT

P.D. No. 017

System Onsite Emergency AC Power System

Discipline Subject Adequate Ventilation for Diesel Generator Control Rooms

Task No. P-EPS-1

Open Item Report No. 017

DESCRIPTION:

FSAR Section 9.4.6.2.3 states that a maximum design temperature of 104°F will be maintained in the Standby Diesel Generator (Div. I and II) and HPCS Diesel Generator control rooms. The temperature in these rooms is maintained by unit coolers 2HVP*UC1A and B and 2HVP*UC2. Calculation 12177-HVP-6, Rev. 1 sizes these unit coolers.

The heat load in these rooms consists of a transmission load, an electrical equipment load, and the unit cooler fan motor load. The overall margin for heat load in the calculation is approximately 4% (this margin represents a 5% allowance for the electrical equipment load). When the unit cooler specification P412M was reviewed, it was observed that a 5 hp fan motor was purchased whereas the calculation only assumed a 1 hp fan motor. This change increases the overall heat load by approximately 13%. Therefore the unit coolers are undersized.

Originator H. R. Greenberg Date 5/10/83

Review Project Engineer Albert A. Patterson Date 5/11/83

Engineer Management Sponsor N. A. Hoffman Date 5/11/83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 018

System Service Water

Discipline Subject Indicator Switches on Panel 601

Task No. C-SWP-4

Open Item Report No. 018

DESCRIPTION:

Significance of Concern:

QA Cat. II switches specified for QA Cat. I service.

See Attachment P.D. #018

Originator M. Lerne Date 5/9/83

Review Project Engineer Albert A. Patterson Date 5/9/83

Engineer Management Sponsor V. A. Hoffman Date 5/9/83

ATTACHMENT P.D. #018

The pushbutton switch shown on LSK-9-10N as "PB Service Water Div. I Manually Inoperable" and located on panel 601 on ESK-4CEC13A are used in a QA Cat. I, Div. I system.

Electrical development of this switch appears on ESK-7SWP13 and ESK-7SWP19 in QA Cat. I circuits for Service Water Inoperable conditions. The type of switch shown on ESK-3E, detail MM, is specified as QA Cat. II.

The switches affected are:

1-1-2SWPA34

1-2-2SWPA34

1-3-2SWPA34

1-4-2SWPA34

1-5-2SWPA34

Similarly, switches shown on ESK-7SWP06 are in QA Cat. I circuits but are identified on ESK-3E as QA Cat. II.

These affected switches are:

1-6-2SWPA34

through

1-19-2SWPA34

As the bypass and inoperable status indication (R.G. 1.47) is not required to be Cat. I, the switches noted as Cat. II would be acceptable if they are electrically isolated and physically separated from the Cat. I portion of the board.

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 019

System Onsite Emergency A-C Power Systen

Discipline Subject One Line Dwg. Review

Task No. E-EPS-12

Open Item Report No. 019

DESCRIPTION:

1. The one line dwg. EE-1Q-6 indicates that the service water pump motor protection relay "50" has no trip function and the relay "50D" trips the lockout relay "86". However, the elementary dwg. ESK-5SWP07, Sh 2 of 2 (1/24/83) indicates that the relay "50" trips the lockout relay "86" and the relay "50D" provides an alarm signal.

   It appears that the one line dwg. EE-1Q-6 will have to be revised to be in conformance with the LSK-9-10A and ESK-5SWP07.

2. The elementary dwg. ESK-5SWP07 Sh 2 of 2 shows a common emergency transfer switch located at the remote shutdown panel for the three service water pumps. No such common switch is shown on the one line dwg. EE-1Q-6.

3. The one line dwg. EE-1Q indicates that the auxiliary relay 27X2/2ENSX04 is tripping the breaker 101-1. However, the ESK-5ENS21, (2/8/83), Sh 1 of 2, the auxiliary relay 27X2/2ENSX04 does not trip the breaker 101-1.

   It appears that the one line dwg. EE-1Q-6 will have to be revised to be in conformance with ESK-5ENS21.

Originator B Patel   Date 5-6-83

Review Project Engineer Albert A. Patter.   Date 5-6-83

Engineer Management Sponsor V. A. Hoffman   Date 5-6-83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 021

System Onsite Emergency A-C Power System

Discipline Subject Review of the one-line dwg. 12177-EE-1Q-6

Task No. E-EPS-12

Open Item Report No. 021

DESCRIPTION:

See Attachment P.D. #021

Originator DPatel Date 5-6-83

Review Project Engineer Albert A. Patterson Date 5-6-83

Engineer Management Sponsor V. A. Hoffman Date 5-6-83

ATTACHMENT P.D. #021

The FSAR Section 8.3, Page 8.3.19 states that:

"During emergency operation, the standby diesel generator is shutdown and the diesel-generator breaker tripped under the following conditions:

a. Engine overspeed

b. Generator differential or generator phase-over current."

1. Review of the one-line dwg. EE-1Q-6 indicates that the generator phase-over current relay 50/51V trips auxiliary relays 51V/X and 86-2/2EGPX02. The auxiliary relay 51V/X trips the generator supply breaker 101-1 and the relay 86-2/2EGPX02 locks out the auto close circuit of the breaker 101-1. Neither of these auxiliary relays are shown to be tripping the diesel engine.

2. The note #2, dwg. EE-1Q-6, states that the loss of generator excitation (40), the reverse power (32) and the ground overcurrent (51N) relay protective trips will be operative only when the diesel generator is being tested. However, the diesel generator can also supply power to the emergency bus during a loss of offsite power which is not an emergency (LOCA) condition. Therefore, the relays 40, 32 and 51N should not be bypassed during this condition.

Note: The relays 40, 32 and 51N are required to be bypassed during an emergency (LOCA) condition.

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 022

System Standby Power System

Discipline Subject Flow Element Sizing

Task No. C-EPS-3

Open Item Report No. 022

DESCRIPTION:

Significance of Concern:

FSAR Table 7.3-15 commits to a required Fuel Oil Transfer Pump Flow (low) instrument range of 0-30 gpm.

Per specification C011N, Rev. 1 dated August 9, 1982 flow elements 2EGF*FE13A, *FE13B, *FE104 were sized and purchased to pass a maximum flow of 20 gpm.

Originator [signature] Date 5/9/83

Review Project Engineer Albert J. Patterson Date 5/10/83

Engineer Management Sponsor V. G. Hoffman Date 5/11/83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 023

System Onsite Emergency A-C Power System

Discipline Subject 600V Cable Sizing Calculation

Task No. E-EPS-7

Open Item Report No. 023

DESCRIPTION:

Calculation No. EC-59-1 refers to Electrical Design Criteria EDC-4 for the minimum cable size required to meet the short-circuit duty for 600-V load center feeders.

Electrical Design Criteria EDC-4, page 19, states that "For load center feeds, the back-up time of 30 cycles is used to yield a minimum size of #1.0 AWG. This too is an impractical result; however as the number of load center loads is relatively low, the result will be imposed."

We cannot confirm the minimum size of No. 1/0-AWG cable indicated in Table Q of EDC-4 to meet short-circuit duty for 600-V load center feeders.

NOTE: The EDC-4 permits the use of 650°C final conductor temperature during a short-circuit condition, which is higher than 250°C conductor temperature recommended by SWEC Electrical Division Technical Guidelines ETG-IV-4-1.

These issues of minimum cable size, fault-clearing time, and conductor temperature should be resolved.

Originator DPatel Date 5-6-83

Review Project Engineer Albert A. Patters. Date 5-6-83

Engineer Management Sponsor V. A. Hoffman Date 5-6-83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 024

System Onsite Emergency AC Power System

Discipline Subject Adequate Ventilation for the Emergency Switchgear Area

Task No. P-EPS-2

Open Item Report No. 024

DESCRIPTION:

FSAR Section 8.3.2.1.2 states that battery room exhaust is discharged to atmosphere to limit hydrogen accumulation to less than 2% by volume and maintain battery rooms (Division I, II & HPCS) temperature at 65-104°F. FSAR Table 9.4-2 lists the capacity of two 100% capacity exhaust fans (2HVC*FN4A,4B) as 1275 CFM each for these battery rooms. Calculation HVC-40 dated 1-5-81 and Flow Diagrams (FSK-22-9B,C&D) indicate exhaust fans' capacity as 1275 CFM for these battery rooms meeting design requirements and FSAR commitments.

The capacity of the purchased exhaust fans (per Specification P413R, Addendum 3, 2-23-79) is 2725 CFM each. Since the ductwork and dampers were sized for 1275 CFM, the increased flow could lead to excessive pressure drop. This could also lead to excessive pressure drop across the battery room fire dampers. The resultant system imbalance could take away cooled air from the emergency switchgear area. The corridor air supply system would also be imbalanced due to higher make-up air flow drawn from the corridor through fire dampers, DMPF 118 and 221, by the unit coolers in the switchgear area.

If the fan capacity remains at 2725 CFM, then the system design for the higher air flow requirements should be reevaluated.

Originator H. R. Granberry Date 5/10/83

Review Project Engineer Albert A. Patterson Date 5/11/83

Engineer Management Sponsor V. G. Hoffman Date 5/11/83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 025

System Onsite Emergency A-C Power System

Discipline Subject Electrical Control Board Review

Task No. C-EPS-3

Open Item Report No. 025

DESCRIPTION:

Significance of Concern:

1. Non-compliance with FSAR commitments.
2. Main Control Board Human Engineering discrepancies.

See Attachment P.D. #025

Originator W. Levine Date 5/9/83

Review Project Engineer Albert A Potter Date 5/9/83

Engineer Management Sponsor V. A. Hoffman Date 5/9/83

ATTACHMENT P.D. #025

1. The FSAR Section 8.3.1 commits to provide in the main control room annunciation of conditions which render each standby diesel generator incapable of responding to an emergency auto-start signal.

According to ESK-4CEC01/Rev. 5 and LSK-9-3 series, the following alarms have been omitted:

"c) Air inlet isolation valve closed"
"d) Turning gear in incorrect position"
"e) DC control power failure at engine panel"

2. Division I Emergency Diesel Generator Annunciator Panel 852100 includes:

a) Emergency Diesel Generator 1-3 Service Water Inlet Header Pressure Low, Annunciator 852124
b) Emergency Bus 101 Protection DC Power Failure, Annunciator 852140

The redundant Division II Emergency Diesel Generator Annunciator Panel 852200 does not include similar annunciators.

3.A. The annunciator window arrangement matrix differs between redundant panels 852100 and 852200. FSAR Section 1.10, Item I.D.1, Control Room Design Review commits to the guidelines of NUREG 0700.

Per NUREG 0700, Section 6.3, Annunciator Warning Systems, 6.8.2.3 Layout Consistency, 6.8.2.4 Standardization and 6.9.2.2 item D Consistent Practice, the aim is to provide:

a) Positive transfer of training
b) Coding by position

Present annunciator layout does not meet these guidelines.

3.B. Annunciator Panel 852100 Division I is mounted above its associated Division I indicators and controls but overlaps above Division II indicators and controls. Similarly Annunciator Panel 852200 Division II overlaps above Division III indicators and controls. Per NUREG 0700 Section 6.3.3.1, Visual Annunciator Panels, the following guideline should be considered:

"a) location - visual alarm panels should be located above the related controls and displays which are required for corrective or diagnostic action in response to the alarm"

3.C. Per NUREG 0700 Section 6.3.3.4 Visual Tile Legends - "Abbreviations and acronyms should be consistent with those used elsewhere in control room." Annunciator titles between Division I windows 852129 and 852122 and Division II windows 852231 and 852224 respectively differ in wording and/or abbreviations.

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 026

System Service Water

Discipline Subject Variable Spring Hanger Design

Task No. N-SWP-08

Open Item Report No. 026

DESCRIPTION:

To account for dynamic movements, FSAR Section 3.9.3.4.1A states that spring hangers are designed for down-travel and up-travel movements in excess of the specified thermal movement. In pipe support calculation 12177-Z19-0122, dated 8-3-79, the pipe movements due to dynamic loads (seismic and hydrodynamic) were not considered when checking the working range of the variable spring hangers. This concern applies to all variable spring hangers in pipe stress packages AX-19L and AX-19F under review.

Originator T. Weu Date 5-6-83

Review Project Engineer Alsur A. Patterson Date 5-9-83

Engineer Management Sponsor V. A. Hoffman Date 5-9-83

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POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 031

System Service Water

Discipline Subject Instrument Piping

Task No. C-SWP-6

Open Item Report No. 031

DESCRIPTION:

Significance of Concern:

PDIS-70A & 71A Hi & Lo Legs improperly tied together.

See Attachment P.D. #031

Originator W. Lorens Date 5/9/83

Review Project Engineer Albert A. Patten Date 5/9/83

Engineer Management Sponsor N. G. Hoffman Date 5/9/83

ATTACHMENT P.D. #031

SIGNIFICANCE OF CONCERN:

FSK-9-10AC & LSK 9-10U requires pressure switches PDIS-70A and 71A to provide Trash Racks & Traveling Screen Hi differential pressure signals for alarm in the Control Room.

Instrument Piping drawing EK 19B-2 shows Hi & Lo Legs of both PDIS-70A & 71A interconnected to the high side piping (see zone I-4).

According to FSK 9-10AC the piping should be as follows:

Hi Leg to High Side PDIS-70A

Lo Leg of PDIS-70A to High Leg PDIS-71A

Lo Leg of PDIS-71A to downstream of Traveling Water Screen

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NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT - NPP UNIT NO. 2
INDEPENDENT DESIGN REVIEW PROGRAM

POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 032

System Service Water Piping

Discipline Subject ARS Peak Spreading

Task No. N-SWP-02

Open Item Report No. 032

DESCRIPTION:

FSAR Section 1.8 commits to comply with Regulatory Guide 1.122 in the development of floor design response spectra for seismic design of floor-supported equipment or components. SWEC computer code PSPECTRA (described in FSAR Section 3.7.3.8.3A) is designed to implement the peak spreading criteria of this Regulatory Guide, as well as for envelope generation.

The ARS calculation 12177-PX-01907 uses the older computer code CURVE 2 (ME-117) for enveloping seismic response spectra (ARS curves) and there is no other design calculation referenced to address the Regulatory Guide requirement. It is not clear how the requirement of Regulatory Guide 1.122 is addressed. Pipe stress packages, such as AX-19L, which use the results of this calculation as their design input should also be re-evaluated.

Calculation 12177-PX-01907, which was done as per PSAR requirement, was voided in April, 1983 and is now superseded by the ARS calculation 12177-PX-01957 in which peak spreading of ARS is done in accordance with FSAR 3.7.3.8.3A and Regulatory Guide 1.122. However, NMP2 project indicates that any pipe stress package which uses the result of 12177-PX-01907 (use older computer code) as its design input shall be revised to use 12177-PX-01957. In addition, a review will be performed by NMP2 project on other pipe stress analysis packages to ensure that no similiar concern exists.

Originator T. Wei Date 5-6-83

Review Project Engineer Albert A. Patterson Date 5-9-83

Engineer Management Sponsor V. A. Hoffman Date 5-9-83

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Form 9

POTENTIAL DISCREPANCY (P.D.) REPORT

P.D. No. 033

System Service Water Line

Discipline Subject Pipe Support design for Geological Movements.

Task No. N-SWP-08

Open Item Report No. 033

DESCRIPTION:

Pipe stress calculation 12177-NP(C)-AX-19F, Rev. 3, dated 10-28-82 provides pipe support loads due to geological movements in addition to other loadings. These support loads are not used in support design calculation 12177-Z19-0338.

Instead of using these pipe support loads for designing the support, an earlier revision, without such loads due to geological movements, was used. In addition, the current revision of pipe support loads has higher thermal loads than the ones used in the present design.

This pipe support design and its structural attachment loads (provided on the pipe support structural attachment load schedule) may have to be revised. NMP2 project indicates that this pipe support calculation shall be revised to include loads due to geological movements in the next update.

Originator T. Wei Date 5-6-83

Review Project Engineer Albert A. Patterson Date 5-9-83

Engineer Management Sponsor V.A. Hoffman Date 5-9-83

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CONSTRUCTIBILITY REVIEW FINDING

Task No./Description: No. 1 - ITT Grinnell Report

1. Items of concern/Item under review:

TASK FORCE REPORT -- REVIEW OF PIPING ERECTION PROBLEMS -- March 19, 1981, and followup reports of May 4 and 7, 1981, were thoroughly reviewed to determine the extent to which recommendations have been implemented.

2. Source of information, persons contacted, background on subject matter:

During the week of April 4, 1983, SWEC personnel F. M. Sheldon, R. K. Headrick, and E. P. Eichen were contacted and provided response to our inquiries regarding implementation of recommendations. Followup conversations were held during the week of April 11, 1983.

3. Finding:

All recommendations have been addressed and implemented.

Implementation of the following three recommendations appears to fall short of the Task Force's intent:

a. Quality of nonmanual personnel
b. Six-month versus 12-month look ahead
c. Preinstallation walkdown by nonmanual personnel.

4. Evaluation of potential impact and conclusions:

a. Quality of nonmanual personnel - Significant improvement has been made over the past 2 years, primarily in management and supervision. Engineering and planning personnel still include some individuals on loan from SWEC. Without continued improvement in staff personnel, ITT Grinnell is not likely to quicken its pace as small bore and system completion are added to the present level of effort.

b. Six-month versus 12-month look ahead - The shorter window does not appear to be having any detrimental effect. However, the need to begin specific preparation (planning) for system installation is leaving large amounts of rework (clearing of unsats, etc) and system completion tasks to the end. A significant effort to plan the time and required manpower for

Originated by F. J. Young 4-18-83 Review/Concurrence C E Goodman 4/18/83
Signature / Date — Construction Manager

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these tasks in support of the startup schedule is necessary for such a schedule to be considered valid.

c. Preinstallation walkdown by nonmanual personnel - Task Force was initially concerned with the use of manual craftsmen for this walkdown activity. It appears that such concern is not now warranted. Presently, ITT Grinnell is walking down hangers with a mix of personnel, both manual and nonmanual, with general success and schedule benefit. Increased efforts along these same lines for small bore installation could contribute to further improvement of ITT Grinnell's schedule performance.

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CONSTRUCTIBILITY REVIEW FINDING

Task No./Description: No. 2(a) - Supports Interferences - General Overview

1. Items of concern/Item under review

   General aspects of site concerns regarding supports interferences.

2. Source of information, persons contacted, background on subject matter

   a. Electrical:

      A. Fallon, Project Manager - L. K. Comstock
      J. Ronco, Assistant Superintendent of Construction - SWEC
      J. Lowry, Construction Supervisor - SWEC
      D. Parkhurst, General Foreman - L. K. Comstock

   b. Instrumentation:

      W. Dunn, Project Superintendent - Johnson Controls, Inc.

   c. Mechanical:

      J. White, Project Manager - ITT Grinnell
      E. Eichen, Mechanical/Pipe Construction Superintendent - SWEC
      T. Staehr, Construction Engineer - SWEC
      K. Ostien, Piping Supervisor (Night) - SWEC
      J. McLoughlin, Night Shift Superintendent - SWEC
      J. Supernavage, Night Shift Engineer - SWEC
      T. Johnson, Construction Supervisor - SWEC

   d. Site Engineering:

      L. E. Shea - SWEC
      J. Giler - SWEC
      T. Landry - SWEC
      M. Oleson - SWEC
      P. P. Svarney - SWEC
      L. Theriault - SWEC
      L. Zak - SWEC

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Signature / Date — Construction Manager

Task No. 2(a) - Supports Interferences - General Overview (Cont)

Background

Over the past several months it has become evident that preengineered Category I/seismic conduit was not thoroughly checked for interferences. (Some potentially interfering items were issued after conduit drawings were issued, also.) Apparently, conduit (primarily direct-attached conduit on walls and building steel) is a "wild card" in the preengineered "deck". Small bore pipe, tubing, and supports have apparently been checked prior to issuance. Also, it appears that the size of small bore support base plates and conduit support base plates is much greater than would be expected for the given line size, thereby increasing the potential for interferences.

3. Finding

A large portion of supports interferences are between Category I/seismic pipe supports (large bore and small bore) and electrical conduit (both unscheduled field-run lighting/communications and scheduled Category I/seismic conduit). Unscheduled conduits are reworked as required. Scheduled conduit interferences are resolved via ACN (if drawing change is required) to rework conduit or revise support as appropriate.

4. Evaluation

Clearing of interferences on scheduled electrical conduit arrangement drawings did not live up to expectations of the preengineered concept. Also, many of the interferences occur with those scheduled conduits attached directly to walls. Direct-attached conduit routing is not preengineered. Rework for these conduits may be as high as 30 percent rather than the 10 to 12 percent expected.

Conclusion: At present rate add 10 to 17 percent to total estimated man-hours for conduit installation as margin for rework due to interferences. Adjust manpower or schedule accordingly.

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CONSTRUCTIBILITY REVIEW FINDING

Task No./Description: No. 2(a) - Supports Interferences - General Overview

1. Items of concern/Item under review

   General aspects of site concerns regarding supports interferences.

2. Source of information, persons contacted, background on subject matter

   a. Electrical:

      A. Fallon, Project Manager - L. K. Comstock
      J. Ronco, Assistant Superintendent of Construction - SWEC
      J. Lowry, Construction Supervisor - SWEC
      D. Parkhurst, General Foreman - L. K. Comstock

   b. Instrumentation:

      W. Dunn, Project Superintendent - Johnson Controls, Inc.

   c. Mechanical:

      J. White, Project Manager - ITT Grinnell
      E. Eichen, Mechanical/Pipe Construction Superintendent - SWEC
      T. Staehr, Construction Engineer - SWEC
      K. Ostien, Piping Supervisor (Night) - SWEC
      J. McLoughlin, Night Shift Superintendent - SWEC
      J. Supernavage, Night Shift Engineer - SWEC
      T. Johnson, Construction Supervisor - SWEC

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      L. E. Shea - SWEC
      J. Giler - SWEC
      T. Landry - SWEC
      M. Oleson - SWEC
      P. P. Svarney - SWEC
      L. Theriault - SWEC
      L. Zak - SWEC

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Signature Date Construction Manager

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Task No. 2(a) - Supports Interferences - General Overview (Cont)

Background

Over the past several months it has become evident that preengineered Category I/seismic conduit was not thoroughly checked for interferences. (Some potentially interfering items were issued after conduit drawings were issued, also.) Apparently, conduit (primarily direct-attached conduit on walls and building steel) is a "wild card" in the preengineered "deck". Small bore pipe, tubing, and supports have apparently been checked prior to issuance. Also, it appears that the size of small bore support base plates and conduit support base plates is much greater than would be expected for the given line size, thereby increasing the potential for interferences.

3. Finding

A large portion of supports interferences are between Category I/seismic pipe supports (large bore and small bore) and electrical conduit (both unscheduled field-run lighting/communications and scheduled Category I/seismic conduit). Unscheduled conduits are reworked as required. Scheduled conduit interferences are resolved via ACN (if drawing change is required) to rework conduit or revise support as appropriate.

4. Evaluation

Clearing of interferences on scheduled electrical conduit arrangement drawings did not live up to expectations of the preengineered concept. Also, many of the interferences occur with those scheduled conduits attached directly to walls. Direct-attached conduit routing is not preengineered. Rework for these conduits may be as high as 30 percent rather than the 10 to 12 percent expected.

Conclusion: At present rate add 10 to 17 percent to total estimated man-hours for conduit installation as margin for rework due to interferences. Adjust manpower or schedule accordingly.

CONSTRUCTIBILITY REVIEW FINDING

Task No./Description: No. 2(b) - Supports Interferences - Control Building Examples

1. Items of concern/Item under review:

   a. ARRGT CND and SIMC SPRTS
   CONTROL BUILDING EL 214 FT 0 IN. SH-1
   Drawing No. 12177-EE-420B-2

   E&DCR No. C41,461 dated June 22, 1983

   Support No. CRD102R was relocated 3 in. to the east in order to resolve interference with floor drain piping and pipe hangers. (E&DCR initiated June 14, 1982; answered June 22, 1982.)

   b. ARRGT CND and SIMC SPRTS
   CONTROL BUILDING EL 237 FT 0 IN. SH-1
   Drawing No. 12177-EE-420E-3

   ACN No. 000758 dated November 5, 1982 (Engineering final approval via E&DCR No. C41,902 on December 10, 1982)

   4-in. conduit 2CL507YD-4 directly attached to building steel of ceiling slab interfered with cable tray support steel. Interference was resolved by moving conduit 3 in. to the south. Clarification of dimension for direct attachment was also provided.

   c. ARRGT - CND and SIMC SPRTS
   CONTROL BUILDING EL 288 FT 6 IN.
   Drawing No. 12177-EE-420S

   E&DCR Nos. C41,828 and C42,341

   Conduit supports as shown on drawing interfered with HVAC duct supports. Resolution involved moving conduit and supports 6 in. (No change to span between conduit supports.)

2. Background

Category I/seismic conduit supports are required by general notes on Drawing No. EE-420A to be installed to ±1 in. of the location shown on the drawing. All deviations require prior Engineering approval (via ACN or E&DCR).

3. Finding

Preengineering of Category I/seismic conduits has not eliminated many interferences. Also, Category I/seismic conduit directly attached to building walls has not been preengineered adding to the number of interferences.

4. Evaluation and Potential Impact

Whether or not the many interferences documented to date represent an unusually high number is difficult to determine, since many such interferences occur on all jobs. It is worth noting that many of the E&DCRs issued over the past 9 months to resolve interferences required only relatively small and simple changes to dimensions. Therefore, many interferences that might otherwise be resolved in the field by craftsmen must be passed back to the engineer and documented on an E&DCR, making the number of documented interferences unusually high.

While a large number of interferences is undesirable, regardless of how they are handled, the fact that job specifications allow the craftsmen only ±1 in. to resolve their interferences necessarily means that more resolutions by the Engineers (i.e., documentation via ACN or E&DCR) are required, with their associated time requirements.

In addition, conduit installation in the past has been largely a matter of the craftsmen establishing the best route in the field using to/from information after practically everything else has been installed. For an office-bound designer to presume to route conduit in an unmodelled area is bound to create the interferences being encountered. Yet, it is recognized that structural evaluation of the conduit and conduit supports system must be accomplished, and the engineering drawing with specified routing is the vehicle chosen for that purpose. Further, structural evaluation and signoff is required on each E&DCR revising conduit routing, thus adding to the approval cycle.

Given the above, it is concluded that:

a. A system providing greater flexibility to resolve conduit interferences without a drawing deviation would enhance timely completion of conduit installation. (Such a system might allow conduit relocation of 1 ft or more provided support system remained the same or might allow supports relocation up to a maximum span; an increase to local tolerances, however, should be used only to resolve interference.)

b. A greater spirit of cooperation and community for getting the conduit installed would enhance timely completion. The following might be considered:

- Encourage contractor (particularly his foremen and supervisors) to request improvements or offer suggestions to the Engineers for conduit routing/relocation, e.g., direct attachment at inserts on a wall in lieu of cantilevered (engineered) supports. Respond to such requests in a timely manner.

- Bring the engineers authorized to approve changes (ACNs) closer to the work area to allow them to develop a greater team spirit with those performing the installation.

- Include -FQC in the circle of communication when revising specification or drawing guidelines.

c. The number of E&DCRs per conduit arrangement drawing is much too high.

Installation rates for conduit in the control building are probably typical of what can be expected for the balance of the Category I/seismic areas. Thus, at present rate, conduit installation is likely to require more man-hours than originally anticipated.

Adjustments to manpower and greater flexibility of installation to resolve interferences would make the present schedule achievable.

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CONSTRUCTIBILITY REVIEW FINDING

Task No./Description: No. 2(c) - Supports Interferences - Reactor Building Examples

1. Items of concern/Item under review:

   a. ARRGT - COND & SIMC SPRTS.
   REACTOR BUILDING EL 240-0
   Drawing No. 12177-EE-460AB

   COND & SEISMIC SUPPORTS
   REACTOR BUILDING EL 240 FT 0 IN.
   Drawing No. 12177-EE-460EL

   In accordance with E&DCR No. C15,867, bank of 5 3/4-in. conduits and junction box required relocation to avoid small bore pipe support. E&DCR both generated and answered on January 12, 1983.

   b. ARRGT - COND & SIMC SPRTS
   REACTOR BUILDING EL 175 FT 0 IN.
   Drawing No. 12177-EE-460B

   In accordance with E&DCR No. C14,807 (revised by E&DCR No. F10,851), conduit support 6B08 required revision to avoid interference from pipe support on BZ-137X.

2. Background

   Much of the conduit in the reactor building is directly attached. The number of E&DCRs/ACNs to resolve interferences is considerably less per drawing than was the case in the control building. Also, General Notes for the reactor building (EE-460A, 460S) now allow field adjustment in a number of areas, e.g., 6-in. relocation to hit centerline of steel, rotation of post supports, and offsets between supports. Also, interferences with directly attached conduit can be resolved by moving the conduit without an E&DCR.

3. Finding

   The two E&DCRs listed above describe conduit interferences with pipe supports in the reactor building and represent the typical scope of such interferences for two drawings.

4. Evaluation and Potential Impact

Some movement towards greater installation flexibility is apparent in the reactor building conduit drawings. Inteferences will continue to occur, particularly with conduit attached directly to walls and structural steel, requiring additional rework man-hours. The extent of this rework may be 30 percent of the original installation man-hours.

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CONSTRUCTIBILITY REVIEW FINDING

Task No./Description: No. 2(d) - Supports Interferences - G-Line Wall (Screenwell)

1. Items of concern/Item under review

G-Line Wall Interference (between pipe supports for two 3-in. lube oil lines and adjacent cable tray)

E&DCR No. C51,450 relocated lube oil lines 2LOS-003-9 and -14 and placed supports for these lines on hold due to interferences. Supports were subsequently issued on E&DCR Nos. V50,233 and V50,251 approximately 2 months later. Design check of location for these 3-in. lines and their associated supports apparently did not correctly account for the adjacent cable trays.

2. Background

Tray arrangement was issued for construction on April 6, 1978, as EE-34AP-3, CABLE TRAY ARRANGEMENT, SCREENWELL BUILDING el 261 ft. Lube oil lines 2LOS-003-9 and -14 first issued on September 20, 1978, as EP-41C-1, TURBINE LUBE OIL PIPING, SCREENWELL BUILDING. Supports were issued by ITT Grinnell on BZ-41G00X series drawings with first issues being approved by SWEC in March 1980.

3. Finding

Pipe supports for two 3-in. lube oil lines (pipe routing issued by SWEC; supports issued by ITT Grinnell) interfered with electrical cable trays issued earlier.

4. Evaluation and Potential Impact

This inteference deals with a Category II installation and, as such, involves pipe supports drawings prepared by the contractor. Therefore, the solution to the interference not only involved SWEC drawing revision (pipe routing changes) but also contractor drawing changes. The multiparty involvement may have contributed to the need for three E&DCRs to provide a final solution. It would appear that the overall solution might have been established at one time with all parties and then issued as one solution on one E&DCR (or one group of E&DCRs) at one time. The issuance of three E&DCRs over a more than 2-month period to finally resolve the interference contributed to the frustration of the construction forces responsible for the installation.

Determining the extent of schedule impact due to such problems and manner of resolution would be subjective. This interference may well have been the most glaring or annoying at the time of the site visit. It is concluded that more timely and thorough resolution of interferences by the responsible site engineer(s) for the given discipline(s) working with all involved parties will be necessary to maintain the present schedule.

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CONSTRUCTIBILITY REVIEW FINDING

Task No./Description: <u>No. 3 - Installation Practicality</u> Sheet 1 of 2

1. Items of concern/Item under review:

   a. Issued for construction drawings in general - can field use them as is.

   b. Ten specific problems; see separate sheets (attached).

2. Source of information, persons contacted, background on subject matter:

   Same as Task No. 2.

   Site interviews were conducted, a field walk (with some supervisors and foreman) was made, and drawings and E&DCRs were reviewed at CHOC.

3. Finding:

   a. Category I/seismic DP drawings are considered insufficient (no hanger locations to building reference lines; dimensions too loose - scaled from ½-in. model; specification tolerance does not allow installation directly from ISO as is).

   b. There are numerous E&DCRs against drawings, particularly Category I/seismic electrical conduit arrangement drawings.

4. Evaluation of potential impact, conclusions:

   a. Category I/seismic small bore effort will continue to lag until more workable arrangement is established to provide locating dimensions or to allow flexibility to install as required by field conditions.

   b. Improved Engineering checking (EE drawings) and more timely completion/processing of design changes will enhance man-hours and schedule performance by Construction. If there are no improvements, expect the same level of progress which can only slow down as emphasis shifts from bulk commodities to finishing systems.

Originated by F. J. Young 5-11-83 Review/Concurrence C. L. Goodman 5-11-83
Signature Date Construction Manager

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1. No locating dimensions (to building reference lines) for hangers; e.g., reactor building DP-340 BP, BQ, BR, INSTR AIR SECONDARY CONTAINMENT.

2. Holddown of vendor equipment is specified to be in accordance with vendor drawings. Field conditions often preclude use of vendor drawing without some revision; e.g., vendor calls for fillet weld size larger than available at edge of embedded sill (reference MCCs el 261, control building).

3. Detail for directly attaching conduit to embedded strut on walls does not allow conduit-to-wall clearance for pull boxes or base plates (reference battery room (2BYS*BAT2B), east face of 12-line wall, el 261 ft).

4. Flex conduit to bridge the building shake space between closed-bottom trays will not fit through opening, el 214 ft, control building (reference Drawing Nos. EE-340AA and 340AT.)

5. West end of south electric tunnel, post support for conduit not oriented to land conduit squarely on tube steel. Reorientation required (reference E&DCR Nos. C14,083 and C14,577 and Drawing No. EE-450A.) NOTE: Reactor building Drawing No. EE-460AG, Note 4, now allows rotation of post supports to suit field requirements in the reactor building primary containment.

6. South electric tunnel at south wall of auxiliary bay--electrical sleeves feed bank of vertical trays which feed bank of horizontal trays. Specification requirement of maximum 3 ft of unsupported cable may need relaxation to accomplish cable installation through this area. Reference Drawing No. EE-450A.

7. Bearing-type drilled-in-anchors called out on BZ-108PW and PX issued for construction prior to issuance of approved specification/procedure for installation.

8. Requests by electrical contractor to cut rebar for installation of drilled-in-anchors have caused some delays. In one case, lengthy delay in response allowed field conditions to change (new pipeline run through area), further complicating the original base plate and support installation (reference control building, 12-line wall, el 237 ft).

9. Tube steel to tube steel wraparound welds cannot be made after pipe erection for pipe sizes 12 in. and under.

10. E&DCR No. C41,849 against Drawing No. EE-420E COND & SIMC SPRTS, CONTROL BUILDING, was required to clear support 2 ft 4 in. so that it would not fall in bend radius of 4 in. diameter conduit being supported.