CONNECTICUT YANKEE ATOMIC POWER COMPANY

BERLIN, CONNECTICUT
P. O. BOX 270 HARTFORD, CONNECTICUT 06101

TELEPHONE
203-666-6911

JUL 16 1982

Docket No. 50-213
A02497

Mr. Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

References: (1) W. G. Counsil letter to D. G. Eisenhut, dated March 1, 1982.

(2) W. G. Counsil letter to Commissioner Hendrie, dated March 19, 1981.

(3) H. R. Denton letter to W. G. Counsil, dated May 10, 1981.

(4) R. C. Haynes letter to W. G. Counsil, dated July 2, 1982.

Gentlemen:

HADDAM NECK PLANT
ADDITIONAL INFORMATION SUPPORTING
EXEMPTION REQUEST FROM APPENDIX R

Connecticut Yankee Atomic Power Company (CYAPCO) provided to the NRC Staff in Reference (1) an assessment of the fire protection features at the Haddam Neck Plant pursuant to the requirements of 10 CFR 50.48 and Appendix R to 10CFR Part 50. In addition, our evaluation of the deviations from Appendix R for each fire zone and proposed design modifications or proposed exemptions from the requirements of Appendix R were also provided. CYAPCO had previously requested an exemption from the schedular requirements of 10CFR50.48(c)(5), specifically for additional time to complete the actions described above, in Reference (2).

The Staff granted the schedular exemption request documented in Reference (3) upon the condition that the submittal be complete as defined in Reference (3). Reference (3) also provided CYAPCO a grace period of 60 days in which to provide any supplemental information to that of Reference (1) in order to comply with the requirements of the exemption.

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In addition to the information transmitted via Reference (3), a meeting was held in your Bethesda Office on May 13, 1982 between our respective Staffs for the purpose of discussing the Reference (1) document. This meeting was beneficial in that it provided for a fruitful information exchange during which our respective positions regarding the proposed exemption requests for the Haddam Neck Plant were discussed openly. Several action items resulted from the May 13 meeting; these are addressed within this document.

The purpose of this document is twofold. First, supplemental information is provided to complement that contained in Reference (1) such that the conditions accompanying the Reference (3) exemption are fulfilled. Secondly, the information requested during the May 13 meeting by the Staff is hereby provided.

Specifically, the following information is provided within this document:

- Section I - Additional narrative and bases regarding the PRA study and the treatment of the control room and switchgear room.
- Section II/Appendix A - Revised and expanded discussions of each of the 15 original exemption requests.
- Section III - Administrative controls.
- Section IV - Discussion of intervening combustibles.
- Section V - Shutdown outside control room.
- Section VI - A revised compliance summary including a discussion of the schedule for proposed modifications.
- Appendix A - Revised safe shutdown Fire Zone Analyses.
- Appendix B - Kerite flame test results for cable coated with Flamemastic.
- Appendix C - Intervening combustibles.
- Appendix D - Haddam Neck Plant Procedure No. AOP 3.2-8, Plant Operation Outside Control Room.
- Appendix E - Compliance status.

Condition (1)a of Reference (3) is fulfilled in that concise statements of CYAPCO's exemption requests are provided in Appendix A. Regarding the revised discussion on the exemption requests, the information provided is intended to fulfill conditions (1) b, and (1) c of Reference (3). Condition (2) does not apply as alternative or dedicated shutdown systems are not being proposed.

I. Probabilistic Risk Assessment -
Treatment of Control Room and Switchgear Room

Probabilistic Risk Assessment (PRA) methodology was utilized combining state of the art fire modeling techniques with probabilistic techniques to determine the overall probability of the Haddam Neck Plant failing to achieve a safe shutdown condition due to a postulated fire. Additional details of the study are provided in Reference (1).

The PRA evaluated every fire zone containing equipment credited for safe shutdown in the Plant. Specific fire zones were determined to dominate the overall fire vulnerability of the plant and were termed key fire zones. The bases for this segregation included an evaluation of:

- The likelihood of fire initiation in the zone.
- The probability of fire propagation in the zone.
- The amount of safe shutdown equipment located within the zone.

The four key fire zones at the Haddam Neck Plant are the switchgear room, the cable spreading area, the primary auxiliary building and the diesel rooms. These key fire zones were analyzed in more detail as discussed in Reference (1).

The control room was not determined to be a key fire zone. The control room is characterized by the following:

- continuously manned,
- low combustible loading,
- ionization fire detectors,
- readily available fire suppression equipment, and
- proposed customized administrative controls including dedicated fire watches for handling flammable liquids.

These features limit both the probability of fire occurrence and the extent of fire propagation should one occur. The result is that any control room fire which may occur would be small, localized and quickly extinguished. The data base of all light - water reactor fires supports this contention. In addition, the two fires which have occurred were small and inconsequential.

It is CYAPCO's contention that with the customized administrative controls proposed for the control room at the Haddam Neck Plant together with the features listed above, control room fire probabilities are extremely low. Furthermore the consequences of such a fire would likely be negligible. In the unlikely event of loss of control room control for a limited number of components, operator actions can be taken to manually control the affected equipment outside the control room. These actions are discussed in more detail within the control room exemption discussion in Appendix A.

Fire vulnerability is determined by the product of the probability of a postulated fire and the consequences of the fire. As discussed above, the probability of a control room fire is remote. Further, due to its size and duration, the resulting consequences would be minor. This results in the control room not being a major contributor to the fire vulnerability at the Haddam Neck Plant, and therefore it is not considered a key fire zone in the Reference (1) PRA.

In this context, the probability of a fire in the control room causing the loss of safe shutdown capability is well below 1x10-5 per reactor year.

The attachments to this letter include the justification for exemption requests on a fire-zone specific basis. Their collective significance with respect to plant-wide fire safety has been assessed via Probabilistic Risk Assessment (PRA) techniques, which were described in Reference (1). This PRA evaluation was instrumental in formulating CYAPCO's revised proposal to modify the switchgear room, as noted below.

One finding of the PRA evaluation was the expected result that the switchgear room is in fact a "key" fire zone. Since its current configuration is more susceptible to damaging fires than desirable using a target safety goal as the criterion, CYAPCO developed conceptual modifications designed to rectify this situation. The resulting improvement in fire safety was quantified, as presented in Reference (1), to be approximately two orders of magnitude.

Subsequent to the docketing of Reference (1), further investigation revealed that the modifications proposed for the switchgear room would not necessarily result in the full enhancement identified, but only a partial improvement. This determination was made as a result of a more conservative interpretation of the methodology associated with the PRA. Once having identified that more extensive modifications would be required to assure the validity of the PRA, CYAPCO developed the modifications for the switchgear room presented herein.

While the PRA is but one element of the justifications for the requested exemptions, CYAPCO opines that this technique is useful in implementing the concept of equivalent protection. Literal compliance with Appendix R is but one method to assure fire safety. Alternate techniques are also acceptable. We have found that the PRA complements the engineering judgement utilized on a fire zone specific basis to result in a cost effective method of assuring overall fire protection safety.

II. Fire Zone Analysis

Section VII of Reference (1) provided an evaluation of each fire zone at the Haddam Neck Plant for compliance with the provisions of Appendix R. Where compliance with Appendix R did not exist, modifications were proposed to bring the fire zone into compliance or an exemption from specific requirements of III.G.2 of Appendix R was and is being requested pursuant to 10CFR 50.48 (c)(6) and 10CFR 50.12(a).

The meeting of May 13, 1982 between our respective Staffs afforded the opportunity to discuss the Reference (1) exemption requests in great detail. Since the Reference (1) submittal, each exemption request has been re-evaluated. Several revised modifications have been engineered which have resulted in compliance for several fire zones. Each exemption request is described in Appendix A with additional discussions to support CYAPCO's remaining exemption requests. It should be noted that out of the original fifteen fire zones for which CYAPCO had requested an exemption from the specific requirements of Appendix R, re-evaluations have resulted in the need for exemptions in only eight specific fire zones.

The fire zone analysis for each exemption is presented in a format identical to that of Reference (1). This will facilitate comparison of the discussions for each fire zone between Reference (1) and this document. Appendix A provides specific fire zone analyses for the following areas:

o Control Room	Area S-1	
o Switchgear Room	Area S-8	
o Cable Spreading Room	Area S-17	
o Diesel Fuel Oil Forwarding Pumps	Area S-21	S-25
	S-22	S-26
	S-23	T-2
	S-24	
o Cable Vault	Area R-1	
o Containment	Area R-2	
o Containment - General	Area R-4	
o Auxiliary Feedwater Pump	Area R-5	
o Screenwell Pumphouse	Area P-1/P2	
o Service Water Pump Cable Duct		

Eight exemption requests are described herein and supersede the exemption requests of Reference (1). The eight areas for which CYAPCO requests exemptions from specific requirements of section III.G.2 of Appendix R are:

1. Switchgear Room
2. Control Room
3. Cable Spreading Room
4. Cable Vault
5. Auxiliary Feedwater Pump Room
6. Screenwell Pumphouse
7. Service Water Cables - Fire Zone S-9

One non specific area has also been added. This area is:

8. Service Water Pump Cable Duct

No additional information concerning Fire Zone S-9, Men's Locker Room, is provided. The information contained in Reference (1) concerning this area and CYAPCO's exemption request for the area is considered full and complete.

III. Administrative Controls

Currently, administrative controls are used to ensure proper performance of safety systems and compliance with NRC regulations. Examples include:

- o maintaining proper boron concentrations and levels in various tanks for safety-related applications,
- o mitigating actions in the event of undervoltage conditions,
- o personnel radiation exposure limitations, and
- o implementing the security plan and the safeguards contingency plan.

CYAPCO proposes to add a customized administrative Technical Specification to control the quantity and use of flammable liquids in specific fire areas at the Haddam Neck Plant. This proposal was discussed at great length during the May 13, 1982 meeting with the Staff at which time the advantages and disadvantages were reviewed.

CYAPCO proposes to restrict flammable liquids from the control room and the cable spreading area. Specifically, Technical Specifications would require written permission from the shift supervisor or supervising control operator prior to introducing flammable liquids in excess of one-half pint into the two areas described above. The Technical Specifications would also require that these liquids be contained in suitable containers which would be non-spillable and have flame arrestors in the nozzles. Container volume would be limited to one quart, independent of the safety features of the containers.

The key provision of these administrative controls would be the requirement to post a dedicated fire watch with appropriate fire fighting equipment to monitor the activity which utilizes the flammable liquids.

Signs would be posted at all entrance ways to the fire areas for which these requirements apply providing additional assurance that the flammable liquid restriction will be adhered to.

Elevating flammable liquid controls to the level of Technical Specifications will provide for higher visibility to both CYAPCO personnel as well as NRC personnel. As such, they would be more readily enforceable. Controls such as proposed herein effectively reduce the potential for fire in the four fire areas described above and add another layer of fire protection defense-in-depth to these zones. Limiting the quantity of flammable liquids available to a fire as well as providing a dedicated fire watch would limit any potential damage which may occur should a fire initiate during the use of such materials.

As stated during the meeting, the Staff's major concern in granting any credit for such a proposal is the difficulty associated with quantifying the reduction in risk associated with the use of such controls. We recognize that the rate of success in the implementation of such controls is highly variable throughout the industry. We note that several reviews have recently been conducted at the Haddam Neck Plant which focused on personnel performance. The Systematic Assessment of License Performance (SALP) as well as Institute of Nuclear Power Operations (INPO) audits have been completed. The results of these audits support CYAPCO's proposal that credit for administrative controls at the Haddam Neck Plant should be granted. Specifically, the following comments were taken from the SALP report for CYAPCO issued in Reference (4).

5.b (3) "The licensee has a comprehensive, well organized and effective system of plant procedures."

6.b (1) "Fire Protection

The resident inspector observed fire protection controls during routine inspections. No items of noncompliance were identified."

6.b (2) "Housekeeping

The licensee has a program which requires that site managers perform a plant tour at weekly intervals to observe equipment material conditions and housekeeping activities and practices. This program has been particularly effective."

In addition, the transmittal letter of Reference (4) states:

"Overall, we find that management attention at your facilities is aggressively oriented toward nuclear safety. Effective use of ample resources has resulted in a high performance in operational safety and construction activities."

In further support of our proposal, we advance our view that the credit being requested in this regard is not conceptually different from that granted by the Staff for other safety-related applications identified above. It would be incongruous for the Staff to accept this approach for certain applications and reject it for others.

CYAPCO's proposed administrative controls for flammable liquids will add another level of fire protection to the control room, switchgear room cable spreading room and cable vault. This added control on flammable liquid introduction into these areas together with the existing and proposed fire protection features described in Appendix A for these areas, will provide equivalent protection to that achieved by fulfilling the requirements of Section III.G.2 of Appendix R to 10CFR50. CYAPCO proposes these additional restrictive administrative controls to support the exemption requests for fire areas S-1, S-8, S-17 and R-1. A formal license amendment application will be docketed upon resolution of the exemption requests for fire areas S-1, S-8, S-17 and R-1.

IV Intervening Combustibles

Section III.G.2 of Appendix R to 10CFR50 specifies the means for ensuring that redundant trains of safe shutdown equipment, located in the same fire area, remain free of fire damage. Item b identifies detection, automatic suppression and separation of safe shutdown equipment by 20 feet with no intervening combustible or fire hazards as one means of compliance with Section III.G.2.

Recognizing that all materials are combustible at sufficiently elevated temperatures, the provision "no intervening combustible or fire hazards" of Section III.G.2.b of Appendix R is subject to interpretation. To ensure Staff cognizance of the approach utilized in our fire hazard evaluations, CYAPCO presents a discussion in Appendix C regarding the interpretation of intervening combustibles in the context of compliance with Section III.G.2.b of Appendix R.

The basis for the definition presented in Appendix C is a consideration of the credible fire which would be expected to occur in any given fire area at the Haddam Neck Plant as well as testing results conducted by the Kerite Company for fire retardant coatings utilized by CYAPCO.

Several of the conclusions presented both in Reference (1) and in Appendix A have been based on an evaluation of intervening combustibles present in each fire zone. CYAPCO has requested exemptions in several fire zones from the requirement of Section III.G.2.b of Appendix R for "no intervening combustibles". In these instances, the evaluation of the specific fire zone concluded that the intervening combustibles present do not compromise the integrity of the redundant safe shutdown equipment in the zone. Details are provided in the discussion sections for individual fire zone analyses.

V. Shutdown Outside the Control Room

At the request of the NRC Staff during the May 13, 1982 meeting in Bethesda, CYAPCO hereby provides Abnormal Operating Procedure No. AOP 3.2-8 for the Haddam Neck Plant. This procedure outlines those actions required to maintain the Plant in a safe condition should the control room become uninhabitable.

This procedure has been reviewed by the NRC Staff under the SEP Topic VII-3, Systems Required for Safe Shutdown. NRC comments will be reviewed by CYAPCO and revisions to AOP 3.2-8 will be made if warranted.

CYAPCO has reviewed this procedure and a walkdown of the procedure has previously been performed.

The current complement of on-shift operations personnel is capable of completing the actions described in AOP 3.2-8. This procedure can be implemented without utilizing members of the site fire brigade. However, fire brigade personnel will be utilized as appropriate upon completion of their fire brigade functions.

VI. Compliance Summary

To complement the information presented in the Fire Zone Analyses presented in Section II above, a revised synopsis of the current compliance status on a fire zone specific basis is provided as Appendix E. It is CYAPCO'S intention to provide the Staff with a revised schedule for the completion of the modifications identified in the attached summary after a review of all fire protection modifications at the Haddam Neck Plant and Millstone Unit Nos. 1 and 2 can be accomplished. This review will establish an optimum fire protection modification implementation schedule for all three of the Northeast Utilities operating nuclear power plants which is compatible with each of the plant's scheduled outages.

This approach will enable Northeast Utilities to better utilize its engineering and construction manpower such that the proposed fire protection modifications can be implemented on a timely and cost effective schedule. The schedules for the fire protection modifications will be provided to the Staff following the completion of supplemental submittals for both operating Millstone Units. As a result of completing this integrated evaluation, we anticipate that additional schedular exemption requests will be necessary.

With the docketing of this submittal, CYAPCO concludes that the requirements of 10CFR50.48(c)(5) for submitting plans to comply with 10CFR50.48(c)(2) and 50.48(c)(3) have been fulfilled. Given the extensive interrelationship between modifications resulting in compliance and those associated with exemption requests, it is not practical to provide detailed implementation schedules at this time. For those modifications associated with fire zones involving exemption requests, we interpret 10CFR to mean that the schedule is tolled pursuant to 50.48(c)(6). For those modifications identified which would result in compliance with 10CFR50.48 and Appendix R, a schedular exemption from the requirements of 10CFR50.48(c)(5) is requested pursuant to 10CFR50.48(c)(6) and 10CFR50.12(a). We are confident that reasonable schedules can be developed promptly after the Staff responds to the proposals contained herein. Such schedules would reflect the results of an integrated evaluation of previously committed plant modifications and other resource considerations in concert with recently articulated Commission policy in this regard.

Subsequent to submitting the enclosed report, CYAPCO will continue verification of the information provided to the Staff. In the event that any clarification of this information is found to be necessary, CYAPCO will provide such clarification as expeditiously as possible.

We remain prepared to interact with the Staff as necessary to bring this issue to resolution.

Very truly yours,

CONNECTICUT YANKEE ATOMIC POWER COMPANY

W. G. Counsil

W. G. Counsil
Senior Vice President

By: J. P. Cagnetta
Vice President, Nuclear and
Environmental Engineering

FIGURE 1

Flammable Liquid Administrative
Technical Specification

ADMINISTRATIVE CONTROLS

FLAMMABLE LIQUID CONTROL

Transient flammable liquids in volumes greater than 1/2 pint shall be restricted for the control room, cable vault, cable spreading room and switchgear room except under the following conditions:

1. Written permission is obtained from the Supervising Control Operator or the Shift Supervisor.

2. The flammable liquids are contained in a suitable container not to exceed one quart in volume, and

3. A dedicated fire watch with fire fighting equipment is assigned to the activity

FIGURE 2

Flammable Liquid Administrative Technical Specification - Reporting

Note: This item is intended to provide for reporting of potentially generic problems.

b. Thirty Day Written Reports The reportable occurrences discussed below shall be the subject of written reports to the Director of the appropriate Regional Office within thirty days of occurrence of the event. The written report shall include, as a minimum, a completed copy of a license event report form. Information provided on the licensee event report form shall be supplemented, as needed, by additional narrative material to provide complete expalanation of the circumstances surrounding the event.

(1) Reactor protection system or engineered safety feature instrument settings which are found to be less conservative than those established by the technical specifications but which do not prevent the fulfillment of the functional requirements of affected systems.

(2) Conditions leading to operation in a degraded mode permitted by a limiting condition for operation or plant shutdown by a limiting condition for operation.

Note: Routing surveillance testing, instrument calibration, or preventative maintenance which require system configurations as described in items 2.b(1) and 2.b(2) need not be reported except where test results themselves reveal a degraded mode as described above.

(3) Observed inadequacies in the implementation of administrative or procedural controls which threaten to cause reduction of degree of redundancy provided in reactor protection systems or engineered safety feature systems.

(4) Abnormal degradation of systems other than those specified in item 2.a(3) above designed to contain radioactive material reulting from the fission process.

Note: Sealed sources or calibration sources are not included under this item. Leakage of valve packing or gaskets within the limits for identified leakage set forth in technical specifications need not be reported under this time.

(5) Unauthorized introduction of greater than 1/2 pint of flammable liquids into the control room, cable vault, cable spreading room, or switchgear room.

APPENDIX A

REVISED FIRE ZONE ANALYSES

DOCKET NO. 50-213

JULY, 1982

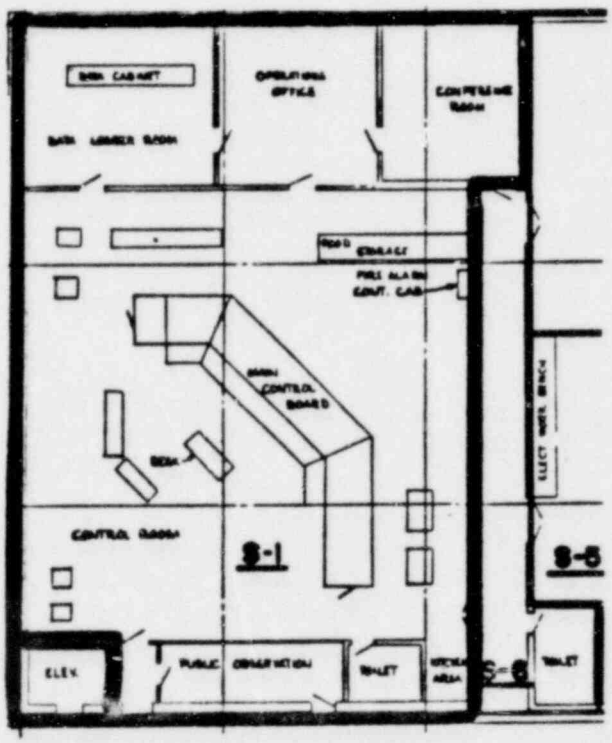
CONNECTICUT YANKEE
SAFE SHUTDOWN FIRE ZONE ANALYSIS

El. 59'6" Service Building
Control Room

Fire Zone No. S-1

Safe Shutdown Equipment

Control board, auxiliary panels, and wiring
Cables



Design Features

- The control room is enclosed by reinforced concrete shielding walls.
- All exit doors are blast resistant and provide a minimum of three hour fire protection.
- The drop ceiling is mineral acoustic tile (noncombustible), and the flooring is vinyl asbestos tile.

Combustible Material

	Quantity	Fire Load (Btu/ft^2)
Paper	45 ft^3	4,600
Plastic	200 lb	400
Cabinet Cables	100 ft^3	16,200

Fire Protection

- Two 20-pound carbon dioxide extinguishers are located in the control room on the north and west walls.
- A hose cabinet is in the hall outside the south door.
- There is a hose reel in the turbine building at the hall entrance outside the south door.
- There is a 125 pound dry chemical wheeled extinguisher at the elevator, outside the west door to the control room.
- Fire detection equipment is installed in the main control board interior corridor.
- Fire detection equipment is installed in the areas that are outside the line of vision of the operators at the console.

Compliance with Appendix R

Does not comply with Section III.G.2 of Appendix R. An exemption is requested from the (See proposed modification and discussion) requirements for automatic suppression and the separation requirements of Section III.G.2.b of Appendix R.

Proposed Modifications

1. Customized administrative controls will be implemented to minimize introduction of flammable liquids in the control room. (See aforementioned discussion on customized administrative controls.
2. Fire rated dampers or equivalent will be installed on louvered openings of the main control board and its auxiliary cabinets.
3. All openings between the cabinets and the floor that would allow a spilled flammable liquid to enter the cabinets will be sealed.
4. Ramps (1/8"/foot) will be installed to divert spilled flammable liquid away from required auxiliary cabinets. (See Attachment #2, Sketch 1.)

Discussion

The main control room at Connecticut Yankee was evaluated under three postulated conditions. In order to evaluate these conditions, it was necessary to identify all safe shutdown required components and panels. Enclosed as Attachment 1 is a description of required components/panels and associated plan views and sketches which will identify all critical/sensitive areas within the control room.

The bases and justification for the requested exemption for the main control room involves three tiers or levels of defense in depth:

- o Level I: A major damaging fire threatening safe shutdown integrity cannot occur because of the unique features of the control room and proposed customized administrative controls.
- o Level II: A flammable liquid spill, the combustible with the greatest potential for damage, is allowed to burn and the proposed fire protection modifications prevent damage to safe shutdown equipment.
- o Level III: An unmitigated fire causes individual panel damage and operator action is identified outside the control room which assures safe shutdown is achieved.

With respect to Level I, CYAPCO concludes that damaging or destructive fires can only result from fires that go undetected for considerable periods of time, or those fires that develop rapidly because of large quantities of combustibles such as flammable liquids.

The control room differs from all other areas of power plant with respect to potential destructive fires. The control room has unique features which eliminate damaging/destructive fires. These unique features include the following.

1. Control room is continuously manned by licensed operators.
2. Control room is a restricted area and transient combustibles are controlled.

Technical Specifications require that three (3) licensed operators be on shift in Modes 1 through 4, and one (1) licensed operator in Modes 5 and 6. The type of fire that can be expected in the control room would be a slow smoldering fire because of the type and quantity of combustible materials present, and heat sources available. This type of incipient fire would be detected promptly by licensed personnel on duty and/or the installed ionization smoke detection system. Portable extinguishers could readily handle any control room incipient fire that could occur. It should be noted also that many licensed operators are trained members of the plant fire brigade.

Because the control room is a locked/restricted area, the potential for introducing large quantities of transient combustibles is remote, and therefore it is not credible to postulate a rapidly developing, damaging, major fire. This basis alone is, in our view, sufficient to justify the exemption requested. Although we do not deem further consideration of damaging fires credible, additional reviews were conducted to inform the Staff that even under incredible hypotheses of fire initiation and propogation, safe shutdown integrity is maintained. These hypotheses are described in Levels II and III.

The control room also has many other favorable features which contribute in preventing, detecting, and/or suppressing a fire. In 1978 the NRC conducted site fire protection inspections to evaluate compliance with Branch Technical Position 9.5-1 Appendix A.

All fire protection recommendations generated for the control room by the NRC and their fire protection consultants have been implemented.

Another factor that must be considered in the defense of the control room is that no high or medium voltage power supplies exist in the control room.

The following active and passive fire protection features for the control room must be considered when assessing the vulnerability of the control room.

1. Uniqueness of Control Room: Continuously manned by licensed reactor operators.

2. Hardened/secure area of the plant: Totally enclosed by reinforced concrete and restricted entry.

3. No significant permanent combustibles.

4. No high/medium voltage power sources.

5. Adequate fire protection for type and quantity of combustibles; portable extenguishers located throughout the room and hose stations available in areas outside control room.

6. Early warning detection; provided by control room licensed operators and ionization detection.

7. Proposed customized administrative controls to restrict flammable liquids in the control room (see aforementioned discussion on administrative controls).

The combined features listed above represent a defense-in-depth approach to fire protection by providing sufficient echelons/levels of active, passive, and administrative control features to assure the functionability of the control room.

With respect to Level II presented in Section III of Reference (1) is a quantitive analysis conducted to model the effects of an unmitigated transient combustible fire involving one gallon of heptane in the control room of the Haddam Neck Plant. It is recognized that such a fire is an extremely unlikely event. Further, no attempt was made to postulate the scenario under which this situation may occur. Rather, the focus of this report is to demonstrate the survivability of critical control panel devices from the effects of an unmitigated fire and the inherent protection afforded by the existing configuration.

In modeling the postulated fire, conservative assumptions are made concerning the fires heat release rate and the heat transfer of energy to a CMC-type switch and the supporting panel. These assumptions are all oriented towards supporting a bounding calculation of the maximum surface temperatures for both the console and the model switch while limiting the flow of heat in a manner which exaggerates the overall severity of the fire scenario. A brief summary of assumptions used in this analysis includes the following considerations.

- Laboratory values for the heat release rate of heptane are used. This assumption results in a more efficient and severe fire than has been measured in actual large-scale fires comparable to the type used in the analysis.

- Instantaneous achievement and continued maintenance of maximum fire heat release rates are postulated. This approach ensures the use of the most severe or bounding conditions in modeling the effects of the control room fire.

- High values for radiation absorptivity are utilized coincident with low values for the emissivity for the subsequent reradiation. This assumption results in the accumulation and retention of the incident radiant heat flux by the panel and switch.

- Unreasonably high air temperatures adjacent to the panel are maintained subsequent to fire self-extinguishment with cooling provided by natural convection.

- Conduction of heat is assumed to occur in only a single dimension up and away from the panel's edge. Cooling resulting from lateral heat conduction in the panel is not considered.

The approach taken in modeling the postulated fire involves a rigorus analysis of the physics of the problem. Time dependent, finite difference solutions for the control panel surface temperature were obtained for a second-order partial differential equation with variable boundary conditions.

The quantitative analysis conducted concluded that the postulated fire <u>would not</u> disable instrumentation and controls located on the main control board, thus ensuring safe shutdown capability and providing additional bases for the requested exemption.

In the Conclusion Section of the Final Report, it is noted that the analysis assumed that the ventilation slots on the lower front panels are closed off. These louvered openings represent a difference between the actual control board configuration and the assumed analytical configuration. Since the analysis did not account for the louvered openings, CYAPCO proposes to provide a barrier that would afford equivalent or greater protection than the control panel itself.

This quantitative/analytical analysis is applicable to the main control board area and was not intended to account for the freestanding auxiliary cabinets which are also located in the main control room.

The design of the main control board does not permit switches, gages, and instrumentation to be directly exposed to heat generated at floor level (flammable liquids) and therefore the quantitative analysis indicates that main control board instrumentation would survive the postulated fire. The auxiliary panels do not have this design feature and therefore their exposure to the fire is more direct. For this reason CYAPCO has proposed to provide ramps in front of these panels to assure that any flammable liquid spill would be directed away from the panel faces (see Attachment #2, Sketch 1).

CYAPCO concludes with the enclosed quantitative fire analysis for the main board and the proposed ramping for the balance of control room panels, that sufficient justification has been presented to demonstrate the survivability of control room required functions.

CYAPCO further concludes that from a fire consideration, sufficient measures have been provided in the form of active/passive fire protection features to assure that an equivalent level of protection for the control room exists.

Even though CYAPCO has provided reasonable justification and proposed modifications to assure control room survivability, CYAPCO has carried the control room analysis one step further (Level III). This condition assumes (incredibly) that all of the control room active and passive fire protection features fail to function.

- Proposed customized administrative controls breakdown.
- Proposed ramp to divert/drain a flammable liquid spill fails to function.
- No operator(s) action to restrict/control the fire is taken.
- No credit is taken for the quantitative fire analysis/model.
- No flammable liquid spill occurs and is ingnited.
- The resulting fire is positioned sequentially (not simultaneously) in front of each panel containing safe shutdown equipment in the control room.

Attachment 3 is a panel-by-panel analysis of the resultant inoperable equipment as well as a statement regarding alternative action(s) which can be taken by the control room operator(s) to compensate for resultant damage.

The results of this level III analysis reveal that CYAPCO can successfully untilize operator action outside the control room to compensate for damage to control room panels such that safe shutdown capability is maintained. These operator actions can be accomplished with on-shift personnel.

Docket No. 50-213

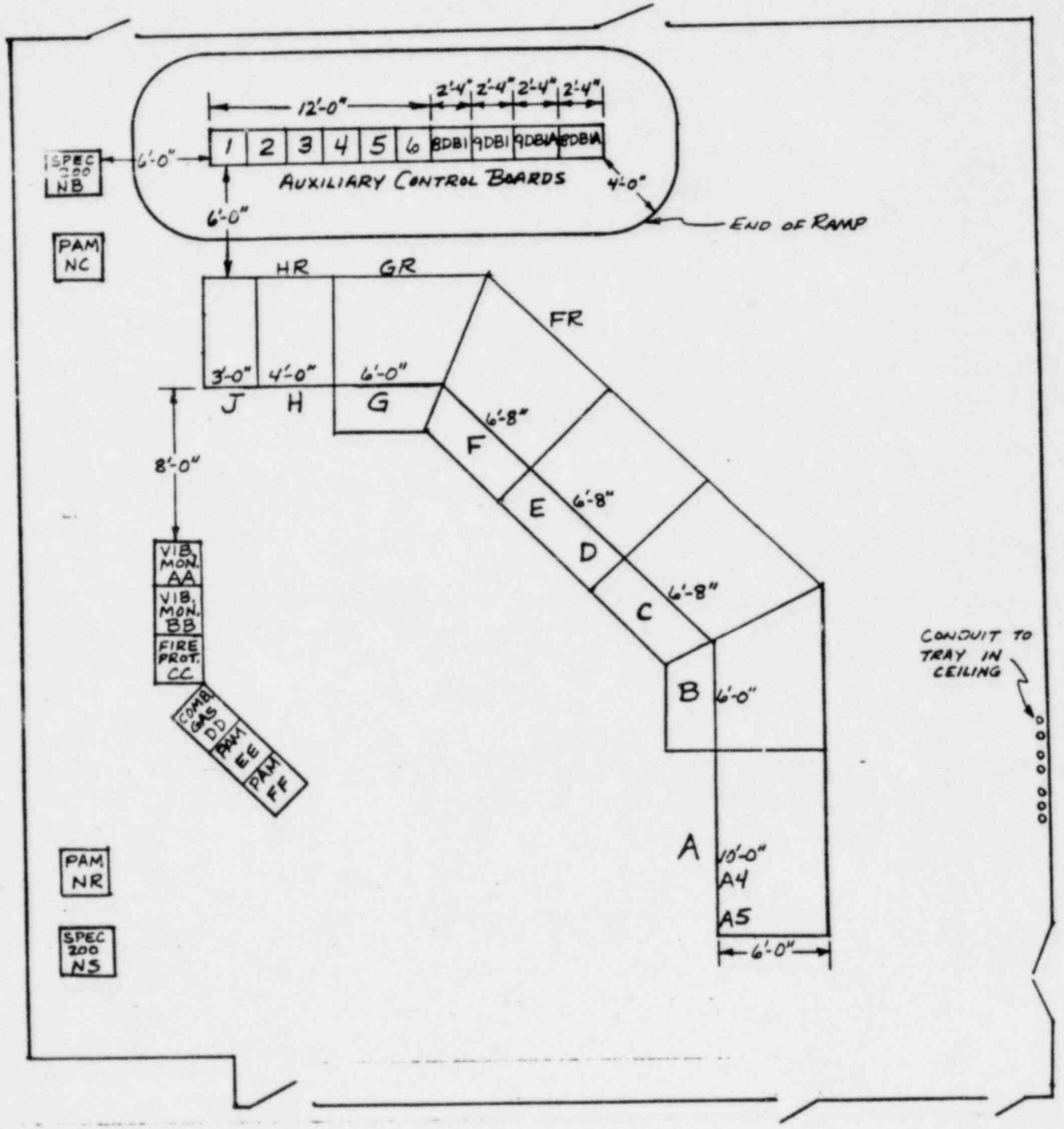
Attachment 1

Haddam Neck Plant

Control Room Layout

July, 1982

CONTROL ROOM LAYOUT



AUXILIARY CONTROL BOARD PANEL 4

This panel contains the undervoltage sensing and load shedding relays for the 480 volt Buses 4, 5, 6, and 7.

AUXILIARY CONTROL BOARD PANEL 6

The affected relays on this panel are the alarm relays which sense a loss of DC control power to the 480 volt bus load shedding schemes.

AUXILIARY CONTROL BOARD PANEL 7 (8DB1)

This is the control panel for emergency diesel EG2A. The affected devices are the diesel generator stop push buttons, the diesel generator breaker control switch, the diesel auto-test switch, the loss of normal power (LNP) relays for 4160 volt emergency Bus 8, and the voltage relays which provide the permissive to close the diesel generator breaker.

AUXILIARY CONTROL BOARD PANEL 8 (9DB1)

This panel contains controls for emergency diesel EG2B. It is divisionally redundant to Panel 7 (8DB1) and the same devices are affected. These devices relate to 4160 volt Bus 9.

AUXILIARY CONTROL BOARD PANEL 9 (9DB1A)

The only device of concern on this panel is the diesel generator start relay which starts diesel EG2B for a LNP and/or safety injection.

AUXILIARY CONTROL BOARD PANEL 10 (8DB1A)

Same as Panel 9 (9DB1A) except for diesel generator EG2A.

MAIN CONTROL BOARD SECTION B (TOP)

Affected devices are the source range nuclear instrumentation channels 11 and 14.

MAIN CONTROL BOARD SECTION C (TOP)

The devices possibly affected on this section of the board are the pressurizer pressure and pressurizer level instrumentation.

MAIN CONTROL BOARD SECTION C (BOTTOM)

This section contains the control switches for the residual heat removal pumps and for the charging pumps (both divisions).

MAIN CONTROL BOARD SECTION D (TOP)

Affected devices on this section of the board are the loop temperature indicators.

MAIN CONTROL BOARD SECTION F (TOP)

This section contains the instrumentation for steam generator level (wide range).

MAIN CONTROL BOARD SECTION F (BOTTOM)

This section contains the control switches for all four service water pumps.

MAIN CONTROL BOARD SECTION G (TOP)

Affected devices on this section are the voltmeters and voltmeter switch for the 480 volt buses.

MAIN CONTROL BOARD SECTION G (BOTTOM)

The devices of concern on this section are the control switches for circuit breakers 4850, 4960, 4851, and 4961.

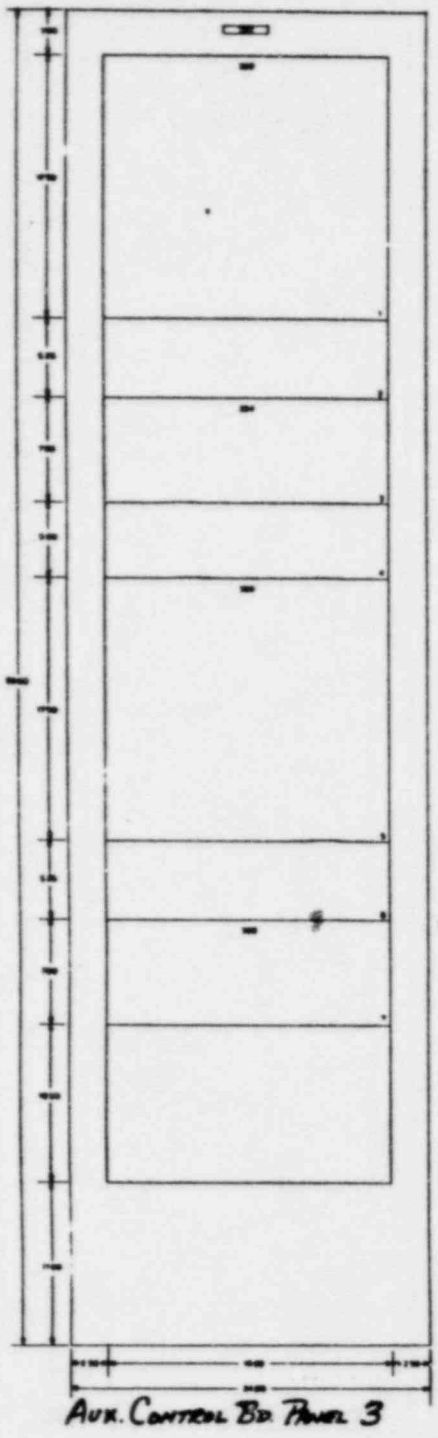
MAIN CONTROL BOARD PANELS A4 and A5

These panels contain equipment required for operation of the source range nuclear instrumentation channels 11 and 14.

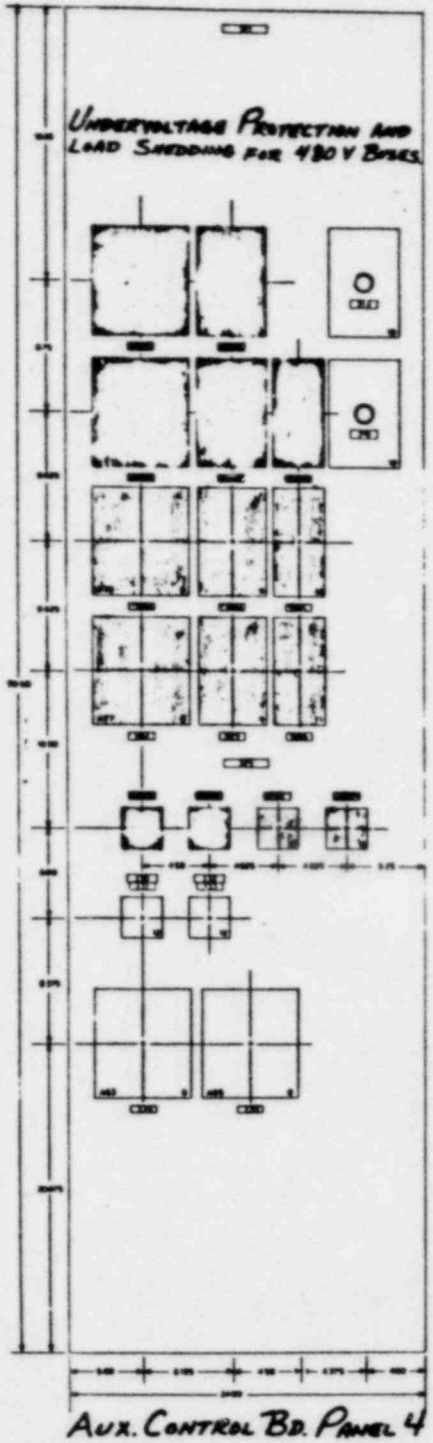
Cables for the required equipment enter the cabinet through penetrations from the switchgear room below. The only exceptions are the steam generator level circuits that run in the overhead tray system above the suspended ceiling. These redundant cables run together with a physical separation of ten feet until they reach main control board (Section F). These are the only cables required for safe shutdown in the overhead tray system.

COLOR CODE:

Red	-	Division A
Green	-	Division B
Yellow	-	MCC 5



AUX. CONTROL BD. PANEL 3



AUX. CONTROL BD. PANEL 4

SEE FLOOR PLAN FOR PANEL LOCATIONS.

BILL OF MATERIAL

ITEM NO	MFG	TYPE	QTY	DESCRIPTION
1	W	TC	1	CARRIER RELAY UNIT FREQ. STYLE NO. [illegible]
2	W	TCU	1	STYLE NO. 5410 329G12
3	GE	CT-51	1	TRANSFER TRIP TRANSMITTER [illegible]
4	GE		1	METER PANEL CAT # 5405P541 P1
5	W	TC	1	CARRIER RELAY UNIT FREQ. STYLE NO. [illegible]
6	W	TCU	1	STYLE NO.
7	GE	CT-51	1	TRANSFER TRIP TRANSMITTER [illegible]
8		CV-7	6	STYLE NO. 187352A6
9		MO-6	4	STYLE NO. 288L360A20
10	W	OT-2	2	PUSH BUTTON
11	W	SG	3	STYLE NO. 1342925A
12	GE	HEA	6	

NAMEPLATE LIST

NAME PLATE NO	SIZE	1ST LINE	2ND LINE	3RD LINE
301	8" x 1"	WESTINGHOUSE		
302		POWER LINE CARRIER	TYPE "TC"	
304		1772 TTX	FREQ. IN KHZ	
306		POWER LINE CARRIER	TYPE "TC"	
308		1208 TTX	155 KHZ	
311	8" x 1"	480 VOLT BUS		
312	2" x 1"	27-4		
313	"	27X-4		
314	2" x 1"	59A/B & S RESET		
315	2" x 1"	27-5		
316	"	27X-5		
317	"	27X1-5		
318	2" x 1"	59A/B & 7 RESET		
319	2" x 1"	27-6		
320	"	27X-6		
321	"	27X1-6		
322	"	27-7		
323	"	27X-7		
324	"	27X1-7		
325	8" x 1"	480 VOLT	BUS LOCKOUT RELAY	
326	2" x 1"	27Y-4		
327	"	27Y-5		
328	"	27Y-6		
329	"	27Y-7		
330	3" x 1"	4160 VOLT BUS 1-2		
331	2" x 1"	27Y1-2		
332	3" x 1"	4160 VOLT BUS 1-3		
333	2" x 1"	27Y1-3		
334	"	27X1-2		
335	"	27X1-3		

REF DWGS.

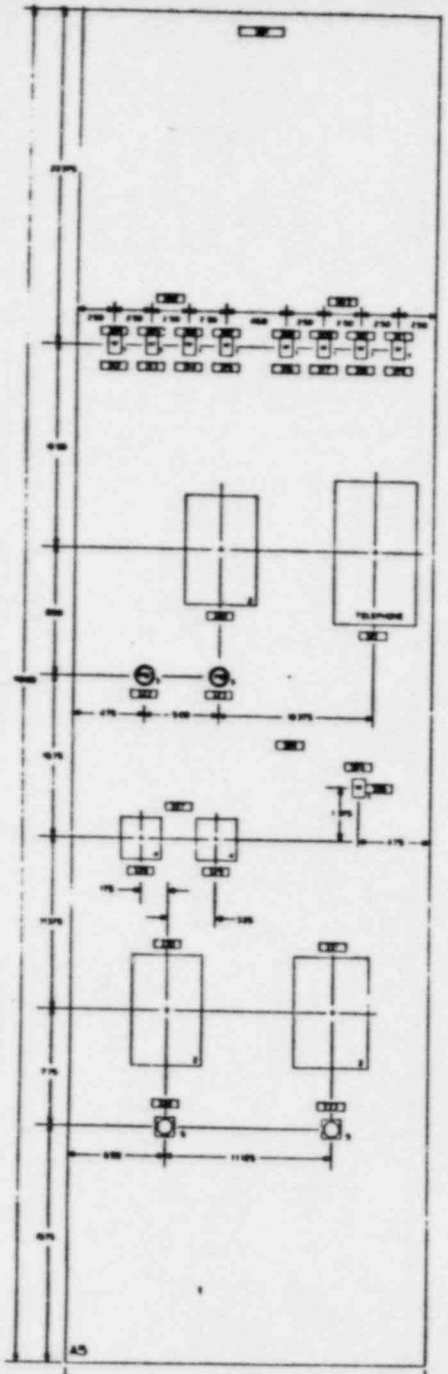
18103-30002		MAIN ONE LINE
18103-30003		4160V ONE LINE
18103-30014	SH 1	FRONT VIEWS, NOS. 1
18103-30015		AUX BD A1 - A6 DET
18103-31001		ARRANGMAIN CON
18103-31013	SH 1	AUX BD A1-A5 EXT
18103-31013	SH 2	AUX BD A6-A5 EXT
18103-31083	SH 1	AUX BD A1-A5 WIR
18103-31083	SH 2	AUX BD A2-A5 WIR
18103-31083	SH 3	AUX BD A3-A5 WIR
18103-31083	SH 4	AUX BD A4-A5 WIR
18103-31083	SH 5	AUX BD A5-A5 WIR
18103-31083	SH 6	AUX BD A6-A6 WIR
18103-32001	SH 1A	SCHEM DIAG INDE
18103-32001	SH 5F	SCHEM 4160V BUS
18103-32001	SH 5G	SCHEM 4160V BUS
18103-32001	SH 5GA	SCHEM 4160V BUS
18103-32001	SH 5H	SCHEM 4160V ACB
18103-32001	SH 5J	SCHEM 4160V ACB
18103-32001	SH 5K	SCHEM 4160V ACB
18103-32001	SH 5L	SCHEM 4160V ACB
18103-32001	SH 5M	SCHEM 4160V ACB
18103-32001	SH 5N	SCHEM 4160V ACB

REDRAWN FROM 18103-30014 SH1 REV 9 12-9-81

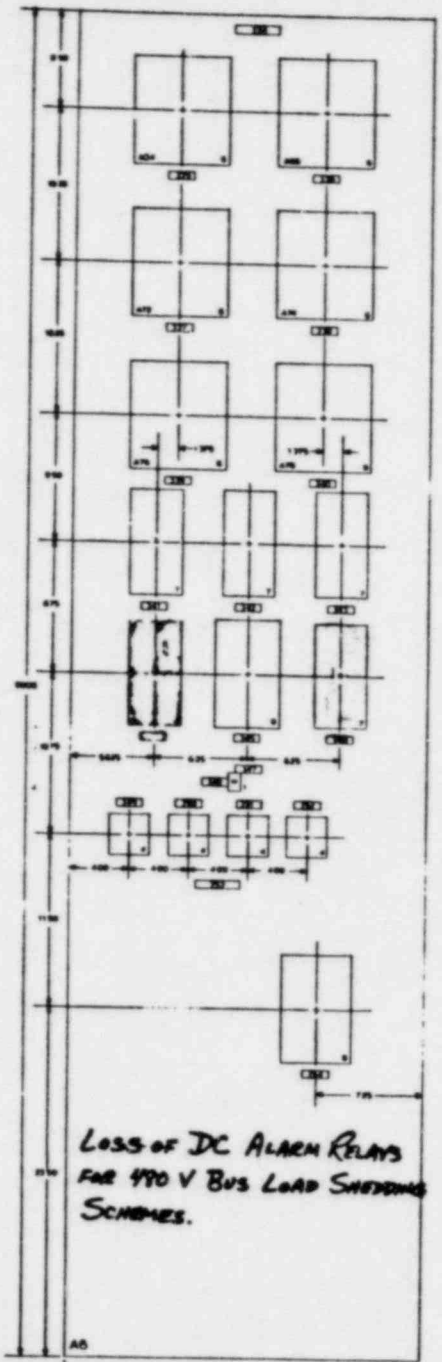
NORTHEAST
CONNECTICUT

TITLE
AUX CONT
FRONT
BILL OF MATERIAL
FAIRFIELD
HADDEN

DWG NO 18103-30014 SH 2 REV 9



AUX. CONTROL BD. PANEL 5



AUX. CONTROL BD. PANEL 6

LOSS OF DC ALARM RELAYS FOR 480 V BUS LOAD SHEDDING SCHEMES.

SEE FLOOR PLAN FOR PANEL LOCATIONS.

BILL OF MATERIAL

ITEM NO	MFG	TYPE	QTY	DESCRIPTION
1	W		10	INDICATING LIGHTS STYLE NO 1599183
2	W	MO-6	3	STYLE NO 7898473A22
3	W	012	2	PUSH BUTTONS
4	GE	HEA	6	LOCKOUT RELAYS
5			2	PLUGS FEMALES
6		CV-7	8	STYLE NO 187532A8
7	W	SG	5	STYLE NO 1347925A
8	W	MO-8	2	STYLE NO 2898360A20

NAMEPLATE LIST

NAME-PLATE NO	SIZE	1ST LINE	2ND LINE	3RD LINE
301	8"x1½"	EMERGENCY POWER		
302	3"x 1"	B ENGINE		
303		A ENGINE		
304	1½"x 1"	33 SEC		
305		33 SEC		
306		48 SEC		
307		43 SEC		
308		38 SEC		
309		33 SEC		
310		48 SEC		
311		43 SEC		
312	2"x 1"	62-6	SERV WTR PP	P-37-10
313		62-2	SERV WTR PP	P-37-5
314		62-7	RECIR FAN	F-17-4
315		62-1	RECIR FAN	F-17-3
316		62-11	SERV WTR PP	P-37-14
317		62-5	SERV WTR PP	P-37-18
318		62-4	RECIR FAN	F-17-2
319		62-10	RECIR FAN	F-17-1
320	2"x 1"	EVAX		
321		EGA-1		
322	2"x 1"	59A11-3 RESET		
323		59A11-2 RESET		
324	2"x 1"	EGA-2		
325		DC SUPPLY		
326		DC SUPPLY	CKT 87	
327	3"x 1"	SERVICE WATER VALVE		
328	2"x	27X5		
329		27X4		
330		27Y2/1-2		
331		27Y2/1-3		
332	1"x 1"	B DIESEL		
333		A DIESEL		
334	8"x 1"	EMERGENCY GENERATOR		
335	2"x 1"	27N1-2		
336		27N1-3		
337		27-4B		
338		27-5B		
339		27-6B		
340		27-7B		
341		27X1-5B		
342		27X1-6B		
343		27X1-7B		
344		74A		
345		27X1-4B		
346		[illegible]		
347		BATT A CKT POT		
348		DC SUPPLY	CKT A-14	
349		27Y-4B		
350		27Y-5B		
351		27Y-6B		
352		27Y-7B		
353	2"x 1"	480V BUS		
354	2"x	CYBX		

THIS DWG REDRAWN FROM 18103-30014 SH 1 REV 12 DATED 12-9-81

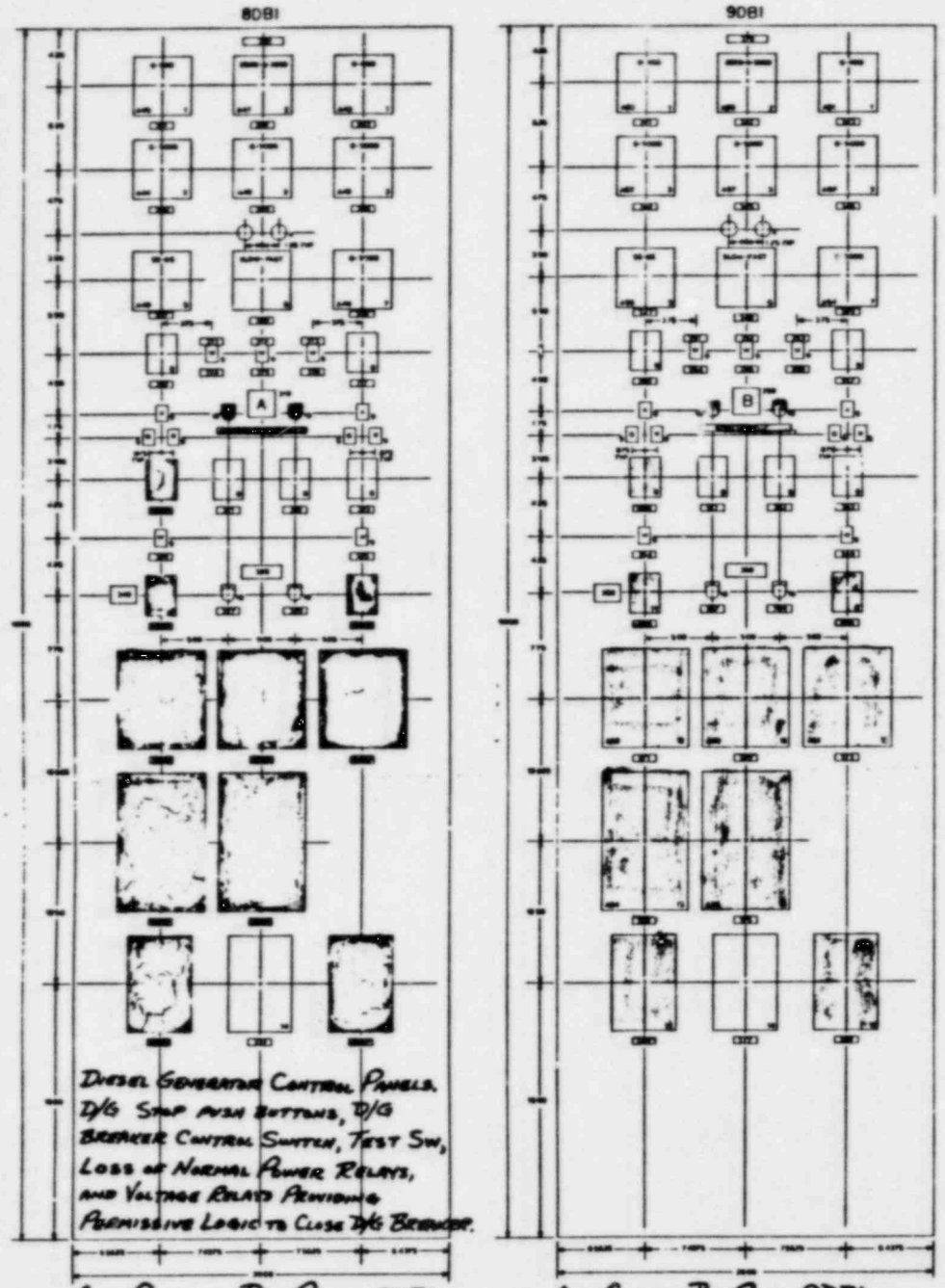
AUXILI FRONT BILL O NO 5

D.J.W

3.15.82

1/4"=1"

81-046



DIESEL GENERATOR CONTROL PANELS. D/G STOP PUSH BUTTONS, D/G BREAKER CONTROL SWITCH, TEST SW, LOSS OF NORMAL POWER RELAYS, AND VOLTAGE RELAY PROVIDING PERMISSIVE LOGIC TO CLOSE D/G BREAKER.

AUX. CONTROL BD. PANEL 8DB1

AUX. CONTROL BD. PANEL 9DB1

SEE FLOOR PLAN FOR PANEL LOCATION.

BILL OF MATERIAL

ITEM NO.	MFG	TYPE	QTY	DESCRIPTION
1	W	KA-241	4	STYLE NO. 2918484A27 SCALE 0-800
2	W	AP-241	2	STYLE NO. 85 484862-4 SCALE 2000-0-3000
3	W	KA-241	8	STYLE NO. 2918484A21 SCALE 0-5000
4	W		4	INDICATING LIGHTS, STYLE NO. 1589184
5	W	MF3-241	2	STYLE NO. 714853BA09 SCALE 55-65
6	W	RZ-241	2	STYLE NO. 1886A2 35A01 SLOW-FAST
7	W	RP-241	2	STYLE NO. HR-754901-1 SCALE 0-5000
8	W	W2	14	CONTROL SELECTOR SWITCH
9	W		22	STYLE NO. 1589184 INDICATING LIGHTS
10	W	OT2	8	PUSH BUTTONS
11	GE	HEA	2	STYLE NO. HE48IC239
12	W	CV-7	6	STYLE NO. 1875524A
13	W	SW	4	STYLE NO. 1876094
14	W	MFS-6	4	STYLE NO. 2898360A20
15	W	MG-6	2	STYLE NO. 2898360A22

NAMEPLATE LIST

NAME PLATE NO.	SIZE	1ST LINE	2ND LINE	3RD LINE
301	2½" x 1"	GEN AMPS	EG2A	
302		GEN VARS	EG2A	
303		BUS TIE AMP	8T2	
304		GEN VOLTS	EG2A	
305		EMERG BUS	VOLTS	4160V BUS 8
306		BUS TIE VOLTS	8T2	
307				
308	2½" x 1"	SYNCH	GEN & TIE BKR	
309				
310	2" x 1"	GOV SPEED CONTROL	EG2A	LOAD CONTROL
311	1½" x 1"	10 SEC		
312		3 SEC		
313		30 SEC		
314	2½" x 1"	62T8-1	MPSU P-15-1B	
315		62T8-2	LPSU P-30-B	
316		62T8-3	CHARGING P-8-1B	
317		(VAR CONTROL)	GEN VOLTAGE CONT	EG2A
318	2" x 1"	A		
319	6" x 1"	DIESEL STOP	P/PB BOTH BUTTONS	
320	2½" x 1"	GEN BKR	EG2A	
321		GEN BKR SYNCH	25-EG2A	
322		TIE BKR SYNCH	25-8T2	
323		TIE BKR	8T2	
324		D.C. CONTROL		
325		EG2A	A/PD	
326		27Y1-8		
327		DIESEL START		
328	4½" x 1"	EG2A		
329	2½" x 1"	FIELD FLASH		
330		EG2A	A/PD-TEST	
331		27A1-8	BUS 8 VV	
332		27B1-8	BUS 8 VV	
333		27C1-8		
334		59A1-8	GEN VOLT CK	
335		59B1-8	GEN VOLT CK	
336		27X1-8		
337		27Y1-8		
338		27Y2-8		
339	7" x 1"	EMERGENCY GENERATOR AUXILIARY PANEL 8DB1		
340	2½" x 1"	RESET	SECOND	

NAMEPLATE LIST

NAME PLATE NO.	SIZE	1ST LINE	2ND LINE	3RD LINE
341	2½" x 1"	GEN AMPS	EG2B	
342		GEN VARS	EG2B	
343		BUS TIE AMPS	9T3	
344		GEN VOLTS	EG2B	
345		EMERG BUS	VOLTS	4160V BUS 9
346		BUS TIE VOLTS	9T3	
347				
348	2½" x 1"	SYNCH	GEN & TIE BKR	
349				
350	2" x 1"	GOV SPEED CONTROL	EG2B	LOAD CONTROL
351	1½" x 1"	10 SEC		
352		3 SEC		
353		30 SEC		
354	2½" x 1"	62T9-1	MPSU P-15-1A	
355		62T9-2	LPSU P-30-A	
356		62T9-3	CHARGING P-8-1A	
357		(VAR CONTROL)	GEN VOLTAGE CONT	EG2B
358	2" x 1"	B		
359	6" x 1"	DIESEL STOP	P/PB BOTH BUTTONS	
360	2½" x 1"	GEN BKR	P-2B	
361		GEN BKR SYNCH	25-EG2B	
362		TIE BKR SYNCH	25-9T3	
363		TIE BKR	9T3	
364		D.C. CONTROL		
365		EG2B	A/PD	
366				
367		DIESEL START		
368	4½" x 1"	EG2B		
369	2½" x 1"	FIELD FLASH		
370		EG2B	A/PD-TEST	
371		27A1-9	BUS 9 VV	
372		27B1-9	BUS 9 VV	
373		27C1-9		
374		59A1-9	GEN VOLT CK	
375		59B1-9	GEN VOLT CK	
376		27X1-9		
377		27Y1-9		
378		27Y2-9		
379	7" x 1"	EMERGENCY GENERATOR AUXILIARY BOARD 9DB1		
380	2½" x 1"	RESET	SECOND	

RECHAIN FROM 18103 30014 SH 2 REV L 1-17-81

NORTHEAST UTILITIES SERVICE C

FOR CONN. YANKEE ATOMIC POWER CO

AUX. CONTROL BOARD

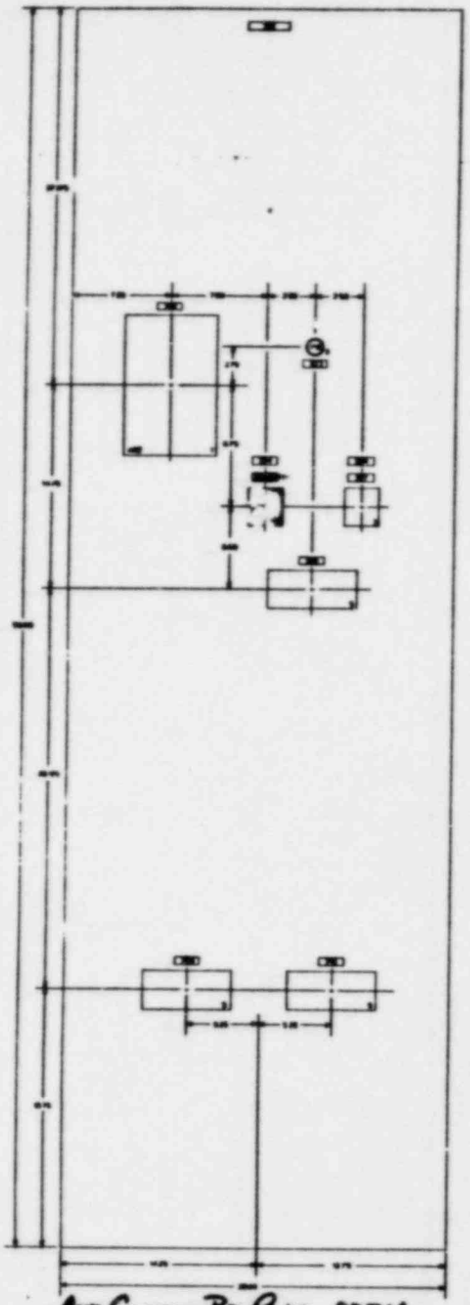
FRONT VIEW

BILL OF MATERIAL AND NAMEPLATE LIST

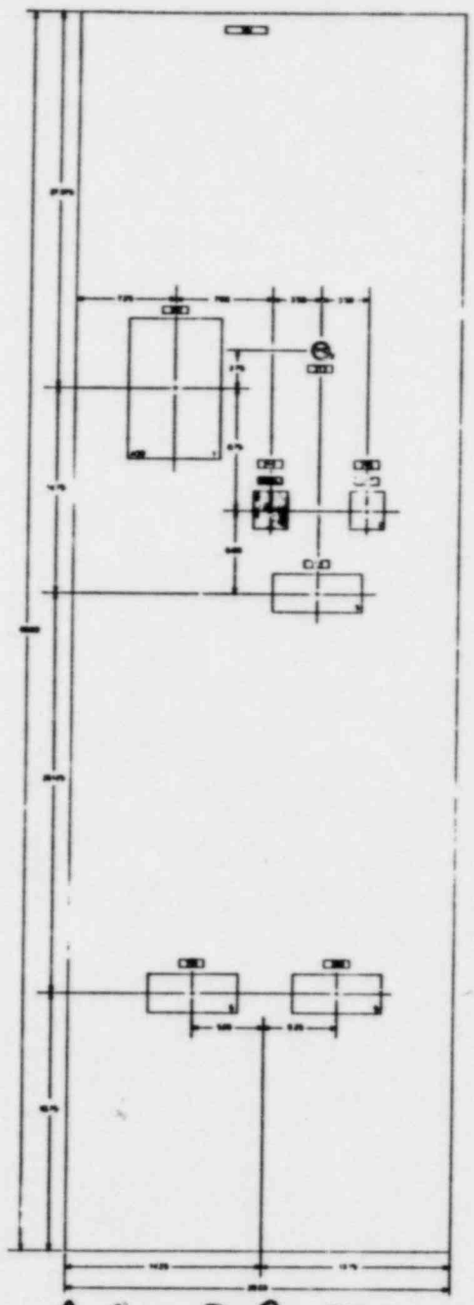
PNL'S 7/8

HADDAM CONN.

DRN		DATE	
CHK	1-15-82	DATE	
APP'D		DATE	
SCALE	1/4"=1'	DWG NO.	18103-30014 SH 2
FILE	81-0-96		



AUX. CONTROL BD. PANEL 9DB1A



AUX. CONTROL BD. PANEL 9DB1A

SEE FLOOR PLAN FOR PANEL LOCATIONS.

BILL OF MATERIAL

ITEM NO	MFG	TYPE	QTY	DESCRIPTION
1	GE	[illegible]	2	STYLE NO 12NDV21B8A
2	W	[illegible]	2	PUSH BUTTONS
3	GE	[illegible]	2	STYLE NO 12HEA81A173
4	W	[illegible]	2	
5	W	[illegible]	6	STYLE NO 12BA50X1X01

NAMEPLATE LIST

NAME PLATE NO	SIZE	1ST LINE	2ND LINE	3RD LINE
301	9	EMERGENCY GENERATOR AUXILIARY BOARD 9DB1A		
302	2	SYNC/1-9		
303		SYNC/1-9 RESET		
304	2	RESET	THIRD	
305	2	[illegible]		
306	2	RESET	FIRST	
307	2	BKR 1-9		
308		TD/79-371-9		
309		TD/79-171-9		
310		TD/79-271-9		
311	9	EMERGENCY GENERATOR AUXILIARY BOARD 9DB 2		
312	2	SYNC/1-8		
313		SYNC/1-8 RESET		
314	2	RESET	THIRD	
315 *	2	[illegible]		
316	2	RESET	FIRST	
317	2	BKR 1-8		
318		TD/79-371-8		
319		TD/79-171-8		
320		TD/79-271-8		

THIS DWG REDRAWN FROM 18103-30014 SH 3 REV 2 DATED 11-10-81 18103-30014 SH 4 REV 2

AFTER CHANGES

NORTHEAST UTILITI

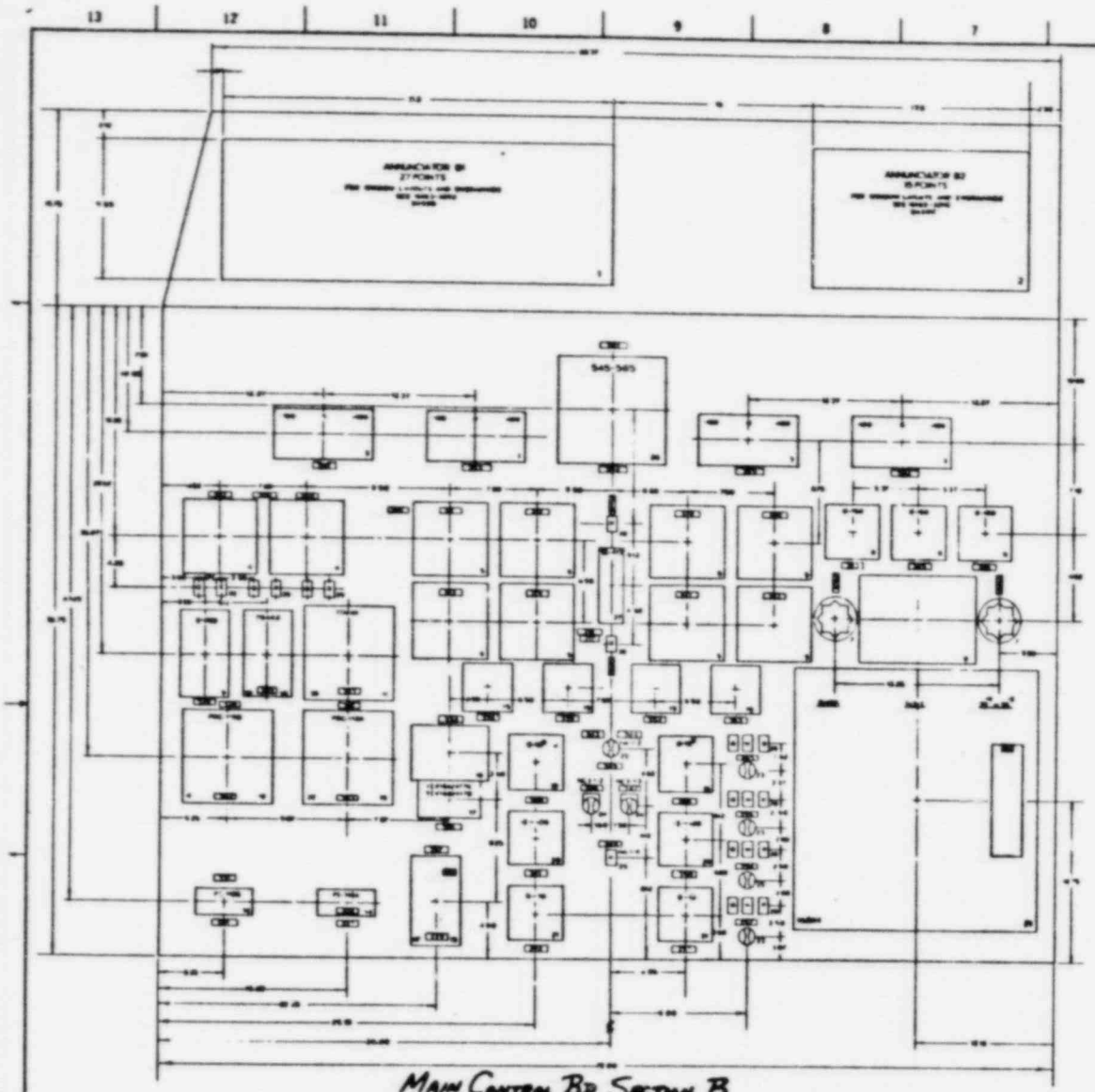
CONN YANKEE ATO

AUXILIARY CONTROL BOAR
FRONT VIEWS, NAMEPLATE
BILL OF MATERIAL-AUXILIA
NO 9 & 10

DJW

3-15-82

18103



MAIN CONTROL BD. SECTION B
(VERTICAL SECTION)

BILL OF MATERIAL

ITEM NO	MFG	TYPE	QTY	DESCRIPTION
1			1	27 POINT ANN
2			1	15 POINT ANN
3			4	INDICATOR SCALE 100 0-100
4			2	SHUTDOWN ROD GROUP POS IND
5			8	BANKS 4&8 CONTROL ROD GROUP POS IND
6			3	STYLE NO 2081J0514-B SCALE 0-750
7			2	SELECTOR SWITCHES
8			1	DC DIGITAL VOLTMETER
9			1	INDICATOR SCALE 0-200
10			1	CHART RECORDER 1 PEN SCALE -40 - 60
11			1	CHART RECORDER 2 PENS SCALES 300 575
12			1	CHART RECORDER 1 PEN SCALES 0-25
13			1	CHART RECORDER 3 PENS SCALES 0-750
14			2	TIMER INDICATORS
15			4	CHART RECORDER 1 PEN SCALE 0-100%

BILL OF MATERIAL

ITEM NO	MFG	TYPE	QTY	DESCRIPTION
16				
17			1	SELECTOR SWITCH 8 POSITIONS
18			1	TEMP IND SCALE 0-700°
19			1	CHART RECORDER 2 PENS SCALE 0-100%
20			2	STYLE NO 4008-48 SCALE 0-10F
21			2	STYLE NO 4B 8B W/ 2 SCALE 0-20
22			4	STYLE NO PER DWG 31 2737-4 SCALE 0-60 - 0-90 %
23			1	CHART RECORDER
24			5	STYLE NO 37 0970-0021 2P2 B
25			2	SELECTOR SW
26			1	INDICATING LIGHT AMBER LENS
27			1	TEMP METER SCALE 347-380
28			1	CONTROL ROD GROUP VPOS IND
29			4	STYLE NO 4A1T-8437-0-10
30			1	STYLE NO 4A1T-8437-0-07

NAMEPLATE LIST

NAME PLATE NO	SIZE	1ST LINE	2ND LINE	3RD LINE
201	1" x 3"	SECTION B		
202	1" x 3"	CH 16 AXIAL OFFSET		
203	1" x 3"	CH 30 AXIAL OFFSET		
204	1" x 3"	PLANT TIME		
205	1" x 3"	CH 13 AXIAL OFFSET		
206	1" x 3"	CH 14 AXIAL OFFSET		
207	2" x 3"	BANK		
208		SHUTDOWN		
209		BANK D		
210	1" x 3"	BANK A		
211	1" x 3"	GROUP 1		
212	1" x 3"	GROUP 2 (MID LABEL)		
213	1" x 3"	BANK B		
214	1" x 3"	GROUP 6		
215	1" x 3"	OUT		
216	2" x 3"	BANK C		
217	1" x 3"	TWO MIN		
218	1" x 3"	8 IN		
219	1" x 3"	GROUP 5		
220		GROUP 4		
221		GROUP 7		
222		GROUP 8		
223	2" x 3"	GROUND DETECTOR	NEGATIVE	
224	1" x 3"	A-BRK (A)		
225	2" x 3"	ROD SUPPLY	VOLTAGE	
226	2" x 3"	GROUND DETECTOR	POSITIVE	
227	1" x 3"	1 MIN (M)		
228	3" x 3"	CONTAINMENT	AIR SYSTEM	
229		A-B (MID LABEL)		
230		A-B (MID LABEL)		
231	2" x 3"	FT 113	BORATE	TOTAL GPM
232		A-B (MID LABEL)		
233	2" x 3"	FT 112A	DILUTE	TOTAL GPM
234	2" x 3"	POS ROD 10	POS ROD 7	POS ROD GROUPED 10
235	1" x 3"	POWER RANGE	CHANNEL 7	
236	2" x 3"	LOW TEMPERATURE		
237	2" x 3"	CT	3 GAL/PERCENT	
238	2" x 3"	GREEN LEVEL	RED PRESSURE	
239	2" x 3"	POWER RANGE	CHANNEL 12	
240	1" x 3"	SOURCE RANGE	CH 18/3	

NAMEPLATE LIST

NAME PLATE NO	SIZE	1ST LINE	2ND LINE	3RD LINE
241	2" x 3"	START UP	RATE	
242	1" x 3"	INTERMEDIATE	RANGE CH 29	
243	1" x 3"	INCORE		
244	1" x 3"	EXCORE		
245	2" x 3"	AXIAL OFFSET		
246	2" x 3"	SUR	CH 1/3 CH 22	
247		TUR	CH 12/14 CH 21	
248		ROD STOP		
249		SOURCE RANGE	CH 1/2/4	
250		START UP	RATE	
251		INTERMEDIATE	RANGE CH 21	
252		POWER RANGE	CHANNEL 13	
253		POWER RANGE	CHANNEL 24	
254	1" x 3"	PR HIGH 1/26		
255		PR HIGH 1/26		
256		PR HIGH 1/27		
257		PR HIGH 1/26		
258		LEVEL (TM)		
259	1" x 3"	PLAN 11		
260	5" x 3"	RED REACTOR COOLANT TEMP	BLUE PEN PROGRAMMED TEMP	
261		A-B (MID LABEL)		
262	5" x 3"	FRC 112B	CONC BORIC ACID MAKE UP CONTROL	
263	3" x 3"	FRC 113A	PRIMARY WATER MAKEUP FLOW CONTROL	
264		A-B (MID LABEL)		
265	6" x 3"	RANGE SELECTOR		
		SWITCHES		
		POSITION SPAN		
		1	100 0-100%	
		2	10 0-10	
		3	1 0-1	
		4	100 0-100	
		5	10 0-10	
		6	1 0-1	
		7	100 0-100	
		8	10 0-10	
		9	1 0-1	
		10	100 0-100	
		11	10 0-10	
		12	1 0-1	

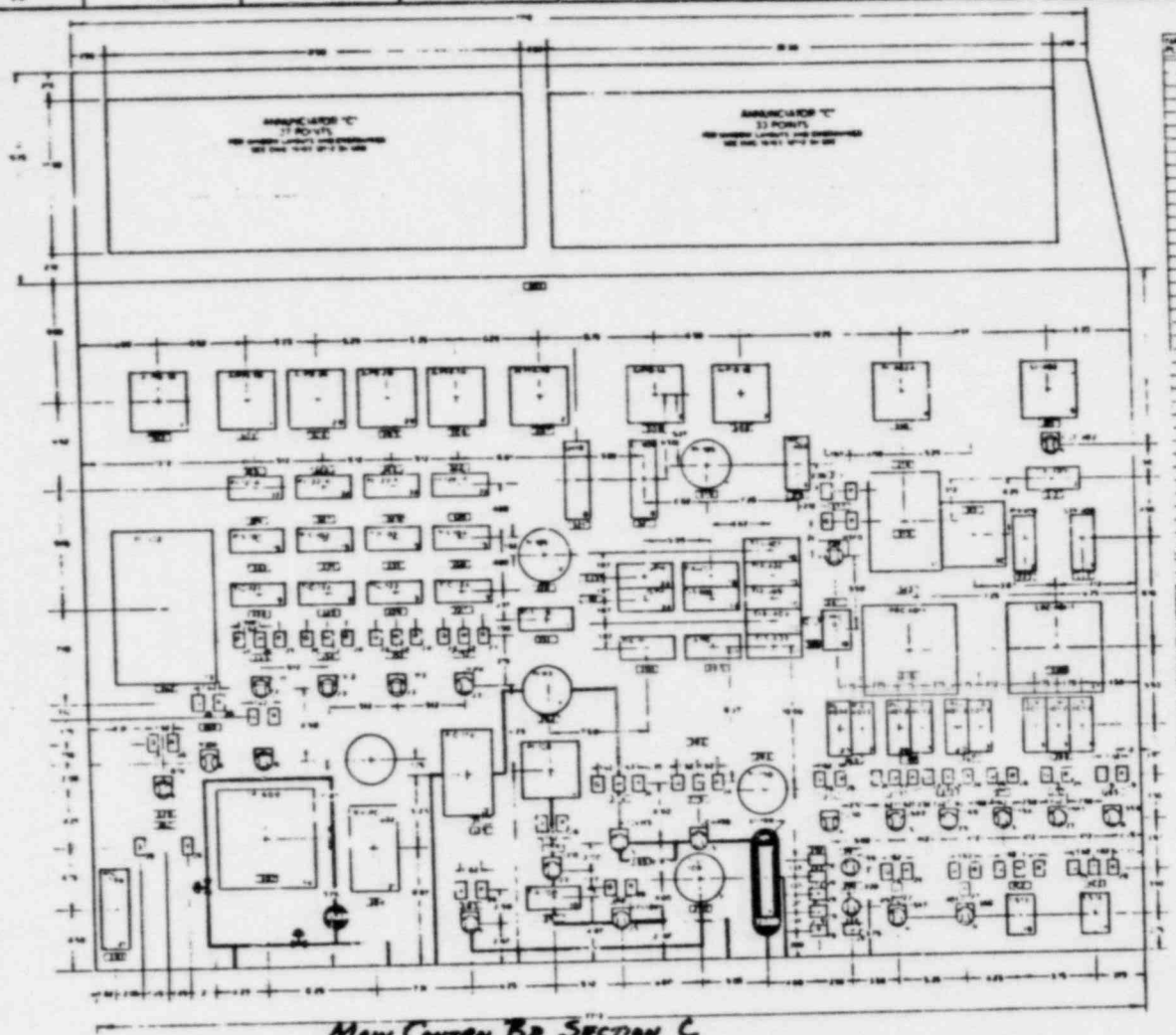
NOTES

SEE FLOOR PLAN FOR PANEL LOCATIONS.

REDRAWN IN PART FROM 15103-30048 SH 1 REV 8

NORTHEAST UTILITIES SERVICE CO
CONNECTICUT YANKEE ATOMIC POWER CO
MAIN CONTROL BOARD
FRONT VIEW
BILL OF MATERIAL AND NAMEPLATE LIST
CONTROL PNL 9 (10-1)
HADDAM CONN.

15103-30048 SH 1



NAMEPLATE LIST

NAMEPLATE LIST

MAIN CONTROL BD. SECTION C
(VERTICAL SECTION)

BILL OF MATERIAL

ITEM NO	MFG	TYPE	QTY	DESCRIPTION
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				

BILL OF MATERIAL

ITEM NO	MFG	TYPE	QTY	DESCRIPTION
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				

NOTES

THIS DWG REDRAWN IN PART FROM 8103-30048 SH 2

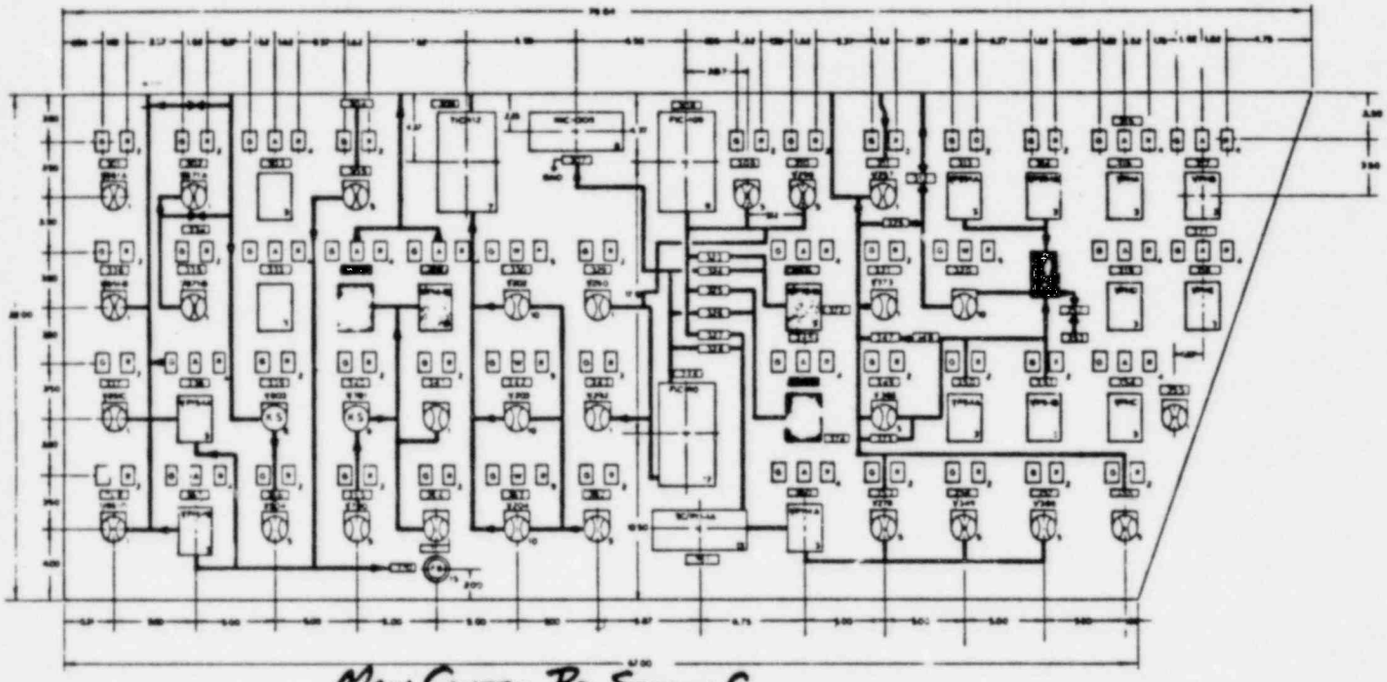
NORTHEAST UTILITIES SERVICE CO.

MAIN CONTROL BOARD
FRONT VIEW, NAMEPLATE LIST AND BILL OF MATERIAL, CONTROL BOARD "C" (TOP SECTION)

8103-30048 SH 2

SEE FLOOR PLAN FOR PANEL LOCATIONS.

13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5



ITEM NO	MFG
1	W
2	
3	W
4	
5	W
6	W
7	
8	
9	
10	W
11	
12	
13	
14	W
15	W

MAIN CONTROL BD. SECTION C
(BENCHBOARD SECTION)

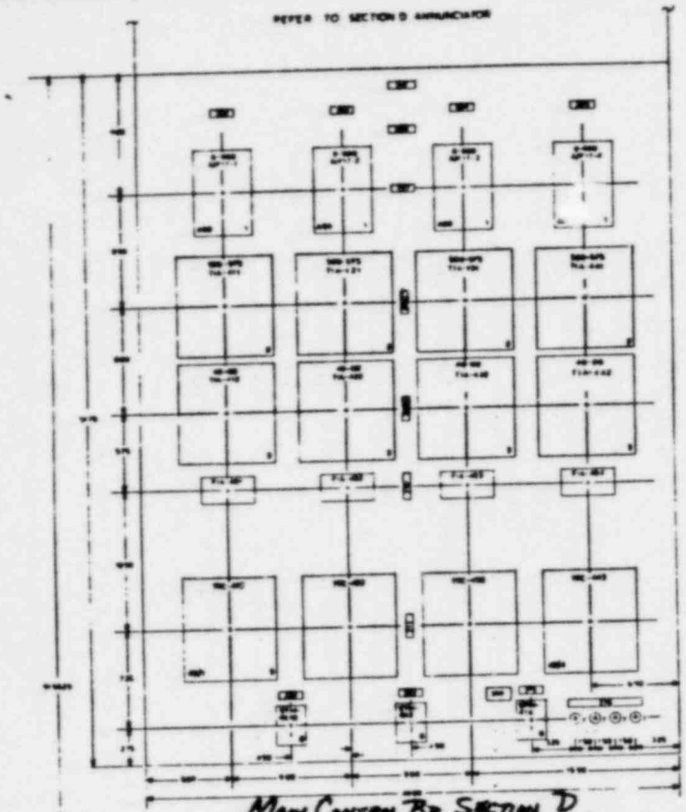
SEE FLOOR PLAN FOR PANEL LOCATIONS.

NAMEPLATE LIST

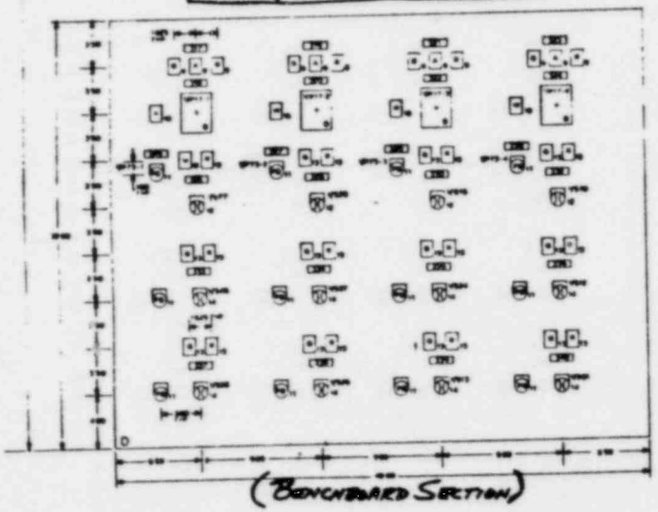
NAME-PLATE NO	SIZE	1ST LINE	2ND LINE	3RD LINE
301	½×2½	LOOP 1 SI	SI-MOV-865A	
302	¾	CORE DELUGE	CD-MOV-871A	
303	1×2½	LP SAF INJ	P-92-A	BV3 B
304	½×2½	RWST		
305		RWST/SI PUMP	SUCTION ISOL	SI-MOV-24
306		LETDOWN TEMP	CONTROL	CC-TCV-112E
307		SEAL WTR SUPPLY	CH-MOV-304	
308		FH FLOW CONTROL		
309	¾	FILL HEADER BYPASS	FH-MOV-349	
310	¾×2½	AUX SPRAY	CH-MOV-296	
311	½×2½	VCT OUTLETS	CH-MOV-257	
312	¾	BA-V-359		
313	1×3½	PRIM WATER TRANS PUMP 1A	P-29-1A	MCC B
314	¾	PRIM WATER TRANS PUMP 1B	P-29-1B	MCC B
315	DIMENSION	GROUP "AA"	(TYPICAL OF 3 T.M. RELAYS)	
316	1×2½	BACKUP HEAT GRP A	266KW	BUS 4
317		BACKUP HEAT GRP D	27.1KW	BUS 6
318		BACKUP HEAT GRP E	228KW	BUS 7
319	¾	BACKUP HEAT GRP B	240KW	BUS 5
320	½×2½	VCT MAKEUP	BA-LCV-112C	
321	¾	RWST TO	CHARGING SUCT	BA-MOV-373
322	1×2½	CHARGING PUMP 1A	P-19-1A	BV3 B
323	½×1½	FH-V-265		
324		CH-V-269		
325		FH-V-274		
326		CH-V-273		
327		FH-V-282		
328	¾	CH-V-281		
329	½×3	CH-MOV	292B	
330	½×2½	LETDOWN ORIFICE	80 GPM	LD-AOV-202
331	1×2½	RESID HEAT PUMP 1B	P-14-1B	BV3 B
332		RESID HEAT PUMP 1A	P-14-1A	BV3 B
333	¾	LP SAF INJ	P-92B	BV3 B
334	½×2	CD-V-873		
335	½×2½	CORE DELUGE	CD-MOV-871B	
336		LOOP 2 SI	SI-MOV-865B	
337	¾	LOOP 3 SI	SI-MOV-865C	
338	1×2½	HP SAF INJ	P-13-1A	BV3 B
339	½×2½	LOOP 2 RHR	OUTBOARD ISOL	RH-MOV-803
340	¾	LOOP 1 RHR	OUTBOARD ISOL	RH-MOV-701

NAMEPLATE LIST

NAME-PLATE NO	SIZE	1ST LINE	2ND LINE	3RD LINE
341	½×2½	RWST TO	RHR SUCTION	RH-MOV-21
342	¾	LETDOWN ORIFICE	40GPM	LD-AOV-203
343	½×3	CH MOV	292C	
344	½×2	CHARGING FLOW CONTROL		
345	1×2½	CHARGING PUMP 1B	P-19-1B	BV3 B
346	1×¾	AUTO	2350 PSIG	
347	½×2½	REFUELING WATER	STORAGE TANK	
348	½	BA-V-363		
349	½×2½	BORIC ACID PPS	TO CHG SUCTION	BA-MOV-356
350	1×2½	BORIC ACID PUMP 1A	P-5-1A	MCC B
351	¾	BORIC ACID PUMP 1B	P-5-1B	MCC B
352	½×2	BA-V-39		
353	½×2½	REFUELING WATER	STORAGE TANK	
354	1×2½	CONTROL	HEATERS GRP C	BUS 5
355	¾	PRESSURIZER	LOW LEVEL	OVERRIDE
356	½×2½	RWST TO CHG	CH-MOV-32	
357		RWST TO	METERING PUMP	BA-MOV-386
358		BORIC ACID TK	METERING PUMP	BA-MOV-393
359		METERING PUMP	SUCT DIVISION	CH-AOV-278
360		METERING PUMP	P-11-1A	BUS 4
361		METERING PUMP	SPEED CONT	
362		LETDOWN STOP	LD-MOV-200	
363		LETDOWN ORIFICE	40GPM	LD-AOV-204
364		CONTAINMENT	SUMP SUCTION	RH-MOV-32
365		LOOP 1 RHR	INBOARD ISOL	RH-MOV-780
366	¾	LOOP 2 RHR	INBOARD ISOL	RH-MOV-804
367	1×2½	HP SAF INJ	P-13-1B	BV3 B
368	½×2½	LOOP 4 SI	SI-MOV-865D	
369		MOV-21 DIDP		
370	¾	TO RH-MOV-21		
371	DIMENSION	GROUP "E"	(TYPICAL OF 3 T.M. RELAYS)	
372	½×2	CH-V-281		
373		BA-V-369		
374		CH-V-270		
375	¾	BA-V-355		

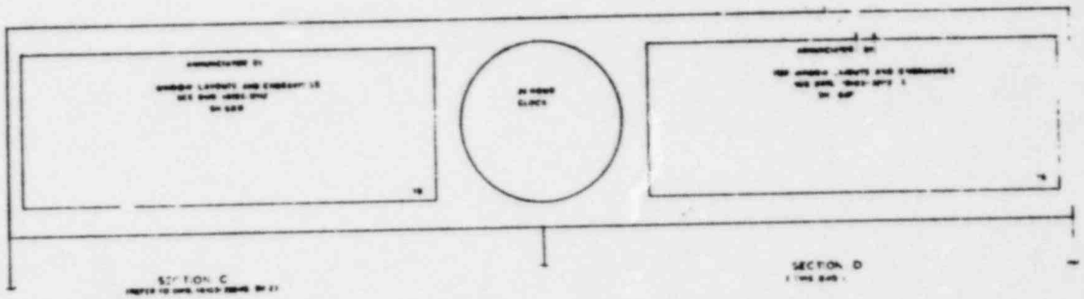


MAIN CONTROL BD. SECTION D
(VERTICAL SECTION)



(BENCHBOARD SECTION)

SEE FLOOR PLAN FOR PANEL LOCATIONS



SECTION C

SECTION D

BILL OF MATERIAL

ITEM NO.	MFR	TYPE	QTY	DESCRIPTION
1	A	A-251	4	STYLE NO 2918461A27 SCALE 0.800
2	A	J0	4	STYLE NO X700J0 SCALE NO.60
3	A	J0	4	STYLE NO X700J0 SCALE NO.60
4	A		4	THERMOSTAT SHELF SCALE -50 +90
5	A	J	4	STYLE NO 800J SCALE
6	A	42	3	STYLE NO SELECTOR SW
7	W		4	INDICATING LIGHTS
8	W	42	4	STYLE NO 5084182J01
9	W		4	NAMEPLATE INDICATING LIGHTS
10	W		4	NAMEPLATE INDICATING LIGHTS
11	W	DT2	12	STYLE NO 3T10990003 0'283
12	W	DT2	4	STYLE NO 3T13142J07 0'291
13	W		12	NAMEPLATE INDICATING LIGHTS
14	W	DT2	8	STYLE NO 3T13142G03 0'2v6
15	A		2	DROP ANNUNCIATORS

NAMEPLATE LIST

NAMEPLATE NO.	SIZE	1ST LINE	2ND LINE	3RD LINE
301	1x2	SPARE 2		
302	1x2	LOOP 1		
303	1	LOOP 2		
304	1	LOOP 3		
305	1	LOOP 4		
306	1x2	ACT MF CV CLOSED		
307	1x2	480 VAC	575 VOLT	
308	1x2	120/1 V		
309		60		
310		125V		
311	1	120V		
312	1x2	LOOP 1	CONTROL TO	1 OF 1 1/2 VOLT
313	1	LOOP 2	CONTROL TO	2 OF 2 VOLT
314	2x4	LOOP 3 & 4	CONTROL TO	LOW PRESS SCRAM
		WITH INTERLOCK		
315				
316	1x6	LOOP 1 LOOP 2 LOOP 3 LOOP 4		
317	1x4	LOOP 1		
318	1x12	RELIEF COOL FLOW 1	P-17-1	240 1-18
319	1x4	LOOP 2		
320	1x12	RELIEF COOL FLOW 2	P-17-2	240 1-18
321	1x4	LOOP 3		
322	1x12	RELIEF COOL FLOW 3	P-17-3	240 1-18
323	1x4	LOOP 4		
324	1x12	RELIEF COOL FLOW 4	P-17-4	240 1-18
325	1x24	ANALYZING PUMP		
326	1	RELAYS	RC MOV 3"	
327	1	ANALYZING PUMP		
328	1	RELAYS	RC MOV 3/8	
329	1	ANALYZING PUMP		
330	1	RELAYS	RC MOV 3-3	
331	1	ANALYZING PUMP		
332	1	RELAYS	RC MOV 3-4	
333	1	TC 3 SP	RC MOV 3-14	
334	1	TC 3 SP	RC MOV 3-1	
335	1	TC 3 SP	RC MOV 3-2	
336	1	TC 3 SP	RC MOV 3-12	
337	1	TH 3 SP	RC MOV 3-13	
338	1	TH 3 SP	RC MOV 3-13	
339	1	TH 3 SP	RC MOV 3-13	
340	1	TH 3 SP	RC MOV 3-14	

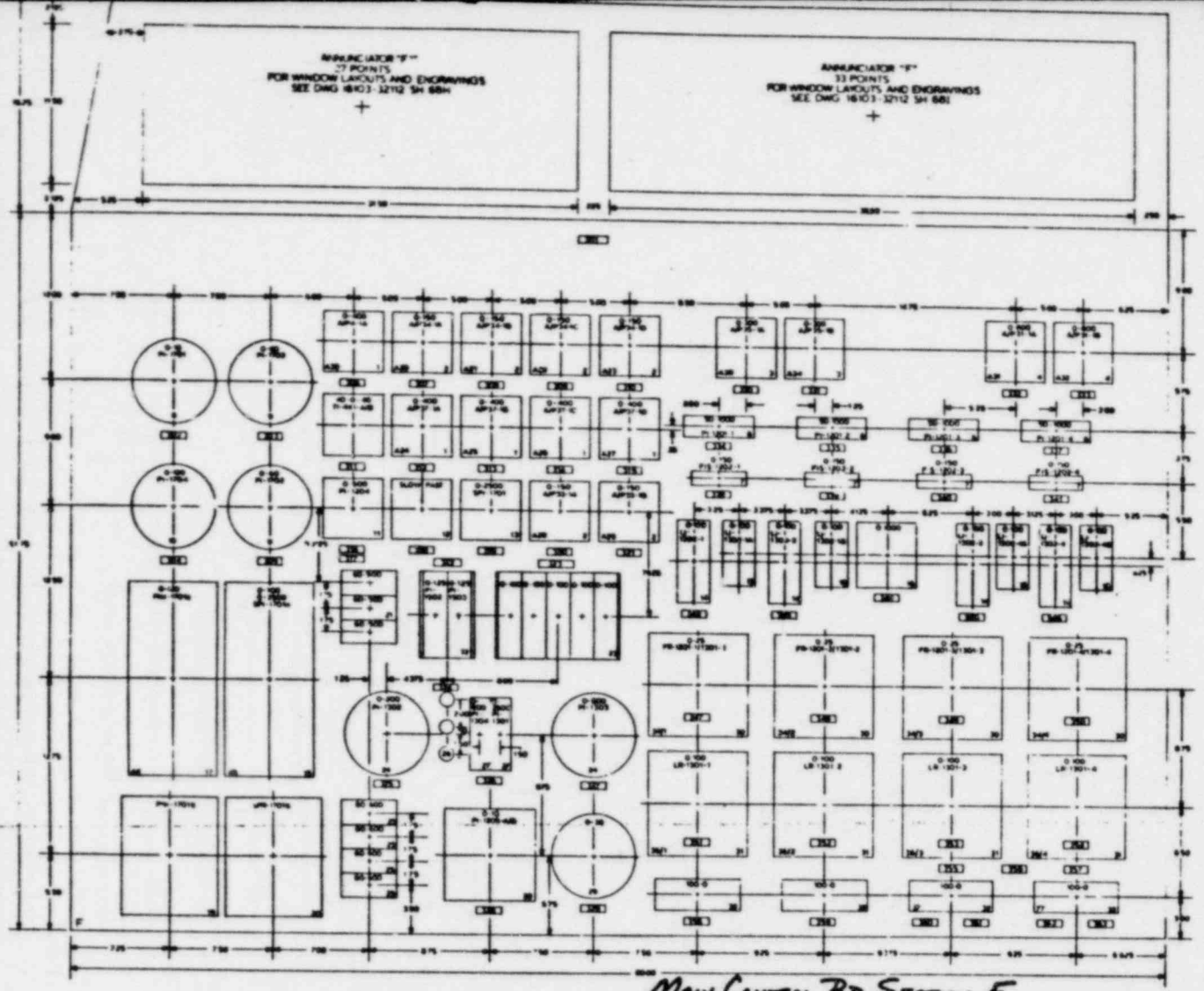
THIS DWG REDRAWN FROM — 8103-30048 SH-4 REV 7 DATED 17-30-80

NORTHEAST UTILITIES SERVICE CO

CONN YANKEE ATOMIC POWER CO

MAIN CONTROL BOARD FRONT VIEW, NAMEPLATE LIST AND BILL OF MATERIAL CONTROL PANEL "P" HADDAM (CONT.)

8103-30048 SH 4A



MAIN CONTROL BD. SECTION F
(VERTICAL SECTION)

NAMEPLATE LIST

NAME PLATE NO.	SIZE	1ST LINE	2ND LINE	3RD LINE
301	1 x 2½	SECTION F		
302	2 x 7½			
303		GOVERNOR SPEED	CONTROL OIL	
304		GENERATOR	HYDROGEN	
305		LOAD LIMIT	CONTROL OIL	
306		ELEC. PUMP	PUMP	
307		CIRC. WATER	PUMP 1A	
308		CIRC. WATER	PUMP 1B	
309		CIRC. WATER	PUMP 1C	
310		CIRC. WATER	PUMP 1D	
311		TAVG ERROR		
312		SERVICE WATER	PUMP 1A	
313		SERVICE WATER	PUMP 1B	
314		SERVICE WATER	PUMP 1C	
315		SERVICE WATER	PUMP 1D	
316		TURBINE	1ST STAGE	
317		CRUISING	TURBINE	1ST STAGE
318		GEN. SYSTEM	SPEED DIFF.	
319		TURBINE	SPEED	
320		HEATER DRAIN	PUMP 1A	
321	½	HEATER DRAIN	PUMP 1B	
322	SYMBOL	AUX. BOI		
323	½	ALL AUX INDICATION		
324	1 x 3½	S/G FEED PUMP	LOW SUCTION PRESSURE	RELAY FAILURE
325	2 x 7½	HEATER DRAIN	PUMP DISCHARGE	
326	1 x 3½	FEED PUMP FEED PUMP	SUCTION DISCHARGE	
327		COND. DISCH. P		
328	1 x 2½	COND. AIR	BACK PRESSURE	
329	2 x 3	CONDENSOR VACUUM		
330	1 x 2½	CONDENSATE	PUMP 1A	
331		CONDENSATE	PUMP 1B	
332		FEED WATER	PUMP 1A	
333		FEED WATER	PUMP 1B	
334		SG1	STEAM PRESSURE	
335		SG2	STEAM PRESSURE	
336		SG3	STEAM PRESSURE	
337		SG4	STEAM PRESSURE	
338		SG1	STEAM FLOW	
339		SG2	STEAM FLOW	
340		SG3	STEAM FLOW	
341		SG4	STEAM FLOW	
342		SG1 LEVEL	WIDE RANGE	
343		SG2 LEVEL	WIDE RANGE	
344		MAIN STEAM	HEADER	
345		SG3 LEVEL	WIDE RANGE	
346		SG4 LEVEL	WIDE RANGE	
347	2 x 5½	AUX-STEAM FLOW #1 #2	BLUE-FEED FLOW #1 #2	
348		AUX-STEAM FLOW #3 #4	BLUE-FEED FLOW #3 #4	
349		AUX STEAM FLOW #1 #2	BLUE-FEED FLOW #1 #2	
350	½	AUX-STEAM FLOW #3 #4	BLUE-FEED FLOW #3 #4	
351	½ x 5½	STEAM GENERATOR	NARROW RANGE LEVEL	
352		STEAM GENERATOR	NARROW RANGE LEVEL	
353		STEAM GENERATOR	NARROW RANGE LEVEL	
354	½	STEAM GENERATOR	NARROW RANGE LEVEL	
355	SYMBOL	SI		
356		AUX FEED SELECT		
357		SI		
358	1 x 2½	SG1 FW BYPASS	FW-HIC-V-1301-1	
359		SG2 FW BYPASS	FW-HIC-V-1301-2	
360		#1 AUX FDW	HIC-1205-4	
361		SG3 FW BYPASS	FW-HIC-V-1301-3	
362		#2 AUX FDW	HIC-1206-3	
363	½	SG4 FW BYPASS	FW-HIC-V-1301-4	

BILL OF MATERIAL

ITEM NO	MFG	TYPE	QTY	DESCRIPTION
1	W	KA-291	5	STYLE NO 291846A24 SCALE 0-400
2	W	KA-291	6	STYLE NO 291846A20 SCALE 0-150
3	W	KA-291	2	STYLE NO 291846A23 SCALE 0-300
4	W	KA-291	2	STYLE NO 291346A27 SCALE 0-600
5	W	KX-291	1	STYLE NO SCALE 40-0-40
6	W	M/65	4	STYLE NO M/65-PH-T SCALE 50-1000
7	W		1	THERMOVOLT SWRC 31HH SCALE 0-150
8	W	XPR	1	STYLE NO 1377A-XPR SCALE C-10
9	W	XPR	2	STYLE NO 1377A-XPR SCALE 0-60
10	W	XP2	1	STYLE NO 1377A-XPR SCALE 0-100
11	W	KX-291	1	STYLE NO SCALE 0-500
12	W	K-291	1	STYLE NO 1884235401 SCALE SLOW-FAST
13	W	KX-291	1	STYLE NO SCALE 0-2500
14	W		4	STYLE NO SCALE 0-100
15	W	N257N2	4	STYLE NO N-257N-2 SCALE 0-100
16	W	KX-291	1	SCALE 0-1000
17			1	1 PEN RECORDER SCALE 0-120

BILL OF MATERIAL

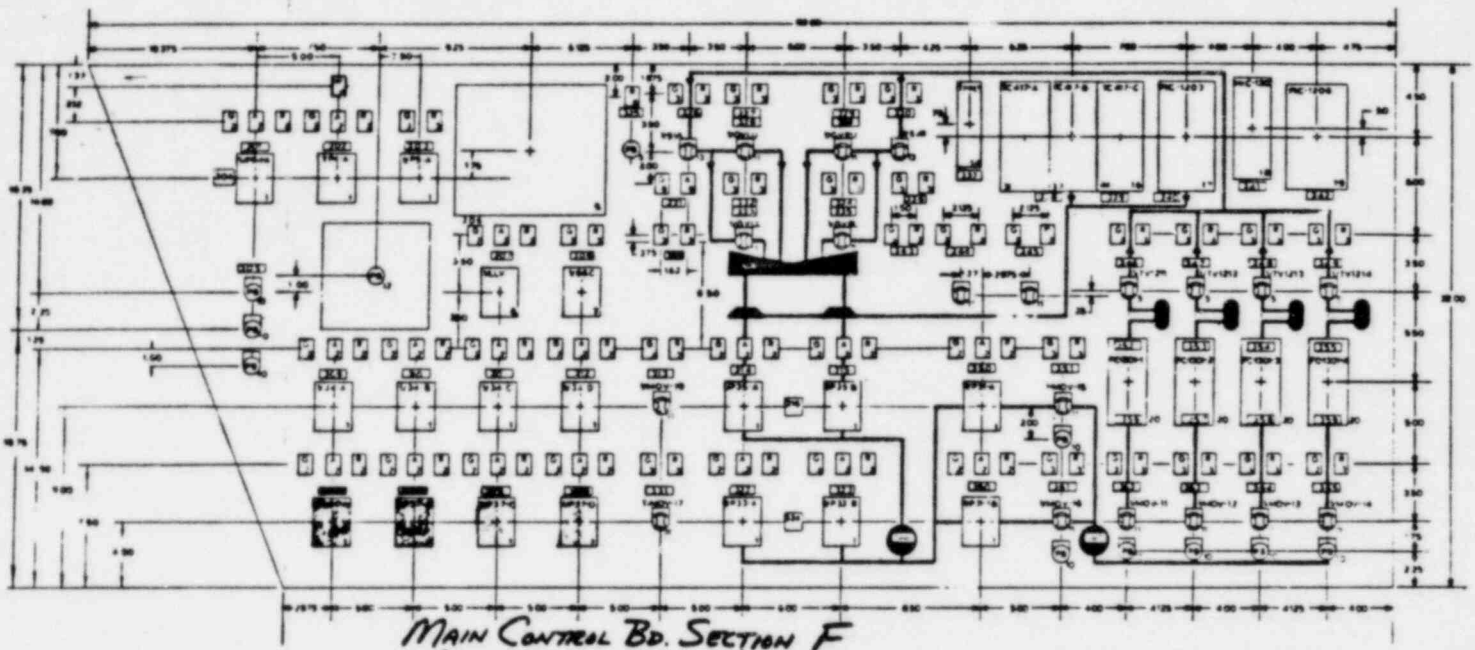
ITEM NO	MFG	TYPE	QTY	DESCRIPTION
18			1	2 PEN RECORDER SCALES 0-100 0-2500
19			1	1 PEN RECORDER SCALE
20			1	2 PEN RECORDER SCALE
21	A	AZR	3	THERMOVOLT INDICATOR AZR 114 SCALE 60-500
22	A	VS	2	REPUBLIC VS INDIC. SCALE 0-125
23	A	VS	5	REPUBLIC VS INDIC. SCALE 0-100
24	A	XPR	2	STYLE NO 1377A-XPR SCALE 0-600
25			4	
26	W		3	INDICATING LIGHTS WA(7A9)1G23
27	A	M/65	2	STYLE NO M/65-PH-T SCALE 0-800 0-2000
28	A	M/69	1	STYLE NO M/6902 D.C. SCALE 0-10
29				SCALE 0-30
30	A	8004	4	RECORDER SCALE 0-25
31	A	8004	4	RECORDER SCALE 0-100
32	A	M/57	4	STYLE NO M/57MG SCALE 100-0

NOTES
1. - FOXBORO
2. - SIEMA
3. - HONEYWELL
4. - MASON
5. - REPUBLIC
6. - TAYLOR

SEE FLOOR PLAN FOR PANEL LOCATION.

THIS DWG REDRAWN FROM 16103-30348 SH 5
REV 7 DATED 10-8-81

NORTHEAS
FOR
CONN YA
MAIN CONTROL
FRONT VIEW AS N
BILL OF MATER
"F" FRONT TOP
DJW
3-5-82



MAIN CONTROL BD. SECTION F
(BENCHBOARD SECTION)

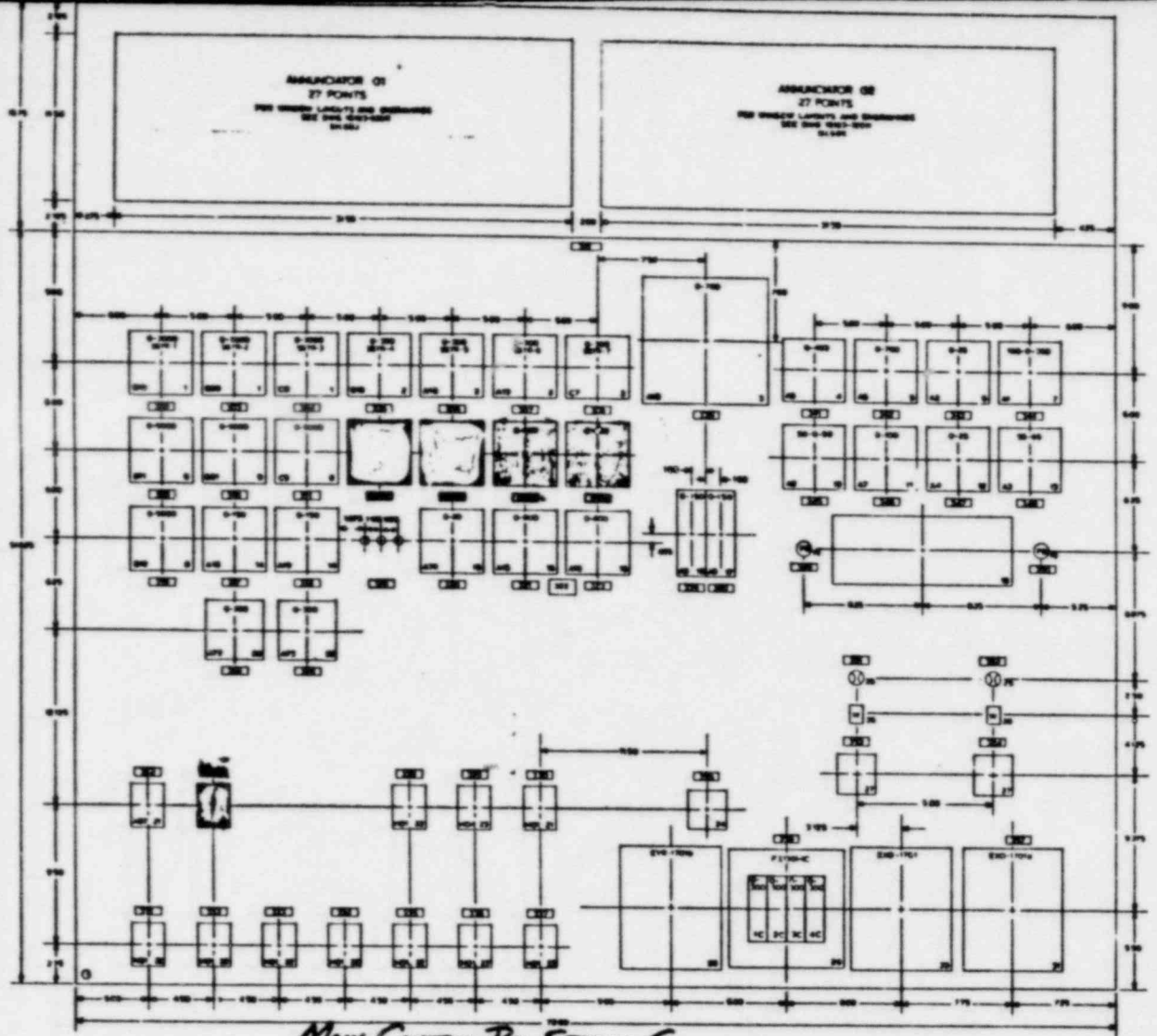
NAMEPLATE LIST

NAMEPLATE NO	SIZE	1ST LINE	2ND LINE	3RD LINE
301		AUXILIARY	OIL PUMP	
302	1 x 2½	ELECT FIRE PUMP	P-4-1A	BUS 4
303		DIESEL FIRE	PUMP	
304		AUTO	SPST	
305		ANNUNCIATOR		
306		REHEAT TEMP	CONTROLLER	
307		LOAD LIMIT		
308		GOVERNOR		
309	1 x 2½	CIRC WATER PUMP 1A	P-34-1A	BUS 1-3
310		CIRC WATER PUMP 1B	P-34-1B	BUS 1-2
311		CIRC WATER PUMP 1C	P-34-1C	BUS 1-3
312		CIRC WATER PUMP 1D	P-34-1D	BUS 1-2
313		COND LOW LEVEL	MAKE UP BYPASS	CD MOV-10
314		CONDENSATE PUMP 1A	P-35-1A	BUS 1-3
315		CONDENSATE PUMP 1B	P-35-1B	BUS 1-2
316		AUTO	32SPST	
317		SERV WATER PUMP 1A	P-37-1A	BUS 4
318		SERV WATER PUMP 1B	P-37-1B	BUS 5
319		SERV WATER PUMP 1C	P-37-1C	BUS 6
320		SERV WATER PUMP 1D	P-37-1D	BUS 7
321		COND HIGH LEVEL	DUMP BYPASS	CD-MOV-17
322		HEAT DRAIN PUMP 1A	P-33-1A	BUS 1-3
323		HEAT DRAIN PUMP 1B	P-33-1B	BUS 1-2
324		AUTO	BOI LEVEL	
325		TURBINE	TRIP	
326		TURBINE STOP	LEFT	
327		GOVERNOR	VALVE 4	
328		42 SL		
329		GOVERNOR	VALVE 3	
330		TURBINE STOP	RIGHT	
331		TEST MOTOR 4		
332		GOVERNOR	VALVE 2	
333		20/37		
334		GOVERNOR	VALVE 1	
335		20/37		
336		TEST MOTOR 3		

NAMEPLATE LIST

NAMEPLATE NO	SIZE	1ST LINE	2ND LINE	3RD LINE
337		PLANT TAVG		
338		STEAM DUMP	TEMP CONTRL	
339		FEEDWATER	VALVE OVERRIDE	
340		STEAM DUMP	PRESS CONTROL	
341		ATMOSPHERIC	VENT	
342		#1 AUX TURB	PRESS CONTROLLER	
343		TEST MOTOR 1		
344		1A SEAL WATER	JET PUMP	
345		1B SEAL WATER	JET PUMP	
346		SG1	TRIP VALVE	
347		SG2	TRIP VALVE	
348		SG3	TRIP VALVE	
349		SG4	TRIP VALVE	
350	1 x 2½	FEEDWATER PUMP 1A	P-31-1A	BUS 1-3
351		1A FEEDWATER	PUMP DISCHARGE	FW-MOV-15
352		RAISE		
353		RAISE		
354		RAISE		
355		RAISE		
356		SHUT		
357		SHUT		
358		SHUT		
359		SHUT		
360	1 x 2½	FEEDWATER PUMP 1B	P-31-1B	BUS 1-2
361		1B FEEDWATER	PUMP DISCHARGE	FW-MOV-16
362		SG1 FEED STOP	FW-MOV-11	
363		SG2 FEED STOP	FW-MOV-12	
364		SG3 FEED STOP	FW-MOV-13	
365		SG4 FEED STOP	FW-MOV-14	
366		NO 2	FEEDWATER	HEATER
367		NO 1	FEEDWATER	HEATER
368		32/49		
369		TEST MOTOR 2		

SEE FLOOR PLAN FOR PANEL LOCATION.



MAIN CONTROL BD. SECTION G
(VERTICAL SECTION)

NAMEPLATE LIST

NAME PLATE no.	SIZE	1ST LINE	2ND LINE	3RD LINE
301	1×2½	SECTION G		
302	½×2½	TRANSFORMER	309	
303	"	TRANSFORMER	389	
304	"	TRANSFORMER	399	
305	"	TRANSFORMER	489	
306	"	TRANSFORMER	489	
307	"	TRANSFORMER	496	
308	"	TRANSFORMER	497	
309	↓	BUS 1-1A		
310	½×2½	BUS 1-2		
311	"	BUS 1-3		
312	"	BUS 4		
313	"	BUS 5		
314	"	BUS 6		
315	"	BUS 7		
316	"	BUS 1-1B		
317	"	BATTERY 1A		
318	↓	BATTERY 1B		
319	1×4½	A/B B/C C/A	MCC/3	
320	1×4½	MEG SEQUENCE		
321	1×2½	EMER GEN 2A		
322	1×2	400 AMPS	2950KW	AT @ 1449
323	½×2½	EMER GEN 2B		
324	½×2½	A BATTERY CHARGER		
325	↓	B BATTERY CHARGER		
326	½×2½	4160V BUS		
327	↓	480V BUS		
328	"	GENERATOR	AMMETER	
329	"	LOW RANGE GEN.	MAN BYPASS	
330	"	GENERATOR		
331	"	TRANSFORMER	309	
332	"	TRANSFORMER	389	
333	"	TRANSFORMER	399	
334	"	TRANSFORMER	489	
335	"	TRANSFORMER	495	
336	"	TRANSFORMER	496	
337	↓	TRANSFORMER	497	
338				
339	½×2	345KV	LINE POT	
340	↓	345KV	GEN BUS	
341	½×2½	GENERATOR MW	LOW RANGE	
342	"	GENERATOR MW	HIGH RANGE	
343	↓	GENERATOR	AMPERES	
344	1×4½	GENERATOR	LEAD IN LAG-OUT	MEGAWATTS
346	½×2½	AC EXCITER	FIELD AMMETER	
347	"	GENERATOR	VOLTAGE	
348	↓	GENERATOR	FREQUENCY	
349	¾×3½	CAUTION PUSHING THESE BUTTONS	TRIPS ST & RT WITHOUT	52 SECOND TIME DELAY
350	↓	CAUTION PUSHING THESE BUTTONS	TRIPS ST & RT WITHOUT	52 SECOND TIME DELAY
351	½×2½	TRAIN A	DEFEAT AUTO	
352	↓	TRAIN B	DEFEAT AUTO	
353	1×2½	AUX PUMP A AUTO	START ACTUATION	TRAIN A
354	↓	AUX PUMP A AUTO	START ACTUATION	TRAIN B
355	1×5	SYNC SWITCH	SOUTH MARCH	
356	1×4	AUX. FEED FLOW		
345	½×2½	VOLTAGE REG	NULL MET	

BILL OF MATERIAL

ITEM NO.	MFG.	TYPE	QTY.	DESCRIPTION
1	W	KA241	5	STYLE NO. 291B461A33 SCALE 0-3000
2	W	KA241	4	STYLE NO. 291B461A23 SCALE 0-330
3	W	KP-241	1	STYLE NO. HR-20573-1 SCALE 0-700
4	W	KP-241	1	STYLE NO. 85-50005-G-19 SCALE 0-400
5	W	KP2241	1	STYLE NO. 8MR 3738 SCALE 0-600
6	W	KA-241	1	STYLE NO. 85-50005-21 SCALE 0-25
7	W	KP2241	1	STYLE NO. 85-50005-G-22 SCALE 100-0-500
8	W	KA-241	4	STYLE NO. 291B462A11 SCALE 0-3000
9	W	KA-241	4	STYLE NO. 291B462A09 SCALE 0-600
10	W	KX-241	1	STYLE NO. 52-Y-1878-4500 SCALE 30-0-30
11	W	KX-241	1	STYLE NO. 409C809440 (SIM) SCALE 0-100
12	W	KA-241	1	STYLE NO. 85-50005-G-23 SCALE 0-25
13	W	KA3241	1	STYLE NO. 7148538A09 SCALE 35-65
14	W	KX-241	2	STYLE NO. 291B201A18 SCALE 0-150
15	G.E.		1	STYLE NO. 6476K51065 SCALE 0-200
16	W	KA-241	2	STYLE NO. 291B461A27 SCALE 0-800
17	⚠	YC-250	2	STYLE NO. 806B818A09 SCALE 0-150

BILL OF MATERIAL

ITEM NO.	MFG.	TYPE	QTY.	DESCRIPTION
18	⚠	BEI-60	1	STYLE NO. BE260-8
19	W		2	PUSH BUTTONS
20	W	2-371	2	MW HIGH RANGE METER SCALE 0-300
21	W	W-2	2	STYLE NO. 5054802G01
22	W	W2	8	STYLE NO. 5054801G01
23	W	W2	1	STYLE NO. 5084164G01
24			1	SYNCHRONIZING SW
25	W	QT-2	2	CONTROL SW
26	W		2	STYLE NO. HA174431G26 INDICATING LIGHTS
27	G.E.	HEA	2	LOCKOUT RELAY
28	⚠		1	ECCENTRICITY DRAWER
29	⚠	257C1	1	AUXILIARY FLOW INDICATORS 4 UNITS
30	W		1	TURBO-GRAF
31	⚠		1	CASING & DIFF. EXPANSION DRAWER

SEE FLOOR PLAN FOR PANEL LOCATION.

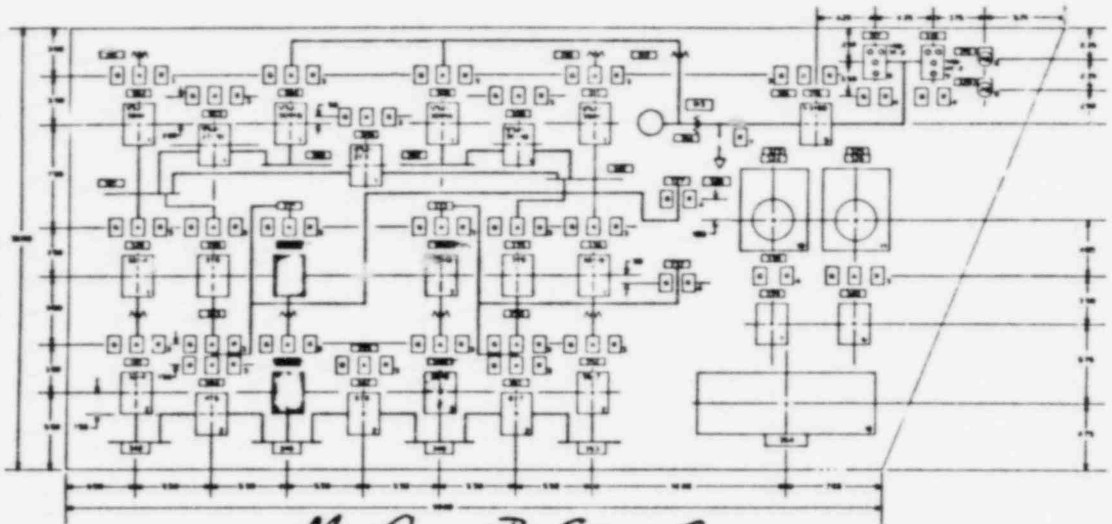
NOTES

REF DWGS

THIS DWG REDRAWN IN PART FROM 16103-30048 SH 7 REV 7 DATED 5-28-81 SH 8 REV 6 5-28-81

NORTH

MAIN CONT
FRONT VIEW
BILL OF MA
"G" TOP SEC



MAIN CONTROL BD. SECTION G
(BENCHBOARD SECTION)

SEE FLOOR PLAN FOR PANEL LOCATION.

BILL OF MATERIAL

ITEM NO	MFR	TYPE	QTY	DESCRIPTION
1	W	W2	11	STYLE NO 5064162G01
2	W	W2	7	STYLE NO 5064169G01
3	W		2*	STYLE NO [illegible]1749316G10
4	W		5	STYLE NO [illegible]1749316G07
5	W	W2	1	STYLE NO 5074861G01
6	W	W2	1	STYLE NO 5074726G23
7	W	W2	1	STYLE NO 5064299G01
8	W	OT2	2	STYLE NO 371295G60
9	W			
10	W			REG VOLT ADJUSTER
11	W			REG BASE ADJUSTER
12	⚠		1	TELEPHONE UNIT (SOUTHERN NEW ENGLAND TEL)

NAMEPLATE LIST

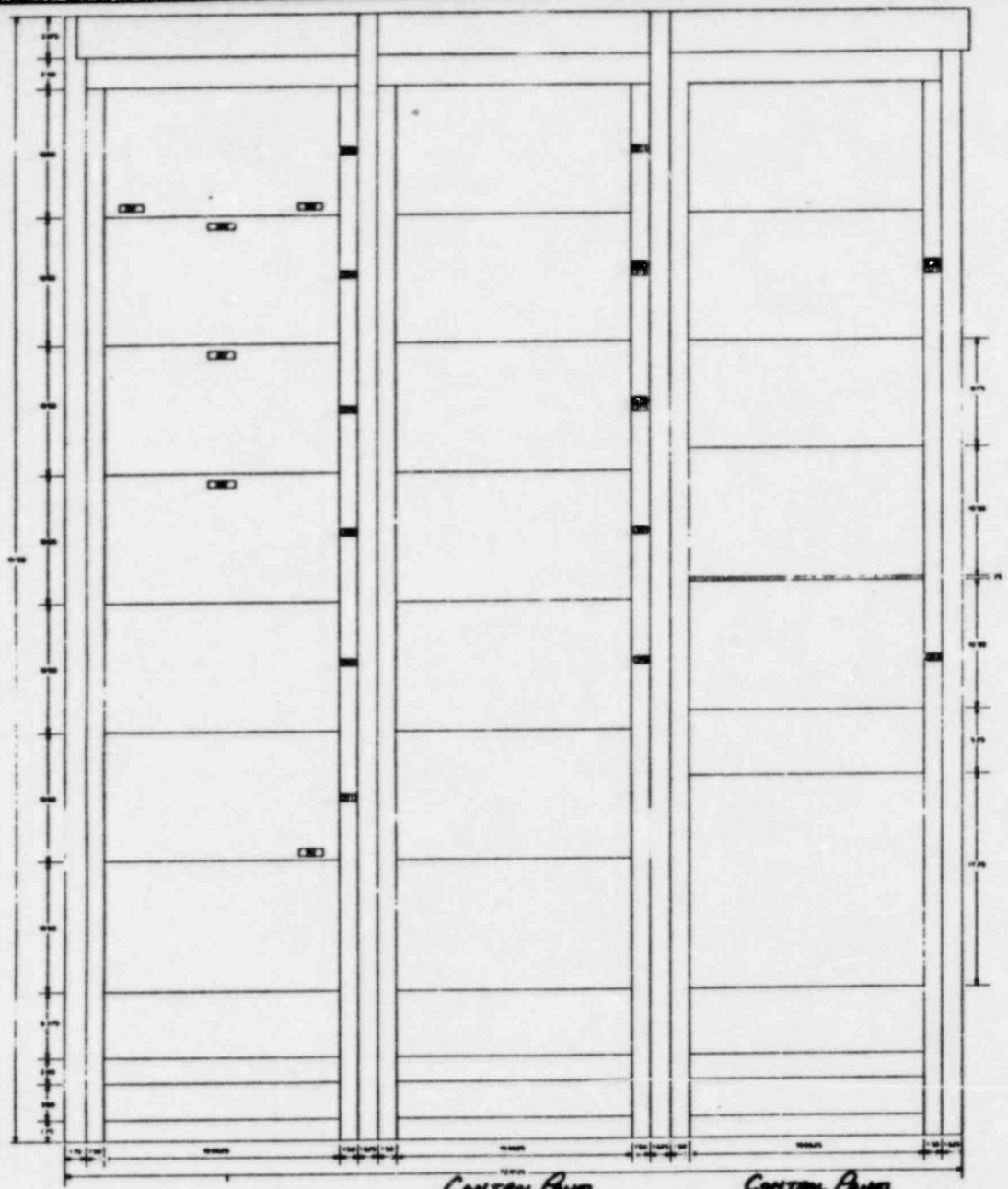
NAME PLATE NO	SIZE	1ST LINE	2ND LINE	3RD LINE
301	2½×1	129-215	389	
302		129-2153-2	3891	
303	2½×¾	27-18		
304	2½×1	309-18		
305	1½×¾	4160 VOLT BUS 1-1B		
306	2½×¾	213		
307	1½×¾	4160 VOLT BUS 1-1A		
308	2½×1	309-1A		
309	2½×¾	37-1A		
310	2½×1	129-229	398	
311		129-2257-2	3981	
312		129-T9	309	
313	2×2	117 DEG CENT	[illegible]	[illegible]
314	2½×¾	319	129-18	
315	2½×1	O C TO OPERATE	COIL 320-12R-5	
316	2½×¾	320-12R-5		
317		1HB-37-2		
3[illegible]		1HC-41-2		
319	1×1	CLOSE		
320	[illegible]	RESET		
321	1½×1½	4160 BUS 1-2		
322		4160 BUS 1-3		
323	2×¾	VARS		
324	2½×¾	VOLTAGE ADJ	REGULATOR	
325	2×¾	NULL		
326	2½×¾	RATE ADJ	REGULATOR	
327		EMER GEN BKR	EG2A	
328	2½×¾	129-14-9		
329		4640		
330		778		
331		FROM	EMERG BUS G	
332		[illegible]		
333		FROM	EMER BUS 9	
334		4980 [illegible]		
335	1½×¾	3-9		
336	2½×¾	4971		
337		W.R GEN BKR	EG2B	
338	2½×¾	MIN VARS 15 (NEG 50)	W 1 [illegible]	
339	2½×¾	EXCITATOR FIELD	BREAKER	
340		VOLTAGE	REGULATOR	
341		4841		
342	3×1	480V BUS 1-4	MCC 1-2-3-4-5	
343	2½×¾	TO 872	AND	EMER BUS 8
344		415		
345		4851		
346	3×1	480V BUS 1-5	MCC 1-2-5-8-10	
347	2½×¾	516		
348		[illegible]		
349	3×1	480V BUS 1-6	MCC 5-6-7-8	
350	2½×¾	TO 913	AND	EMER BUS 9
351		617		
352		4971		
353	3×1	480V BUS 1-7	MCC 3-4-6-7	

NOTE
⚠ [illegible]

THIS DWG REDRAWN FROM 16103-30048 SH 7
REV 7 DATED 5-28-81 16103-30048 SH 8
REV 6 DATED 5-28-81

AFTER CHANGE (N. [illegible])

NORTHEAST UTILITIES SERVICE CO.
FOR CONN YANKEE ATOMIC POWER CO
TITLE MAIN CONTROL BOARD
FRONT VIEW NAMEPLATE LIST AND
BILL OF MATERIAL CONTROL PANEL "G"
(BOTTOM SECTION) HADDAM, CONN
BY DJW
DATE 3-15-82



SEE FLOOR PLAN FOR PANEL LOCATIONS.

NAMEPLATE LIST

NAME PLATE NO.	SIZE	1ST LINE	2ND LINE	3RD LINE
301	2"x1"	B DETECTOR OUT		
302	1"	A DETECTOR OUT		
303	1"x1"	WR1		
304		CH 32	LOOP 2	
305	1"	CH 34	LOOP 1	
306	1.5MM	NEUTRONS		
307		PRIMARY		
308	1"	NEUTRONS BACK-UP		
309	1"x1"	CH 31	LOOP 2	
310		CH 33	LOOP 1	
311	1"	CH 42	CH 44	
312	2"x1"	NEUTRON FLUX	COMPENSATING	
313	1"x1"	WR3		
314	1"	CH 24 ✓		
315	1"x1"	SR 1		
316	1"x1"	CH 11 ✓		
317	1"x1"	SR 2		
318	1"x1"	CH 21		
319		CH 22		
320	1"	CH 12 1		
321	1"x1"	SR 3		
322	1"	WR4		

RE-DRAWN FROM 9103-30050 SH 1A

NORTHEAST UTILITIES SERVICE

CONNECTICUT YANKEE ATOMIC POWER

MAIN CONTROL BOARD
FRONT VIEWS
BILL OF MATERIAL AND NAMEPLATE LIST
CONTROL PNL'S A3-A5 (FRONT)

HADDAM, CONN

9103-30050 SH

Docket No. 50-213

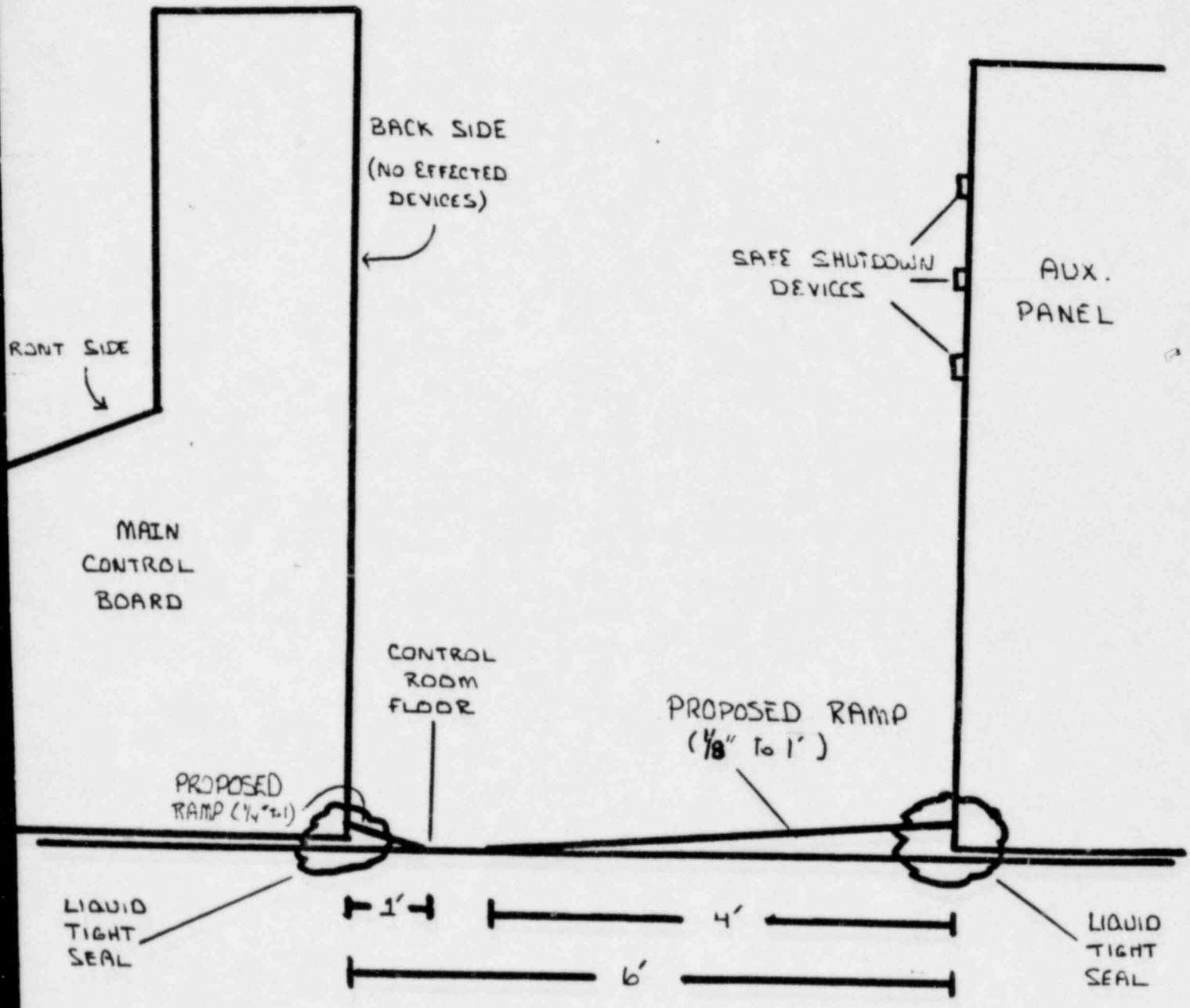
Attachment 2

Haddam Neck Plant

Conceptual Control Room Modifications

July, 1982

PROPOSED RAMP



ATTACHMENT #2
SKETCH #1

Docket No. 50-213

Attachment 3

Haddam Neck Plant

Analysis of Control Room Fire Damage

July, 1982

The following pages detail those control room devices required for safe shutdown that are assumed to be damaged by fire in a manner which could interfere with an orderly controlled safe shutdown. Each panel or control board section reviewed is marked to indicate the locations of these devices. The link between the evaluation sheets and Sketch 1 of Attachment #1 is the three-hundred series nameplate number shown next to each device on the drawings. These numbers also are used on the evaluation sheets. The following guidelines were used in performing this analysis.

1. The fire is assumed to be an exposure fire occurring outside of the confines of the various boards and panels.

2. The customized administrative controls proposed in CYAPCO's March 1982 submittal and further delineated in this supplement are depended upon to limit the magnitude of the fire as well as to prevent exposure fires internal to boards and panels. No credit is taken, however, for the posted fire watch which can realistically be expected to extinguish the fire prior to total consumption of the available flammable liquid. The administrative controls allowed volume of flammable liquid is assumed to be one quart. However, for the circuit analysis the fire was assumed to progress to the point of complete destruction of components as defined by items 4 and 5.

3. The control room quantitative analysis results are credited for demonstrating that a fire external to a board or panel does no damage to wiring/devices mounted within that same board or panel.

4. Components/equipment mounted on the surface of panels of board or which penetrate to any extent the protective skin of a panel or board are assumed to be failed upon exposure to the postulated external fire in a "worst case" manner. As an example, a required-to-be-open contact is assumed closed and vice versa, an instrument fails to present a useful indication, etc.

5. Fires are assumed not to be started via in-situ conditions such as faults or overloads, as:

   (a) Circuits are control or instrumentation type, not of sufficient energy level to start a fire due to a fault especially without a single failure of protective devices. Single failures are not required to be taken for Appendix R assumed events; and,

   (b) Long term overloads which could challenge the installed wiring capability are excluded due to the nature of powered devices. Relays, switches, indicating lights, meters, etc., do not change their characteristics such as to support long term overloads without going to a faulted condition which will be removed via circuit protective devices.

The acronym "LNP" used on the following pages refers to a loss of normal power.

Where the evaluation sheet refers to a previous evaluation as being similar, it should be understood that the panels are identical except that they function for different divisions; i.e., Panel 8DB1 functions for emergency diesel EG2A and Buses 8, 1-4, and 1-5, whereas 9DB1 functions for EG2B and Buses 9, 1-6, and 1-7.

NOTES

1. 480 volt switchgear circuit breakers can be tripped manually by operation of a push button on the front of the switchgear. This push button mechanically operates the breaker.

2. 480 volt switchgear circuit breakers can be closed manually by inserting a breaker handle and turning it one-half turn, clockwise. The breaker handle is located on the west wall of the switchgear room, adjacent to the north door. This is the main entrance to the switchgear room.

3. If a 480 volt breaker fails to operate because of a control switch failure (or any other failure that results in a permanent close or trip signal), the fused knife switch for the breakers DC control power will be disconnected. These devices are labeled.

4. The 4160 volt circuit breakers may be manually tripped from the front of the breaker compartment by operation of a mechanically operated trip level.

5. Manual closing of a 4.16 KV breaker is possible. However, this presents personnel safety concerns due to the slower operation of the circuit breakers main contacts.

   To alleviate this concern, provisions will be made for local electrical control (complete with protective relaying) for closing of the necessary 4.16 KV circuit breakers.

6. The analysis has assumed that the fire could cause a short circuit around the light bulbs of indicating lights due to the manner in which they are mounted on control boards. However, because these devices have resistors mounted behind them which are connected in series with the bulbs, it is our position that a fire external to the control board is not going to cause a short across the entire bulb/resistor assemblies. Therefore, fire related indicating light failures will not cause short circuits which could affect circuit breaker operation.

7. If a fire related failure caused the diesel generators to operate without service water, and the service water pumps could not be restarted from the main control board, the diesel engine coolant temperature would be monitored. If service water pumps could not be manually started before the diesel reached its alarm set point of 190°, the diesel would be shut down until a service water pump is available or until a fire pump can be lined up to provide cooling. Since the diesel would have almost no load on it, sufficient time is available to secure service water.

NOTES (continued)

8. The control room analysis assumes the occurrence of a coincident LNP. However, in certain cases, an LNP would not be caused by the fire under consideration. Such cases are conservative and any evaluation should consider that most plant loads would continue to function and would be available during the plant shutdown.

9. The evluations in this section refer to the auxiliary panels and control boards described in Attachment 1.

PANEL:

Auxiliary Control Board Panel 4 (480 Volt Buses)

AFFECTED DEVICES:

27-4 (312), 27-5 (315), 27-6 (319), 27-7 (322), 27X-4 (313), 27X-5 (316), 27X-6 (320), 27X-7 (323), 27X1-5 (317), 27X1-6 (321), 27X1-7 (324), 27Y-4 (326), 27Y-5 (327), 27Y-6 (328), 27Y-7 (329)

Numbers in parentheses refer to nameplate identification on drawings.

SYMPTOM:

Failure of any of these devices could prevent load shedding of the associated 480 volt bus. Failure of the 27 devices could also cause the bus PT fuses to blow, defeating the MCC-5 throwover circuit and the permissives for loading the service water pumps on to the emergency diesels.

ALTERNATE ACTION:

Manual load shedding of the 480 volt buses (to be done locally). Since the bus may trip due to in-rush when the diesel breaker closes, it may be necessary to manually re-energize the bus and start the service water pumps. Verify that MCC-5 remains connected to an energized 480 volt bus.

Refer to Notes 1, 2, & 7.

MODIFICATIONS:

Ramp the spill away from panel.

PANEL:

Auxiliary Control Board Panel 6 (Emergency Generator)

AFFECTED DEVICES:

74A (344) and 74B (346)

SYMPTOM:

Shorting of the operating coil of either relay would cause a loss of DC for the associated 480 volt emergency bus load shedding schemes.

ALTERNATE ACTION:

Same as for Auxiliary Control Board Panel 4.

MODIFICATIONS:

Ramp the spill away from panel.

PANEL:

Auxiliary Control Board Panel 7 (8DB1) for EG2A

AFFECTED DEVICES:

Stop Push Buttons (319), Gen. Breaker Control Switch (320), 27Y/1-8 (326), Auto-Test Switch (330), 27A/1-8 (331), 27B/1-8 (332), 27C/1-8 (333), 59A/1-8 (334), 59B/1-8 (335), 27X/1-8 (336), 27Y1/1-8 (337), and 27Y2/1-8 (338)

SYMPTOM:

Symptoms listed by device: Stop Push Buttons - Shorting these puts a permanent trip on the engine and the circuit breaker.

EG2A: Breaker Control Switch - Failure could prevent automatic operation during a LNP by opening the closed circuit or by permanently energizing the trip bus.

27Y/1-8: Failure could prevent automatic start of the diesel generator, sequencing of the service water pumps, tripping of the off-site supply to Bus 4, and closing of tie breaker 4T5.

Auto-Test Switch: Failure could block auto start of the diesel generator.

Undervoltage Relays (27A/1-8, 27B/1-8, 27C/1-8) - Relays operate in a 2/3 logic. Failure could prevent sensing of an LNP or could cause an LNP when none existed.

59A/1-8 and 59B/1-8: Either device must operate to allow diesel generator breaker closure. Failure of both would block auto-closing of this breaker.

27X/1-8: Failure would prevent operation of the load shedding and diesel starting features of the LNP circuit.

27Y2/1-8: Failure could leave Bus 8 connected to Bus 1-2. However, Bus 1-2 is load shed from relays on auxiliary control board Panel 4.

ALTERNATE ACTION:

Possible combinations of the following: Manual isolation from the off-site supply, manual diesel generator starting, manual closing of the diesel generator breaker, manual service water starting, and it may be necessary to disconnect a lead to the diesel generator stop push buttons.

Refer to Notes 1, 2, 5 and 7.

MODIFICATIONS:

Per the discussion on manual operation of 4160 volt breakers in Note 5. Implement a procedure to unwire the diesel generator stop push buttons.

Ramp the spill away from the panel.

PANEL:

Auxiliary Control Board Panel 8 (9DB1) for EG2B

AFFECTED DEVICES:

This panel is identical to Panel 7 (8DB1) for EG2A and is similarly affected.

PANEL:

Auxiliary Control Board Panel 9 (9DB1A)

AFFECTED DEVICES:

4/EG2B/1-9 (305)

This is identical to Panel 10 (8DB1A).

SYMPTOM:

Failure of this device would prevent auto-starting of the associated diesel generator.

ALTERNATE ACTION:

Manually start diesel generator from either the diesel control panel in the diesel room or from auxiliary control board Panel 8 (9DB1).

Refer to Note 8.

MODIFICATIONS:

Ramp the spill away from panel.

PANEL:

Auxiliary Control Board Panel 10 (8DB1A)

AFFECTED DEVICES:

4/EG2A/1-8 (315)

This is identical to Panel 9 (9DB1A).

SYMPTOM:

Failure of this device would prevent auto-starting of the associated diesel generator.

ALTERNATE ACTION:

Manually start diesel generator from either the diesel control panel in the diesel room or from auxiliary control board Panel 7 (8DB1).

MODIFICATIONS:

None.

PANEL:

Main Control Board Section "B"

AFFECTED DEVICES:

Nameplate No. 340 and No. 349 - Source Range Nuclear Inst. Ch. 11 & 14.

Nameplate No. 358 - Nuclear Inst. Recorder.

SYMPTOM:

Loss of source range indication both meter and recorder.

ALTERNATE ACTION:

Source range level and rate can be monitored at source range drawer which is not affected by the same fire that disables the indication.

MODIFICATIONS:

None.

PANEL:

Main Control Board Panel "C"

AFFECTED DEVICES:

Device #311 - Cold Pressurizer Level Instrument #L1-402 (indicator) and 1/LT-402 (Switch)

Device #345 - Pressurizer Level Recorder/Controller Instrument #LRC-401-1

Device #365, #366, & #367 - Pressurizer Pressure-Instrument #P401-1, 2 & 3 (Indicators)

SYMPTOM:

Loss of pressurizer pressure and both hot and cold level indications. Possible loss of alarms and controls associated with these instruments.

ALTERNATE ACTION:

CY Procedure AOP 3.2-8, Section 4.2.1, refers to portable instruments which are available in the cable vault to measure pressurizer level and pressure at the penetrations. Level and pressure controls will be done at remote locations.

MODIFICATIONS:

None.

PANEL:

Main Control Board Section "C" (Bottom)

AFFECTED DEVICES:

Control Switches for RHR Pumps P-14-1A (332) and P-14-1B (331), Charging Pumps P-18-1A (325) and P-18-1B (346).

SYMPTOM:

RHR pumps: failure of the control switch could cause inadvertent closing or tripping of the breaker.

Charging Pumps: control switch failure could cause inadvertent opening of the associated circuit breakers.

ALTERNATE ACTION:

The RHR circuit breakers may be manually operated once control power is removed from the associated breaker. The charging pump breakers (4160 volt) may be closed per the discussion in Note 5.

Refer to Notes 1, 2, 3, 5 and 8.

MODIFICATIONS:

Per the discussion on manual operation of 4160 volt breakers in Note 5.

PANEL:

Main Control Board Panel "D" (Top)

AFFECTED DEVICES:

Nameplate No. 308, 309, 311, 312, 313, and 314: Temp. Inst. (Tavg, ΔT, TCWR, Loop Tavg, & ΔT).

SYMPTOM:

Loss of temperature indication.

ALTERNATE ACTION:

Loop temperature can be determined by measuring resistances of each RTD and converting to temperature; incore thermocouples can be read on the computer or direct readout in cable vault as directed in CY Procedure AOP3.2-8, Section 4.4.

MODIFICATIONS:

None.

PANEL:

Main Control Board Panel "F" (Front Top)

AFFECTED DEVICES:

Nameplate No. 342, 343, 345, and 346: Steam Generator Wide Range Level (Inst. No. 1302-1, 2, 3, & 4) (Hagan Inst. Feedwater Control System).

No Nameplate: Steam Generator Wide Range Level (Inst. No. 1302-1A & B, 2A & B, 3A & B, 4A & B) (Foxboro Inst. Auto Aux. Feedwater System)

SYMPTOM:

Loss of steam generator level indication and possible loss of automatic feedwater control.

ALTERNATE ACTION:

Portable battery powered instruments can be installed in the cable vault to monitor steam generator levels.

MODIFICATIONS:

Procedure is needed to install portable equipment to Foxboro transmitters to monitor steam generator level remote of the control room.

PANEL:

Main Control Board Section "F" (Bottom)

AFFECTED DEVICES:

Control Switches for Service Water Pumps P-37-1A (317), P-37-1B (318), P-37-1C (319), and P-37-1D (320)

SYMPTOM:

Failure of a control switch could cause inadvertent tripping of the associated circuit breakers.

ALTERNATE ACTION:

Pull control circuit fuses and manually operate the circuit breakers.

NOTE: Fire at this control board section would not cause an LNP. Refer to Notes 1, 2, 3, 7 & 8.

MODIFICATIONS:

None.

PANEL:

Main Control Board Section "G" (Top)

AFFECTED DEVICES:

Voltmeters for the 480 volt buses 4, 5, 6, and 7 (312, 313, 314, and 315), Voltmeter Switch (327) for the 480 volt bus voltmeters.

SYMPTOM:

Voltmeters and voltmeter switch: failure of these devices could cause loss of PT fuses for the associated PT's. This could result in loss of the permissive logic which allows closure of the associated service water pump breakers. On buses 5 and 6 the MCC-5 auto-throwover would also be lost. Load shedding would occur on the 480 volt buses.

ALTERNATE ACTION:

Manual closure of the service water pump breakers and verification that MCC-5 is connected to an energized bus. The diesel may have to be tripped until service water is available.

Refer to Notes 1, 2, and 7.

MODIFICATIONS:

None.

PANEL:

Main Control Board Section "G" (Bottom)

AFFECTED DEVICES:

Control Switches for circuit breakers 4850 (332), 4960 (334), 4851 (345), and 4961 (348).

SYMPTOM:

Failure of a control switch could cause a permanent trip signal on the associated circuit breaker. Assuming failures of other control switches have caused an LNP, the four identified breakers would be required to establish two divisions of on-site power.

ALTERNATE ACTION:

The 480 volt breakers may be manually closed once control power is removed from the associated breaker. The 4160 volt breakers may be closed per the discussion in Note 5. These switching operations will assure power delivery to 480 volt buses 5 and 6 to support shutdown operations.

Refer to Notes 1, 2, 3, 5.

MODIFICATIONS:

Per the discussion on manual operation of 4160 volt breakers in Note 5.

PANEL:

Main Control Board Panel A4 and A5

AFFECTED DEVICES:

Nameplate No. 314, 316, and 320, Source Range Nuclear Inst. Ch. 14 and 11 - Normal source range channels.

CH 12 - Refuel source range channel.

SYMPTOM:

Loss of source range inst. level and startup rate indications.

ALTERNATE ACTION:

A spare source range drawer can be directly installed in the cable vault to monitor source range level and rate.

MODIFICATIONS:

1. The spare source range drawer must be modified before it can be used for this purpose.
2. A. C. power must be made available in the cable vault to power the drawer.
3. A procedure will be written to direct personnel on installation of the spare equipment.

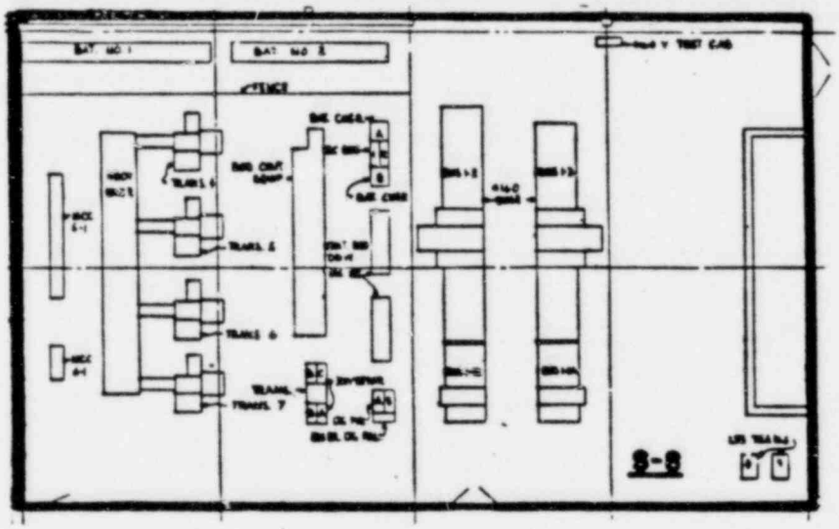
CONNECTICUT YANKEE
SAFE SHUTDOWN FIRE ZONE ANALYSIS

El. 59'6" Service Building
Switchgear Room

Fire Area No. S-8

Safe Shutdown Equipment

Battery banks A & B
Battery chargers 1A and 1B
DC buses 1 & 2
DC/AC inverters A, B, C, and D
4160/480 V transformers
480 V switchgear
MCC 5-1 & 6-1
Cable



Design Features

- Walls, floor, and ceiling consist of reinforced concrete.
- Blast resistant walls and doors separate this area from the turbine building.
- Eight-inch block wall separates the redundant battery banks.
- Separate ventilation system (1,000 cfm) is supplied over battery banks.
- 4160/480 volt transformers are cooled with noncombustible fluids.
- Lighting and inverter transformers are dry type.
- North wall, portions of the east and south walls are external metal insulated siding.

Combustible Material	Quantity	Fire Load (Btu/ft3)
Cable	148 ft3	16,200

Existing Fire Protection

- o Total flooding Halon 1301 automatic suppression system with an early warning ionization smoke detection system is provided.
- o Twenty-pound carbon dioxide extinguishers are located in the area.
- o One hose reel is located inside the door entrance from the turbine building.
- o Hose stations and portable extinguishers are located in the turbine building (adjacent to this fire zone).
- o All cables are coated with fire retardant material (Flammastic).
- o One hundred pound wheeled dry chemical unit is provided.

Compliance with Appendix B

Does not comply with Section III.G.2 of Appendix R.

Proposed modifications will bring this fire zone into compliance with Section III.G.2.b of Appendix R except for the issue of intervening combustibles between redundant electrical equipment (cabling for redundant safe shutdown equipment will be in compliance once the modifications are made). Therefore, an exemption is requested (see Proposed Modifications and Discussion) from the separation requirements with no intervening combustibles of Section III.G.2.b of Appendix R for the safe shutdown equipment.

Proposed Modifications

1. Install a new safety related 480 volt load center.
2. Install a new safety related 480 volt motor control center.
3. Relocate one of the station batteries to the south end of the switchgear room.
4. Relocate all four static inverter vital bus power supplies to two diverse locations.
5. Relocate one battery charger and DC bus to the south end of the switchgear room.
6. Reroute two channels (one battery related division) of instrumentation cable identified for the safe shutdown for Appendix R. The cable to be rerouted originates in the control room and terminates in the containment cable vault. Instrumentation cable separation improvements are proposed in fire zones S-1, S-8, S-17, and R-1.
7. One division of required cables not in conference with the 20' separation requirements will be enclosed in a one hour fire rated barrier.

Discussion

The switchgear room contains the major power distribution elements for the plant except for the two 4160 volt emergency buses (8 and 9) which are located in separate diesel rooms (fire zones D1 and D2).

The two station batteries, battery chargers, and DC distribution panels, four static inverters, motor control center 5, and 480 volt load centers 4, 5, 6, and 7 are located within the switchgear room (see Sketch No. 1).

To satisfy the requirements of Appendix R, CYAPCO has proposed the following (see Sketch No. 2).

1. Post-fire shutdown required loads presently powered from division B switchgear bus No. 6 (one of two color coded green) in the existing 480 volt load center line up will be recabled to be powered from a new safety related 480 volt load center. This will result in one service water pump, one residual heat removal pump, and the new motor control center (see Item #2 below) deriving power from the new remotely located load center (see Sketch No. 3). Note that on Sketch No. 2, one 480 volt load center (Bus No. 7) of the B division remains in its existing position. This is an acceptable situation as in the event of a switchgear room postulated fire, no credit is assumed for the Bus 7 supplied service water pump D. Note that for a fire in the screenwell (fire zone P-1) A and D (Buses 4 and 7) service water pumps are credited for operation due to their physical separation from each other in the screenwell pump house.

2. The existing lineup of switchgear requires MCC No. 5 to be functional at all times. This configuration is recognized to be acceptable to the NRC as described in a Safety Evaluation Report issued by the Atomic Energy Commission dated July 1, 1971. By providing a new MCC (green), all Division B equipment will be powered from it (see Sketch No. 4), while Division A equipment continues to utilize MCC No. 5. This new MCC will be located next to the new 480 volt load center on the south side of the switchgear room (see Sketch No. 2)

3. One station battery, its charger, and DC bus, will be relocated to the south end of the switchgear room to provide a physical separation in excess of forty feet from its redundant counterpart.

4. The existing four static inverters will be relocated in the switchgear room so a physical distance in excess of forty feet exists between the redundant pairs of inverters.

5. The overhead cable tray and conduit system in the switchgear room contains control and instrumentation cable of both safety related divisions. Control cable between the control room and the two emergency diesel generator rooms pass through this area. The cables for Division A travel in tray C1, while the cables for Division B travel in tray C. One of the trays will be enclosed with a one-hour rated fire barrier. Control cables for emergency diesel generators, charging pumps, 480 volt load center feeder breakers,

room panel (in the control room) to another control room panel by way of tray C in the switchgear room. One division of these interconnecting cables will be recabled and enclosed in a one-hour fire rated raceway.

All cabling associated with new equipment or equipment to be relocated will be in accordance with Section III.G.2.b or III.G.2.c of Appendix R.

Based on the proposed modifications and the existing detection and automatic suppression systems in Fire Zone S-8, the requirements of Section III.G.2.b are fulfilled in this area with one clarification.

The term "no intervening combustibles" is not specifically defined within Appendix R. The two 4160V switchgear cabinets could be construed as intervening combustibles. It is CYAPCO's position that these two cabinets as well as any other metal clad switchgear cabinets or control cabinets in Fire Zone S-8 are not combustibles.

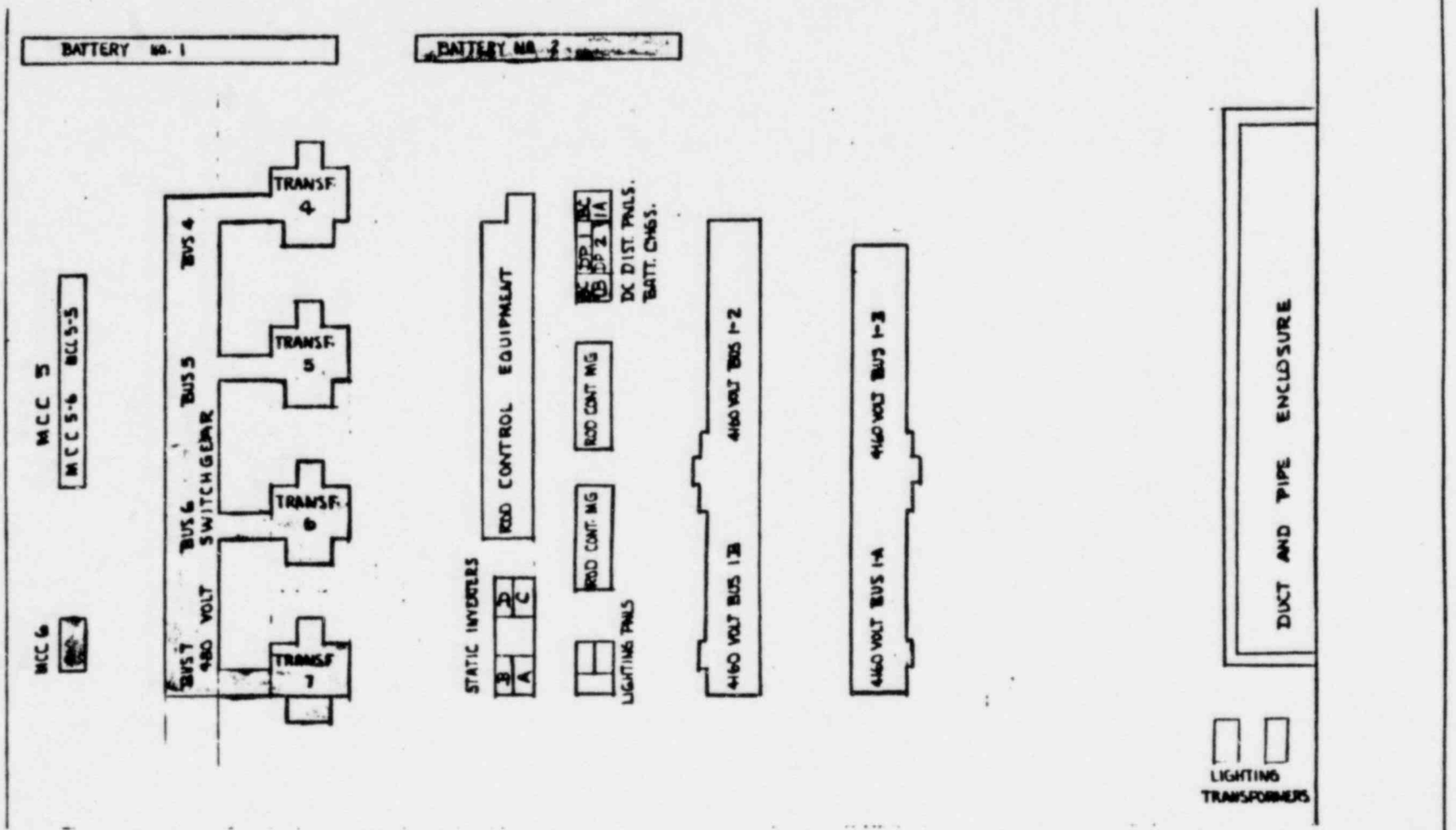
The switchgear room contains a cable tray system in the overhead between eleven feet and eighteen feet above the floor. The tray system contains cable qualified to the requirements of IEEE 383 and PE/PVC cable liberally coated with flamemastic fire retardant coating (see Appendix C for additional information concerning intervening combustibles). Cable associated with new equipment and equipment to be relocated will be enclosed in a one hour fire rated raceway. Based on the low fire spread potential of the cable system, the metal enclosures for the electrical equipment, and the height of the cable systems above the equipment, a fire will not spread to involve both divisions of safe shutdown equipment. Because of the proposed one hour fire rated raceways, the suppression and detection systems, and the low fire spread potential of the cable system, a fire will not affect both divisions of cables required for safe shutdown.

As such, CYAPCO requests an exemption from the requirement of Section III.G.2.b of Appendix R that no intervening combustibles be present between these redundant components. Also see Generic Discussion on Intervening Combustibles, **Appendix C**

The type of fire which would consume cabling installed in the switchgear and control cabinets is not capable of being transmitted to another cabinet several feet away. As such, the separation proposed for redundant equipment in Fire Zone S-8 together with the detection and suppression systems currently installed provide equivalent protection to that required by Section III.G.2.b of Appendix R.

Reference Drawings

FE 27 B 15103-33002



NORTHEAST UTILITIES SERVICE COMPANY
CONNECTICUT YANKEE SWITCHGEAR RM.

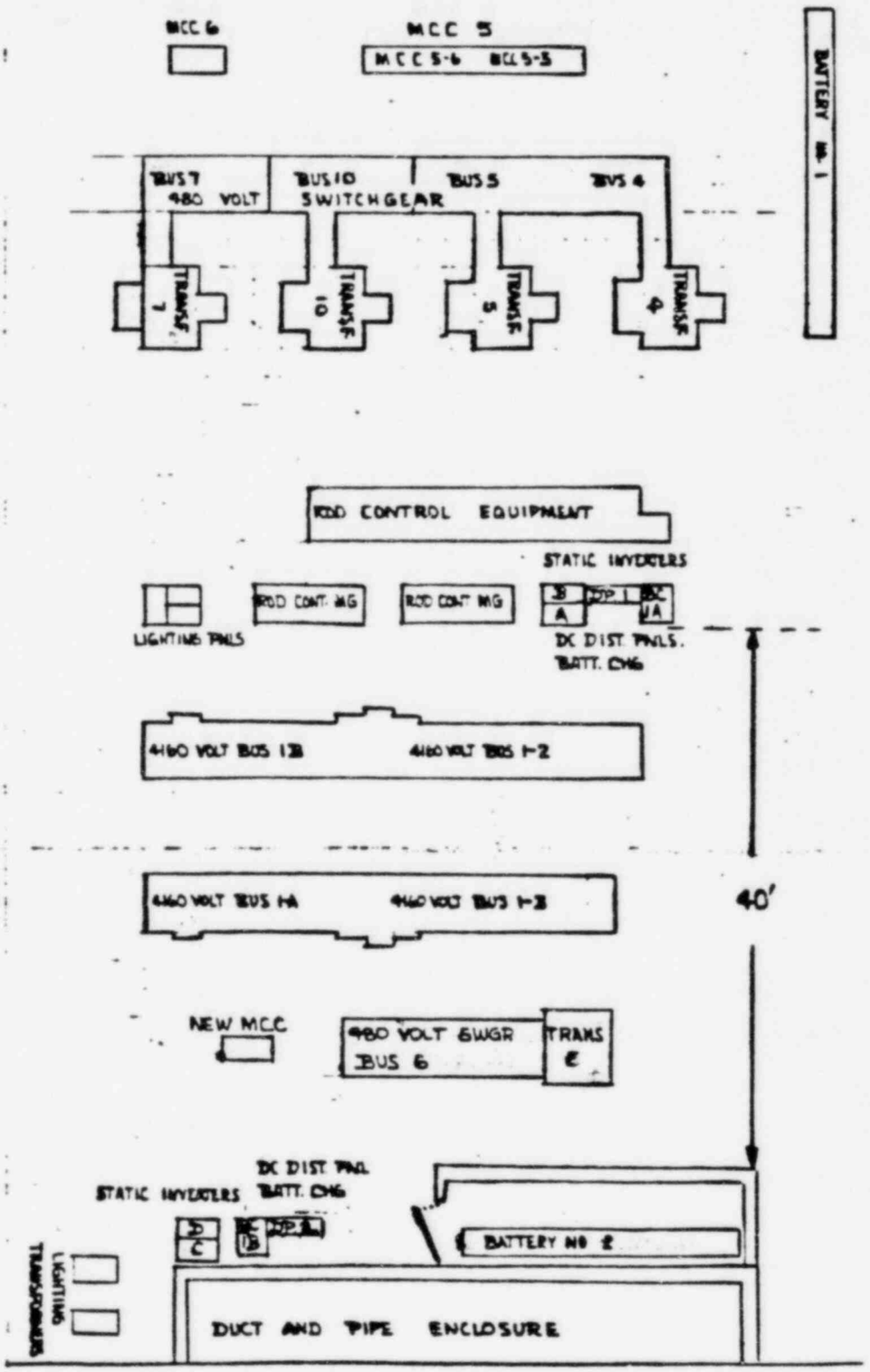
APPENDIX R STUDY
SKBAT0605821

SKETCH NO. 1

NOTES

BUS 7 LOADS ARE NOT REQUIRED FOR A FIRE IN THIS AREA. RELOCATED BUS 6 SERVES DIVISION B UNDER THESE CIRCUMSTANCES.

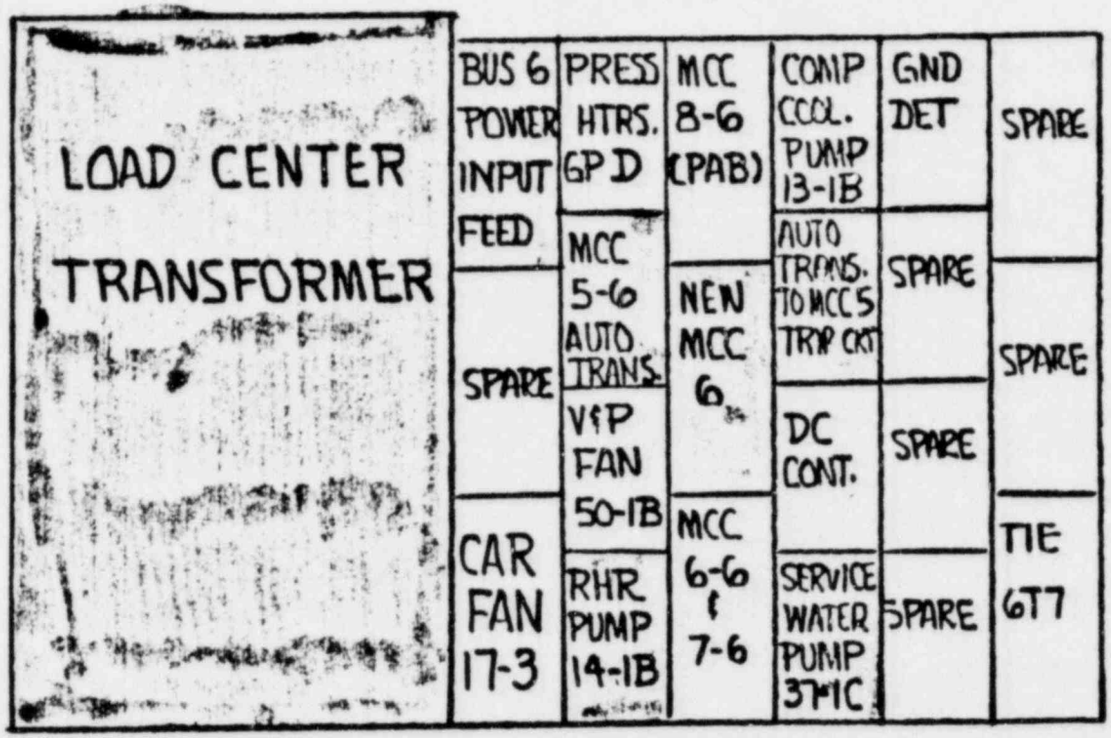
MCC 5 CAN RECEIVE POWER FROM EITHER DIVISION A OR DIVISION B THEREFORE IT IS COLORED YELLOW. AFTER THE PROPOSED MODIFICATIONS ONLY DIVISION A (RED) SAFE SHUTDOWN LOADS WILL BE POWERED FROM MCC 5.



NORTHEAST UTILITIES SERVICE COMPANY
CONNECTICUT YANKEE SWITCHGEAR RM
APPENDIX R STUDY
SKBAT 0605822

SKETCH NO. 2

NEW 480 VOLT LOAD CENTER BUS 6



SKETCH NO. 3

NORTHEAST UTILITIES SERVICE CO.
CONNECTICUT YANKEE
APPENDIX "R" STUDY
SKBAT C609821

NEW MOTOR CONTROL
CENTER BUS 6 POWERED

INCOMING FEED	MOV 257 VCT OUTLET	
	MOV 313 RWST TO CHG PP B	
FUEL OIL PP 44-1B		
BATT E6-2B CHG DIST. B6-1B FNL		

SKETCH NO. 4

NORTHEAST UTILITIES SERVICE CO
CONNECTICUT YANKEE
APPENDIX "R" STUDY
NEW 480 VOLT MCC
SKBAT 0607821

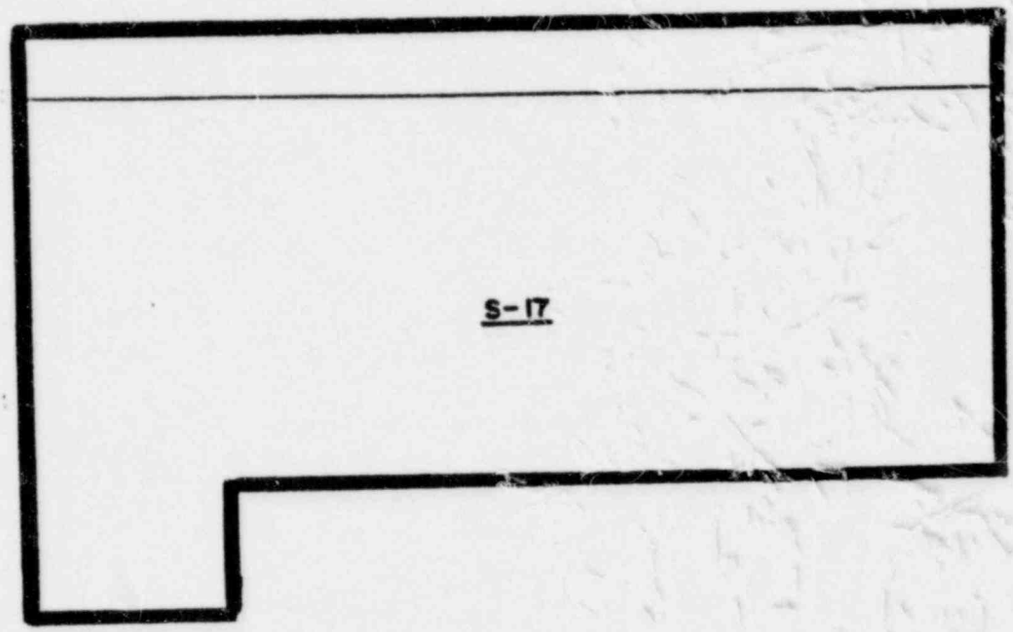
CONNECTICUT YANKEE
SAFE SHUTDOWN FIRE ZONE ANALYSIS

El. 30' Service Building
Cable Spreading Area

Fire Area No. S-17

Safe Shutdown Equipment

Cable



Design Features

- Walls consist of reinforced concrete, concrete block, and metal siding.
- Ceiling consists of 6" monolithic concrete, hardened and sealed.
- Floor consists of 6" concrete.
- Ceiling height - 12'.
- Volume of room - 50,880 cubic feet.
- Fire dampers are installed in vent openings and air intake as identified in CYAPCO's SER.
- Ventilation - 10,000 cfm.

Combustible Material

	Quantity (ft^3)	Fire Load (Btu/ft^2)
Cables	160	15,800

Fire Protection

- Portable extinguishers located throughout this fire zone.
- Two hose cabinets in corridor section of cable vault.
- Ionization detection system exists for early warning.
- Cables are coated with a fire retardant material.
- An automatic water fire suppression system specifically designed for calbe tray concentrations.

Compliance with Appendix R

Does not comply with Section III.G.2 of Appendix R.

In response to provision 1a of Reference (2) an exemption is requested (see proposed Modification and Discussion) from the separation requirements of Section III.G.2.b of Appendix R for the safe shutdown cables, including the provision for no intervening combustibles.

Proposed Modification

- Customized administrative controls will be implemented to minimize introduction of flammable liquids in the cable spreading area (see aforementioned discussion on customized administrative controls. Section III of cover letter.)
- A directional spray automatic water suppression system will be provided for the hallway passage area of this fire zone.
- Reroute one division of required instrumentation cables.
- Reroute MOV 373 cables.
- Reroute cables for one RHR pump.
- Reroute and protect with a one-hour fire rated raceway, all required cables impacted by the addition and relocation of equipment in the switchgear room.

Discussion

The cable spreading area is located directly below the switchgear room and in a mezzanine area above the service building locker room/HP support area. This fire zone is designated S-17.

Supplemental Sketch 1 shows a passageway through the cable spreading area (S-17) from the service area (S-9 through S-19 locker room area, HP offices, and chemistry labs, etc.) to the primary auxiliary building (PAB). The passageway is considered a part of fire zone S-17. The passageway is at elevation 21'6" while the cable spreading area is in a mezzanine area at elevation 30'. Supplemental Sketch 1 and Photos #1 and #2 are enclosed for clarity.

Power cables enter the spreading area from the switchgear room. Medium and low voltage power is distributed to the plant through the cable spreading room. Control and instrumentation cables pass through the cable spreading room in risers along the east wall and enter duct lines to the containment cable vault (see Photo #3).

It is proposed that one complete division of instrumentation cables (pressurizer level, pressurizer pressure, RCS temperature, steam generator level and source range nuclear instrumentation) required for safe shutdown will either be rerouted outside the fire zone or grouped together in a segregated cable tray system enclosed in a one-hour fire barrier. Power and control cables for one RHR pump and MOV 373 will also be rerouted within the cable spreading area and enclosed in a one-hour rated barrier.

The equipment relocations and additions in the switchgear room above will require the recabling of much of the three division cables. Where these cables pass through the spreading area they will be routed or protected in accordance with the requirements of Appendix R.

Safe shutdown cables not affected by the aforementioned changes are those cables originating or terminating in the emergency diesel generator rooms. These cables are shown on Sketch #2, and they are the cables for which an exemption is requested. Cables within the two trays can be characterized as follows.

Division A (Red)

- o Diesel control
- o Charging pump control
- o Control for tie breaker between Buses 8 and 2.

Division B (Green)

- o Diesel control
- o Charging pump control
- o Control for tie breaker between Buses 9 and 3.

It should be noted that Division A cables run in one tray (C1) with Division B cables located in a separate parallel tray (C). Physical separation of three to twelve feet exists between these redundant trays. An automatic water sprinkler system specifically designed for cable tray concentration has been installed in this area to satisfy CYAPCO's SER Item 3.1.5.

NOTE: As shown on Photos #4 and #5, sprinkler nozzles are located directly between each tray to provide full coverage. Also see attached Sketch SKMP1-FP604-1 to clarify design concept of this unique water spray system.

The cable spreading area has an early warning ionization detection system for early warning and a flammastic fire retardant coating has been applied to the cables for added protection where PE/PVC cable exists. The remainder of the cable is IEEE-383 qualified. The use of flammastic coating, IEEE-383 qualified flame retardant cable, and the water spray system eliminate the fire spread potential due to intervening combustibles. (See Appendix C for additional information concerning intervening combustibles).

The proposed modification to install a water curtain type automatic directional spray system for the hallway area of this fire zone will assure that transient combustibles could not affect the cable spreading area. This system would be installed at the top of the block wall and provide water curtain separation between the passageway and the cable spreading area (see supplemental sketch).

CYAPCO concludes that based on the existing features of this fire zone, which include:

- o Restricted entry to the mezzanine area;
- o Automatic water spray system designed specifically for high density cable tray protection;
- o Early warning ionization detection;
- o Flammastic fire retardant coating for cables;

and proposed modifications:

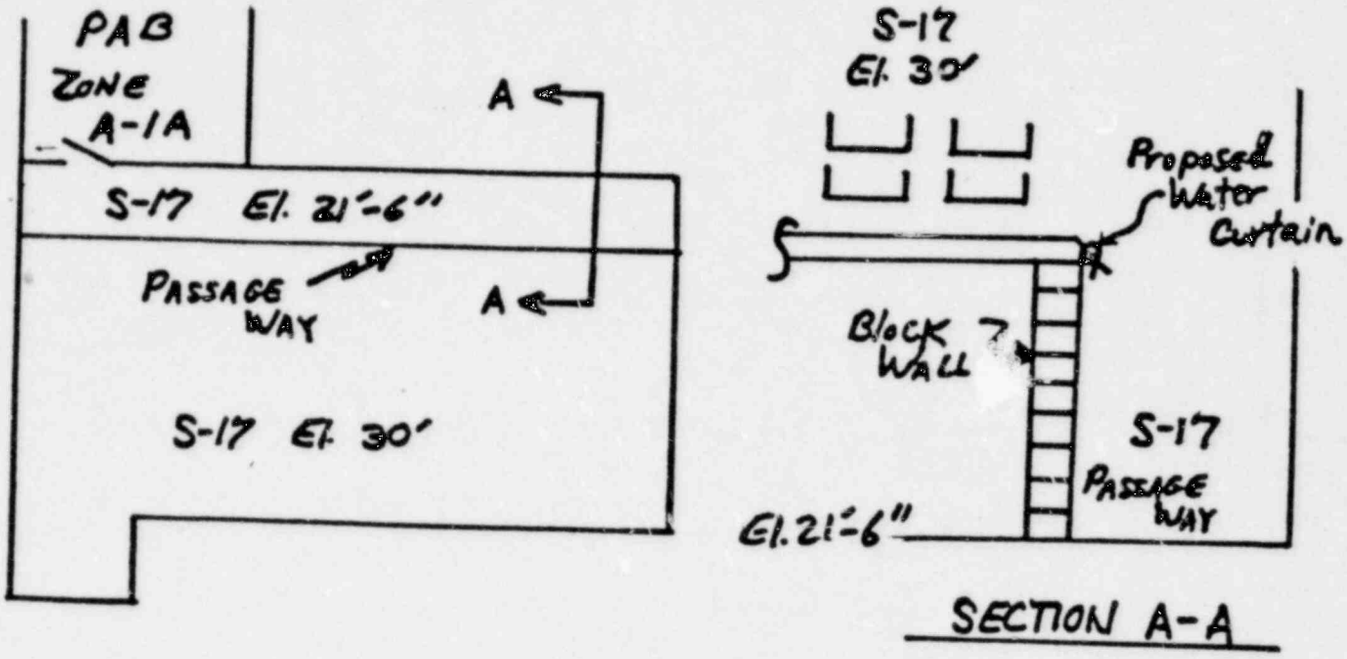
- o Customized administrative controls;
- o Reroute control cables, RHR pump cables, and MOV 373 cables;
- o Install a water curtain spray system;

that sufficient levels of defense-in-depth have been provided, that safe shutdown capability will be maintained, and that sufficient justification has been provided to support the requested exemption.

Reference Drawings

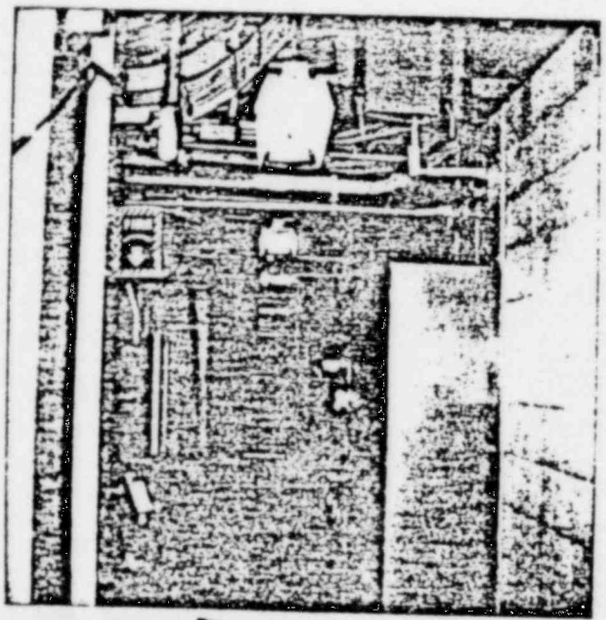
FE42A 16103-34005

SUPPLEMENTAL SKETCH



SECTION A-A

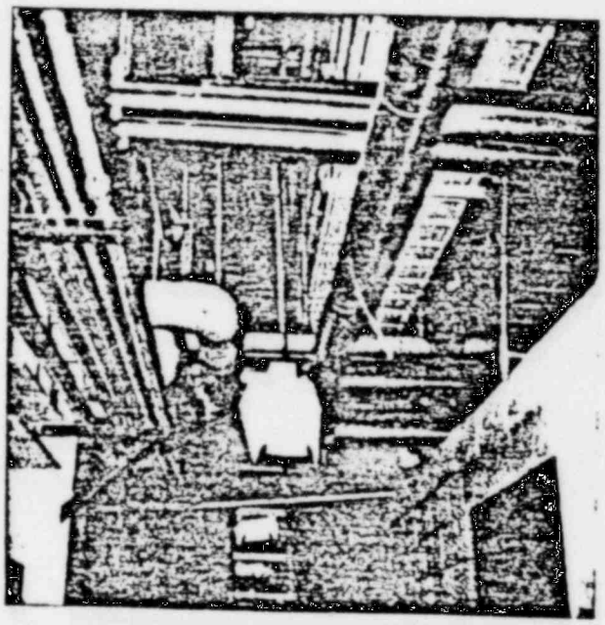
PHOTO #1



PASSAGE WAY S-17

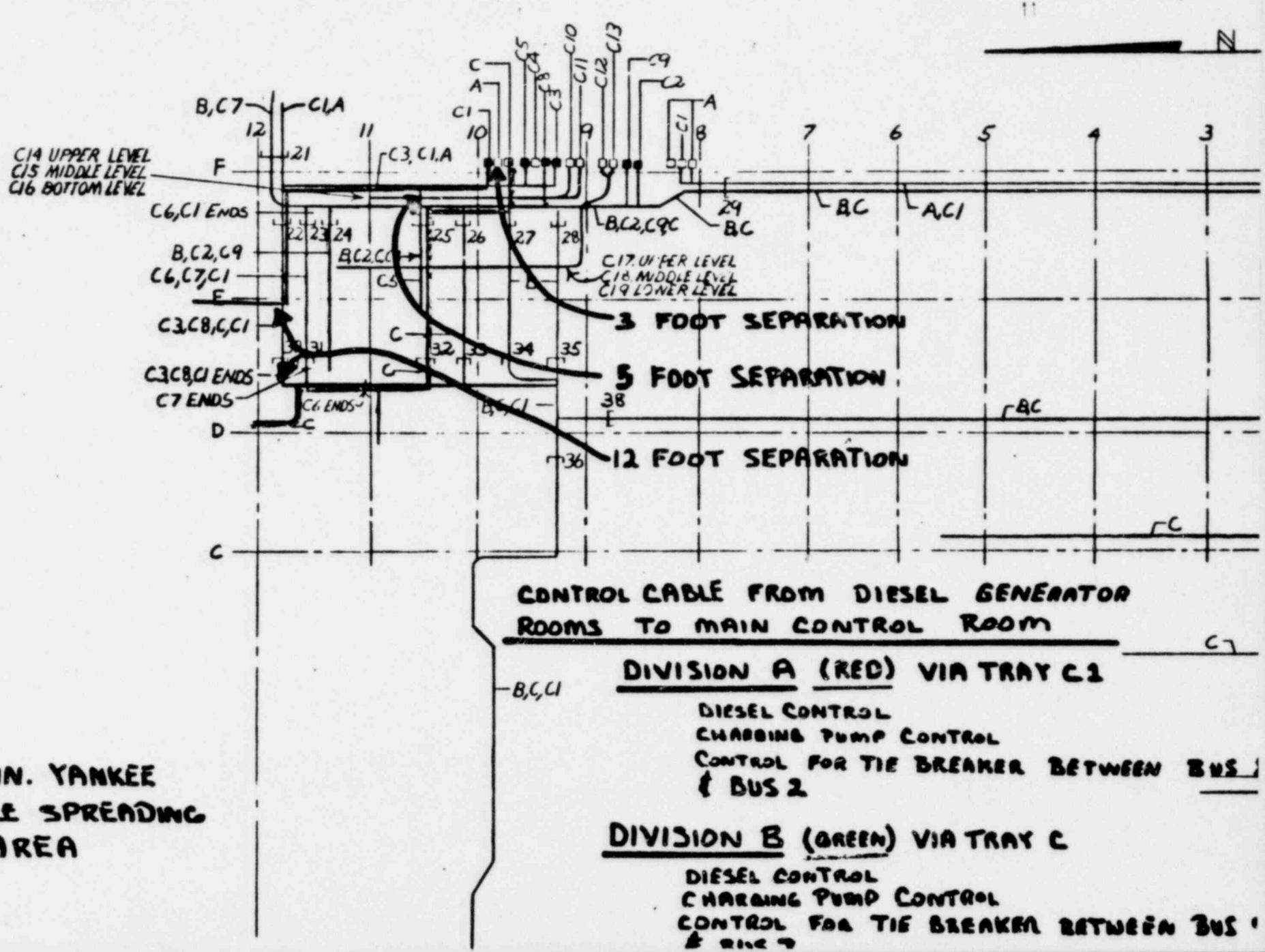
BLOCK WALL

PHOTO #2



SPRINKLER WATER CURTAIN PROPOSED TO BE INSTALLED AT TOP OF BLOCK WALL

SKETCH #2



CONN. YANKEE
CABLE SPREADING
AREA

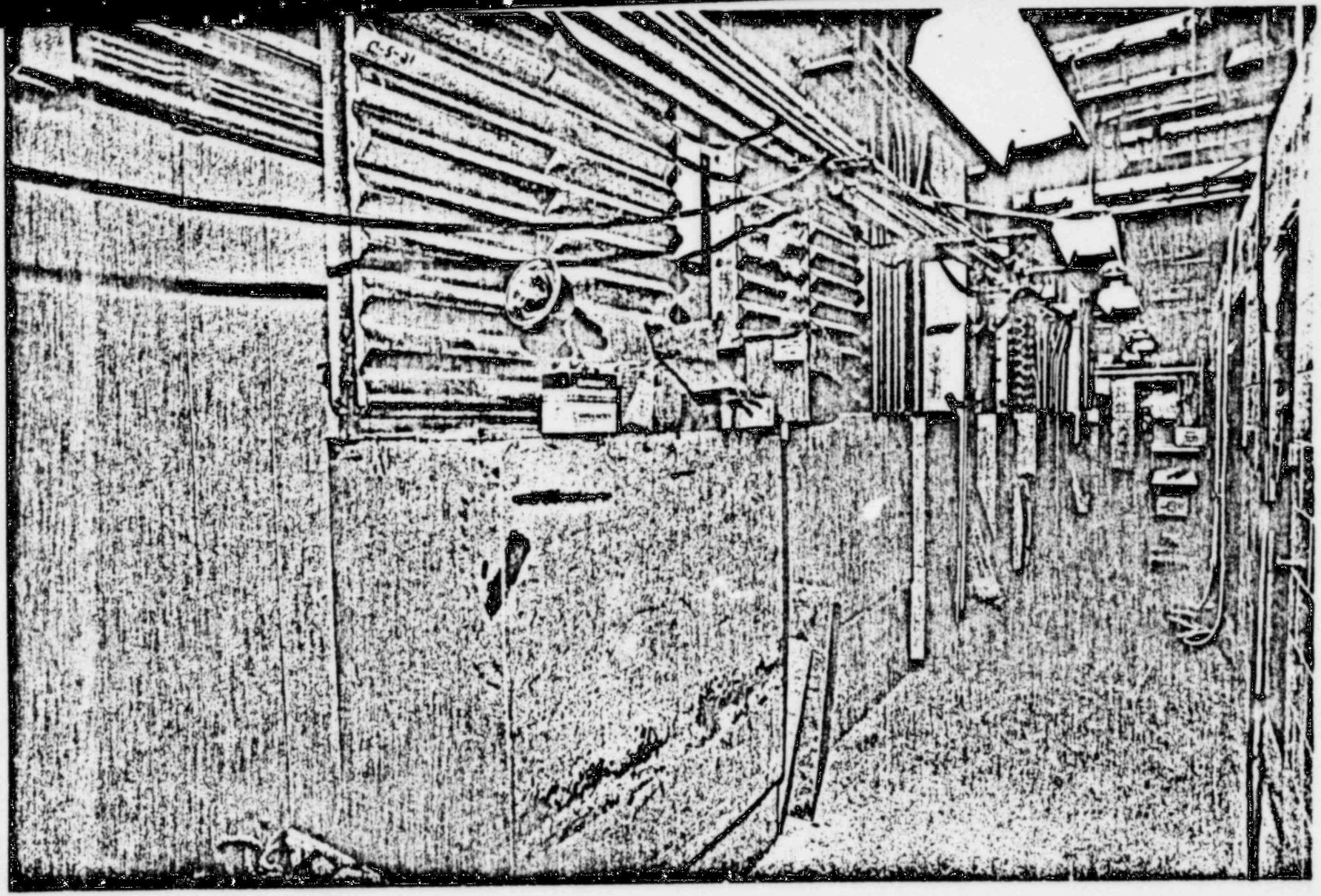


PHOTO #3

Passageway of cable spreading area.

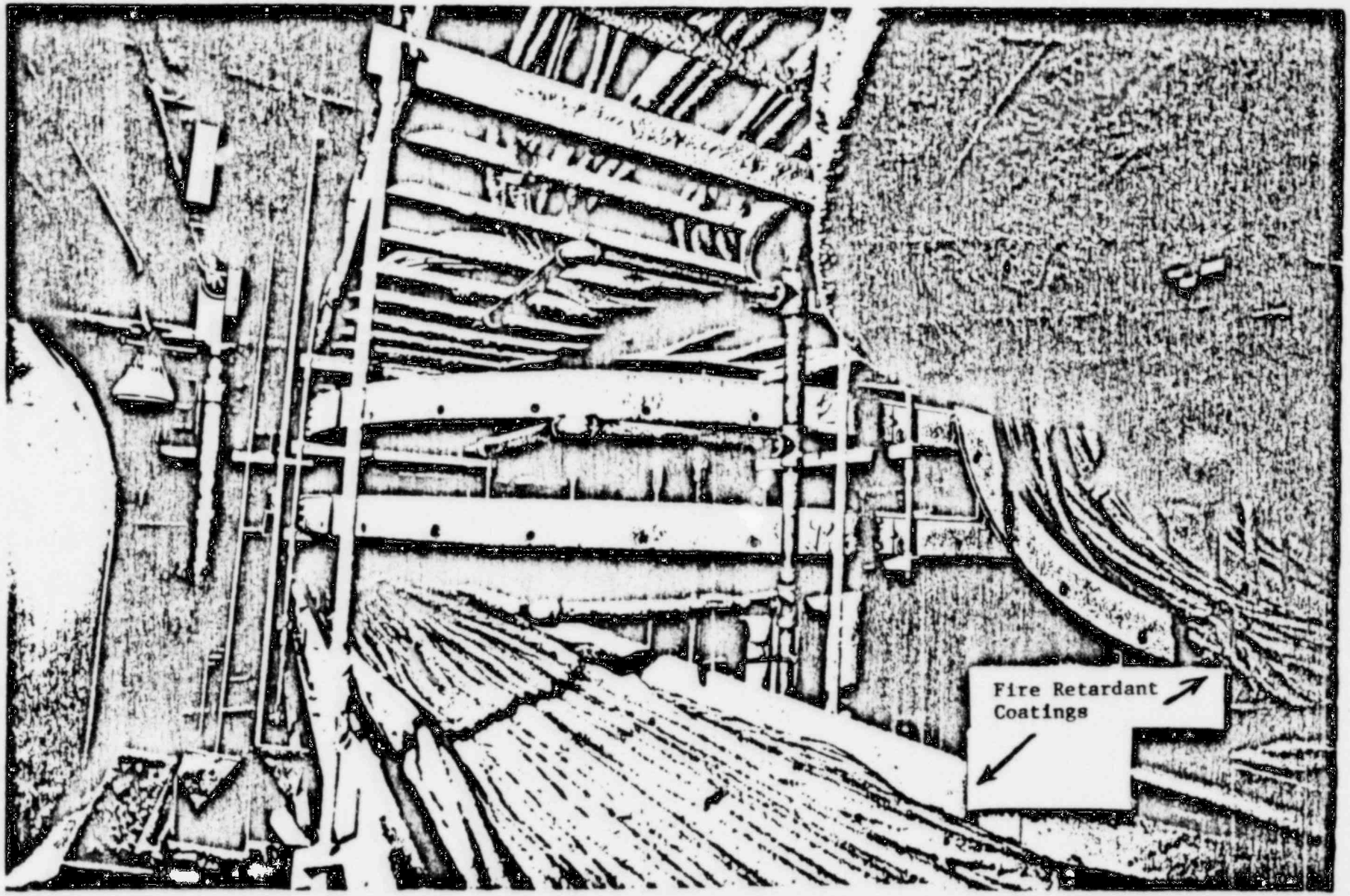


PHOTO #4

NOTE - Sprinkler System Design provides water directly between cable trays.

NOTE - Flammastic Fire Retardant coating on cables.

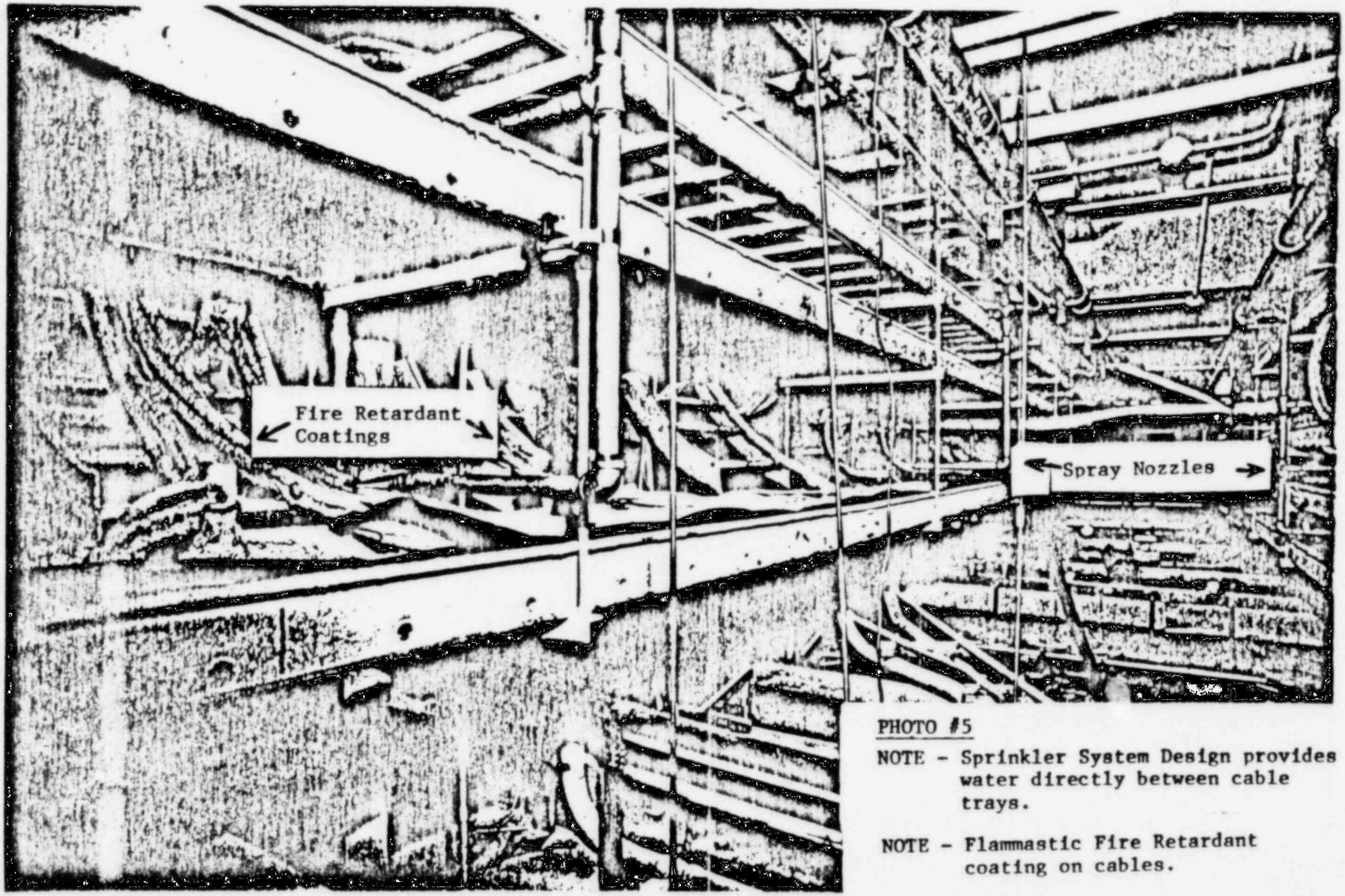
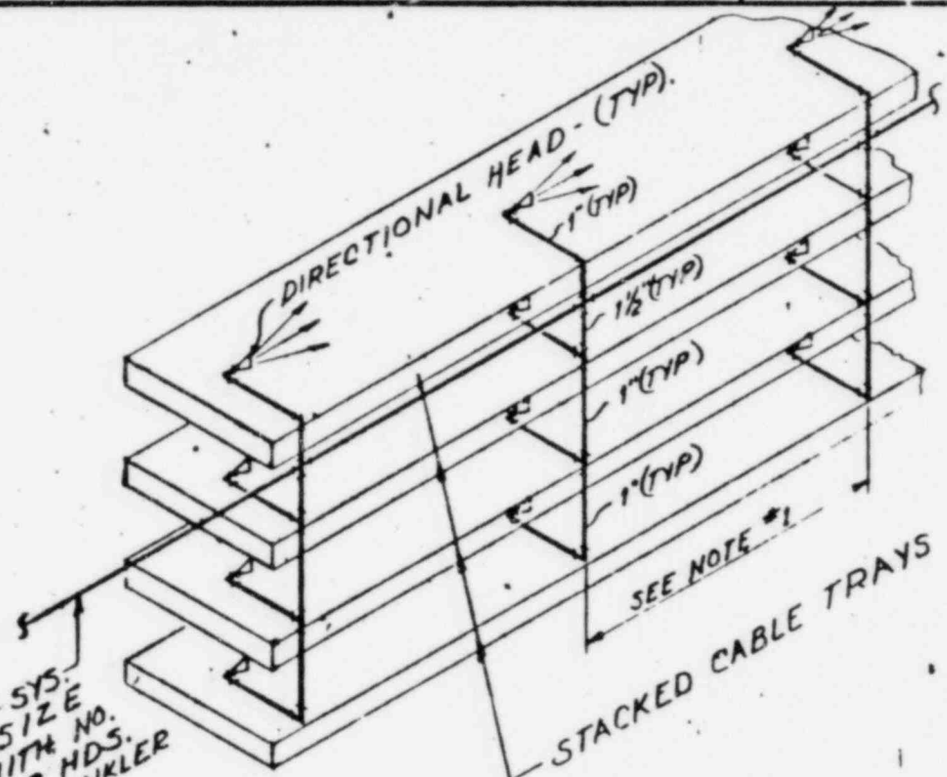


PHOTO #5

NOTE - Sprinkler System Design provides water directly between cable trays.

NOTE - Flammastic Fire Retardant coating on cables.



NOTES:

1) DISTANCE BETWEEN BRANCH LINES ≈ 10'-0". VARIES WITH SPR. HEAD COVERAGE AREA.
2) BRANCH LINES SHALL BE POSITIONED AS CLOSE TO CABLE TRAYS AS POSSIBLE.
3) GRINNELL TYPE EA-1 IS THE INTENDED SPRINKLER HEAD FOR THIS APPLICATION
4) THIS PIPING ARRANGEMENT IS TYPICAL OF ALL CABLE CONCENTRATION AREAS. INDIVIDUAL PIPE RUNS MAY VARY SLIGHTLY TO ACCOMODATE ACTUAL PLANT ARRANGEMENT.

REVISIONS DURING CONSTRUCTION	P.A.#
ISSUED FOR INFORMATION ONLY - NOT FOR CONSTRUCTION	

NO	P.A.#	DATE	REVISIONS	BY	CHK	APP	APP

NORTHEAST UTILITIES SERVICE CO.
for NORTHEAST NUCLEAR ENERGY CO.

TITLE FIRE PROTECTION CONCEPT FOR CABLE TRAY CONCENTRATIONS

BY SAH	CHKD JNG	APP'D [illegible]	APP
DATE 5/10/79	DATE 5/14/79	DATE 5/14/79	DATE
SCALE NONE	P.A.# 77-609	DWG NO. 5K-MP1-FP609-1	

Connecticut Yankee
Safe Shutdown Fire Zone Analysis

El. 21'6" Service Building

Fire Area Nos:
S-21 S-24
S-22 S-25
S-23 S-26
T-2

Safe Shutdown Equipment

Diesel fuel oil forwarding pumps, cables

Compliance with Appendix R

Subsequent to the docketing of Reference (1) and as a result of the meeting on May 13, 1982 with the NRC Staff, CYAPCO has re-evaluated the exemption requests for the above fire zones. It is CYAPCO's intention to complete modifications at the Haddam Neck Plant which eliminates the need for the diesel fuel forwarding pumps and as such, the power and control cables for these pumps in the seven (7) fire zones listed above.

This modification consists of installing a pipe connection between the outside diesel fuel storage tank to the diesel day tank suction line. This connection will provide a gravity feed flow to the diesel day tanks from the outside storage tank eliminating the diesel fuel forwarding pumps from the list of equipment required for safe shutdown. The flow rate from this connection is sufficient to supply adequate fuel to support diesel generator operation.

CYAPCO therefore withdraws the requests for exemption from III.G.2 of Appendix R for fire zones S-21, S-22, S-23, S-24, S-25, S-26 and T-2 as the diesel fuel forwarding pumps are no longer included in the safe shutdown concept for Appendix R at the Haddam Neck Plant.

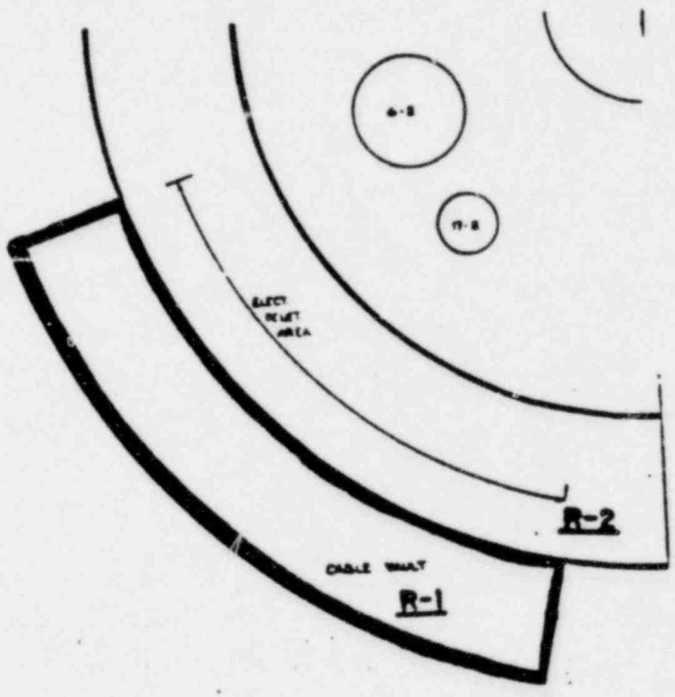
CONNECTICUT YANKEE
SAFE SHUTDOWN FIRE ZONE ANALYSIS

El. 5'6" to 21'6" Primary Plant
Containment Cable Vault

Fire Area No. R-1

Safe Shutdown Equipment

Reactor containment electrical penetrations
Cables for all safe shutdown electrical equipment inside containment pass through the cable vault.



Design Features

- The cable vault has reinforced concrete walls and roof.
- Roof construction is Class I.

Combustible Material

	Quantity (ft^3)	Fire Load (Btu/ft^2)
Cables	24	11,400

Fire Protection

- An automatic total flooding carbon dioxide system with additional reserve supply.
- Smoke detection equipment provided for both levels and alarms in the control room.
- Automatic fire dampers in the intake and exhaust ducts shut down on actuation of the carbon dioxide total flooding system.
- A 20 pound dry chemical extinguisher is located near the door in the upper level.
- A hose station in the service building can be used in this area.

Compliance with Appendix R

Does not comply with Section III.G.2 of Appendix R.

An exemption is requested from the separation requirements, with no intervening combustibles, of Section III.G.2.b of Appendix R for the safe shutdown cables.

Proposed Modification

1. Two (2) channels of safe shutdown instrumentation will be rerouted to provide physical separation as required by Appendix R, Section III.G.2.b with an exemption from the requirement for no intervening combustibles. The instrumentation circuits involved are pressurizer level, pressurizer temperature, pressurizer pressure, steam generator level and source range nuclear instrumentation.

2. Redundant cables (conduit runs) that have a physical separation less than 20 feet will be separated by a one-hour fire barrier in conformance with Section III.G.2.c of Appendix R.

Discussion

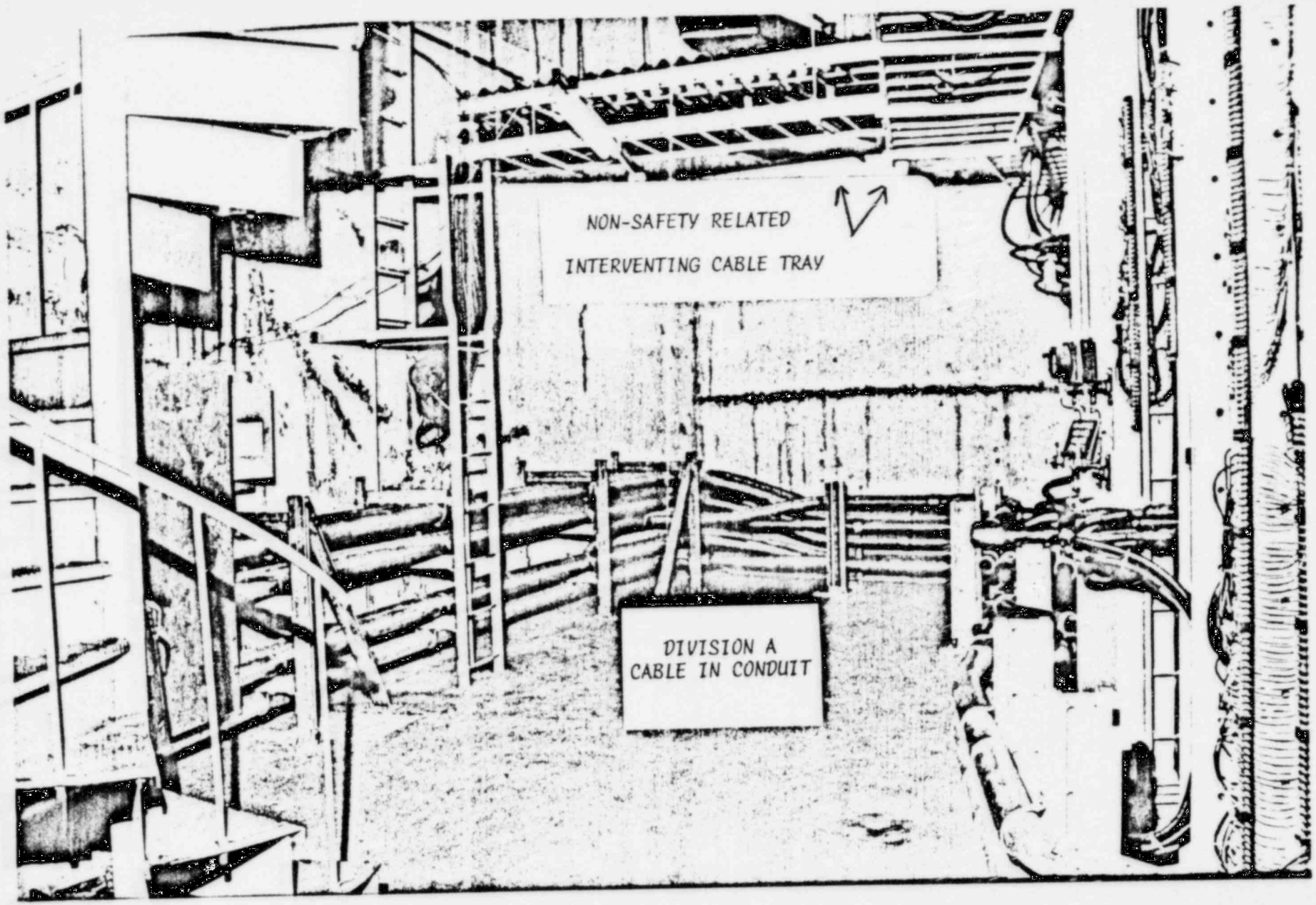
In 1980 the reactor containment electrical penetrations were replaced with new, fully qualified penetration modules. Safety related cables in the cable vault were replaced with IEEE-383 qualified cable, and the raceway system was rearranged in conjunction with the electrical penetration

replacement. All safety related cables exit the duct banks which carry cable from the turbine building, and enter the new raceway system. The new raceway system carries division A around one side of the cable vault in conduit, and carries division B around the other side of the cable vault in conduit. The safety related conduit systems have been located low in the cable vault to minimize the effects of a fire on the conduit system and to maximize the separation between the new safety related conduit system and the remaining non-safety related cables which are carried in trays near the ceiling. The non safety related tray system is approximately ten feet off of the floor and is separated from the safety related conduit systems by approximately six feet (see attached photo). Embers reaching the floor from an overhead fire do not pose a fire spread problem since they are essentially consumed by the time they drop from the tray. The metal conduit in which the safety related cables are located will afford shielding from the overhead trays. Separation for instrumentation cables at the penetrations is a minimum of 28 feet. With the separation distance, the vertical configuration, and the detection and and suppression systems, the overhead cables do not present an intervening combustible hazard. Similarly, these factors are the basis for the lack of an intervening combustible hazard along the penetration wall.

Reference Drawings

16103-34021, Sheet 2

16103-34021, Sheet 1 (FE46F)



CONTAINMENT

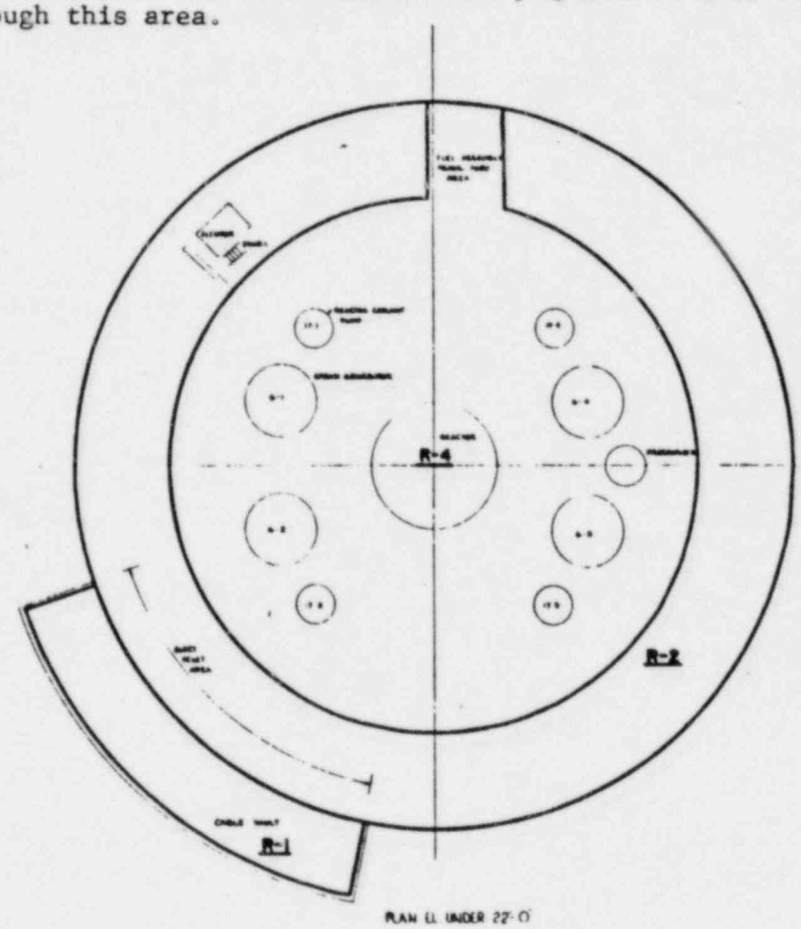
CABLE VAULT

CONNECTICUT YANKEE
SAFE SHUTDOWN FIRE ZONE ANALYSIS

El. 22'0" Primary Plant
Reactor Containment - Lower Annulus — Fire Area No. R-2

Safe Shutdown Equipment

Reactor containment electrical penetrations.
Cables for all safe shutdown electrical equipment located within the containment pass through this area.



Design Features

- The containment is a high integrity concrete and steel structure.

Combustible Materials

	Quantity	Fire Load (Btu/ft^2)
Cables	303 ft^3	45,100

Fire Protection

- Smoke detection located above electrical penetration and cable concentration areas.
- 125 lbs. dry chemical (Type ABC) wheeled extinguisher is located in annulus area.
- 20 lb. carbon dioxide extinguisher located at entrance to loop #4.
- Cables are in conduit or coated with fire retardant material.

Compliance with Appendix R

Compliance with Section III.G.2.f of Appendix R is achieved with implementation of proposed modification.

Proposed Modification

Two channels of instrumentation will be rerouted to provide physical separation as required by Appendix R, Section III.G.2.d.

Redundant cables (conduit runs) that have a physical separation less than 20 feet will be separated by a noncombustible radiant energy shield in accordance with Section III.G.2.f of Appendix R.

Discussion

With the implementation of proposed modification, the containment lower annulus/ electrical penetration area will comply with Appendix R as defined above.

Reference Drawings

16103-34021, Sheet 2

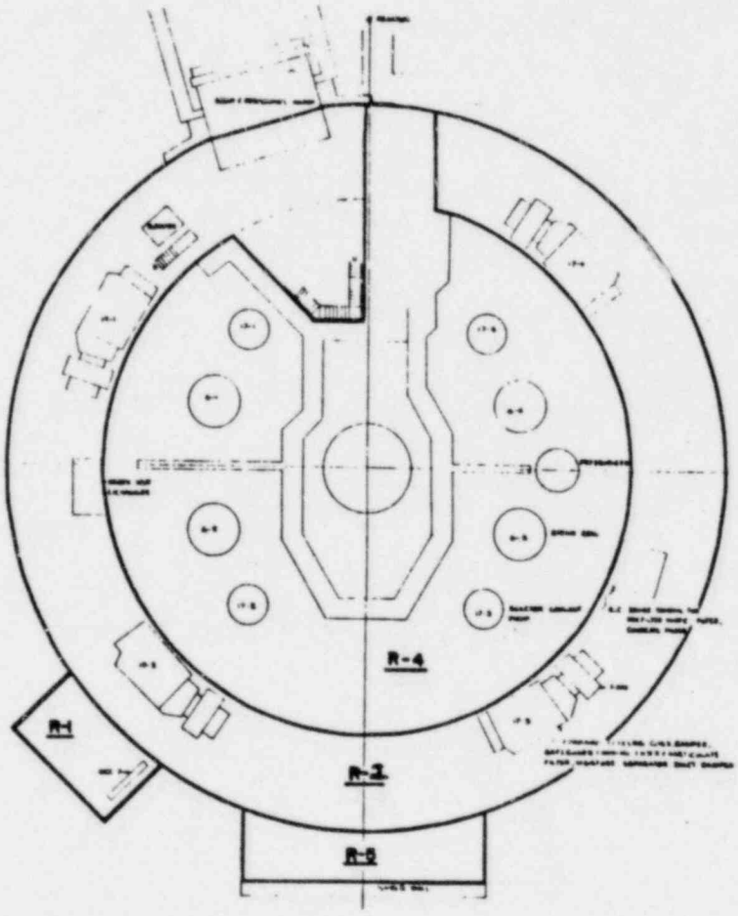
16103-34021, Sheet 1 (FE46F)

CONNECTICUT YANKEE
SAFE SHUTDOWN FIRE ZONE ANALYSIS

Primary Plant
Reactor Containment General Area — Fire Area No. R-4

Safe Shutdown Equipment

Equipment and cabling associated with RCS temperature, and source range nuclear instrumentation



Design Features

- The reactor coolant pumps and steam generators are in the four quadrants, separated from each other by at least 50 feet and by the concrete primary shield around the reactor.
- Each pump is equipped with an oil collection system to divert any dripping bearing oil to a tank and away from hot valves or steam lines that could ignite the oil.

Combustible Material

	Quantity	Fire Load (Btu/ft^2)
RCP bearing oil	225 gal. for each of four pumps	25,300

Fire Protection

- o There are 20 pound dry chemical and 20 pound carbon dioxide extinguishers strategically located throughout the reactor containment.
- o Fire detection equipment is located at each of the reactor coolant pumps.

Compliance with Appendix R

Full compliance with Section III.G.2 of Appendix R.

Proposed Modifications

None.

Discussion

Connecticut Yankee's primary containment is divided into quadrants by concrete walls that form the containment building. Inside each quadrant is a steam generator and required cables and instrumentation. Compliance with Appendix R is achieved because the cables and instrumentation associated with each steam generator required to reach cold shutdown are separated by a "radiant energy shield" and physical distance of about fifty feet in accordance with Section III.G.2.f.

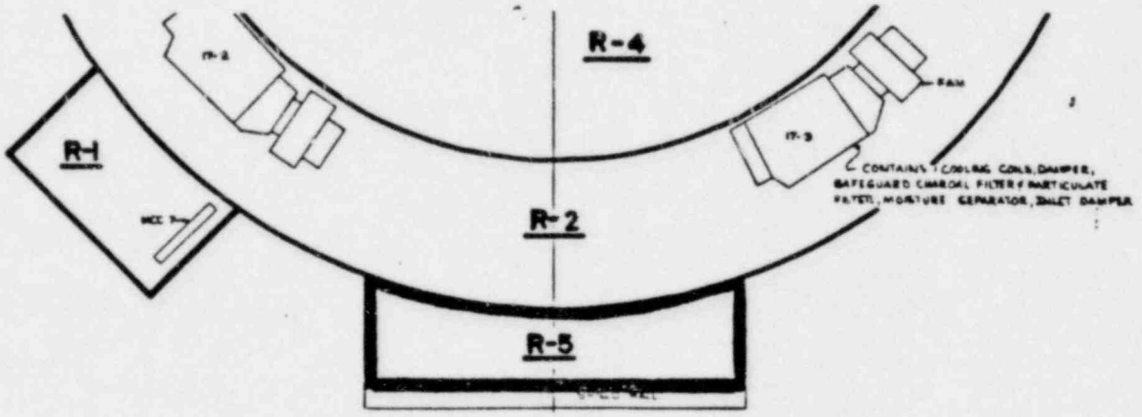
In addition, fire detection instrumentation is installed in the area of each reactor coolant pump. This provides an increased level of fire protection above and beyond that required by Paragraphs III.G.2.d and f of Appendix R to 10CFR50.

CONNECTICUT YANKEE
SAFE SHUTDOWN FIRE ZONE ANALYSIS

El. 21'6" Primary Plant
Auxiliary Feedwater Pump Room — Fire Area No. R-5

Safe Shutdown Equipment

Two (2) auxiliary feedwater pumps (hot shutdown)



Design Features

- The 12' x 60' room adjoins the reactor containment and has a ceiling elevation of about 20'.
- Room volume 14,400 ft^3.
- Ventilation - natural.
- The steam turbine driven pumps are located on the ground level.
- Floor is poured concrete.
- Walls and ceiling are corrugated steel.
- The room encloses steam lines, feedwater lines, steam flow instruments, and the controllers for the pumps.

Combustible Material

Negligible.

Fire Protection

- o There are dry chemical and pressurized water extinguishers in the service building passageway.
- o A 20 lb. carbon dioxide extinguisher is located inside the door to the cable vault.
- o The hose station in the service building can be utilized as a backup.

Compliance with Appendix R

Does not comply with Section III.G.2 of Appendix R.

In fulfillment of Provision 1a of Reference (2), an exemption is requested from automatic fire suppression requirement of III.G.2.b (see proposed modifications and discussion) for Fire Area No. R-5.

Proposed Modifications

Install early warning detection.

Discussion

This sheet metal building, separate from the main plant, provides limited accessibility. Traffic is restricted to those persons who have a specific job assignment in this area. Flammable/combustible liquids are not routinely introduced into this area.

Located in this building are two (2) steam driven auxiliary feed pumps and their air operated controls. A physical separation of 21' exists between the pumps with negligible intervening combustibles. Two (2) lube oil reservoir would result in the spillage of a maximum of one (1) gallon of lube oil, which does not represent a significant fire hazard.

An exemption from the automatic fire suppression requirement of III.G.2.b is requested because the automatic application of water to this pump area is not desirable. CYAPCO has performed stress analyses to determine what effect the application of fire water would have on an operating auxiliary feedwater pump turbine. The stresses resulting from the thermal shock caused by the fire water spray exceed code allowables creating the potential for turbine damage and loss of auxiliary feedwater. Other automatic fire suppression systems such as Halon or CO2 would be ineffective because gaseous agent concentrations could not be maintained. Further, the installation of an automatic fire suppression system would not significantly contribute to fire protection safety. Thus, pursuant to 10CFR50.48(c)(6), the exemption request is based, in part, on our assertion that the installation of an automatic water suppression system would not significantly enhance fire protection safety and could be detrimental to overall facility safety.

Because of the lack of in-situ combustibles, restricted access for transient combustibles, detection for early alarm and 21 feet of spatial separation, CYAPCO concludes that sufficient active and passive fire protection features have been provided and proposed to assure equivalent protection for this area.

Over and above the fire protection features discussed herein which we have determined provide equivalent protection for this area, it is noteworthy to mention the existance of an additional electric motor driven auxiliary feedwater pump. This pump is located in a completely separate enclosure from the auxiliary feedwater pump room. This pump is not safety grade or seismically and environmentally qualified. Of more relevance to Appendix R, it is not currently capable of being power form onsite emergency power sources and as such, cannot be credited in Appendix R evaluations. However, the availability of this pump is relevant to evaluating the merits of this exemption request.

In the event of a fire in the auxiliary feedwater pump room, it would not be expected that offsite power would be lost, as offsite power supply and distribution systems are independent of this fire area. Although not specifically allowed by Appendix R, this electric pump would be expected to be available. Its capacity of 1000 gpm is more that sufficient to fulfill safe shutdown requirements. This pump can be controlled from both the main control room and locally as required. The availability of this pump strengthens the basis for the exemption request, in the extremely unlikely event of a fire incapacitating both steam driven auxiliary feedwater pumps.

The Staff is referred to letters W. G. Counsil to D. M. Crutchfield, dated August 27, 1981 and D. M. Crutchfield to W. G. Counsil, dated November 20, 1981, for additional details and features of this system. The referenced correspondence relates to the Staff's TMI-related reviews of auxiliary feedwater systems.

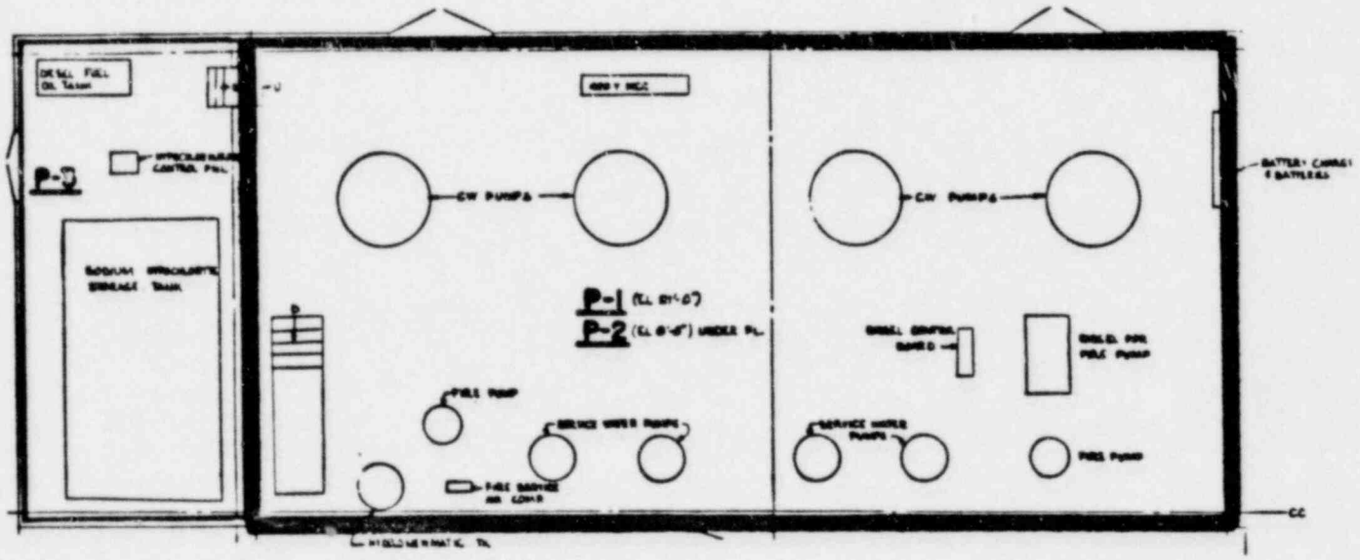
CONNECTICUT YANKEE
SAFE SHUTDOWN FIRE ZONE ANALYSIS

Elevation 21'0" + 8'0" Screenwell Pumphouse
Pump Motor Room

Fire Area No. P-1/P-2

Safe Shutdown Equipment

Service water pump (four)[hot shutdown].
Service water cables (in conduit).



Design Features

- The building floor and walls are concrete.
- The roof is a concrete slab with tar and gravel.
- 21'6" elevation - volume ~ 25,900 ft^3.
- 8'0" elevation - volume ~ 24,900 ft^3.

Design Features (continued)

- Ventilation - natural.
- Diesel fire pump is enclosed by curbing and is provided with drainage.
- Diesel fuel oil line is protected with guarded pipe.

Combustible Material

Insignificant.

Existing Fire Protection

- A hydrant house is located outside the building.
- There is a 20 lb. carbon dioxide extinguisher on the diesel fire pump control pump.
- A 20 lb. dry chemical extinguisher is on the north wall near the stairs.
- Early warning ionization detection is installed in both Fire Areas P-1 and P-2.
- Sprinkler protection is provided for the diesel fire pump.
- Diesel fire pump has a one foot high dike to contain any major diesel fuel oil spill.
- The dike area of the diesel fire pump has an independent drainage system.
- A hose station is located near the north door.

Compliance with Appendix R

Does not comply with Section III.G.2 of Appendix R.

In response to Provision 1a of Reference (2), an exemption is requested from the automatic suppression requirement of Section III.G.2.b of Appendix R (see proposed modifications and discussion) for Fire Area P-1 and Section III.G.2.c of Appendix R for Fire Area P-2.

Proposed Modifications

1. Provide curbing/diking to separate service pumps A & B from pumps C & D.
2. Enclose cable runs for service water pumps A & D at the 8'0" elevation to comply with the enclosure requirements of Section III.G.2.c.

Discussion

The screenwell pumphouse is a concrete structure located west of the main plant. The building consists of two elevations (21'6" and 8'0") and can be entered through card access doors at the 21'6" elevation. Access is limited to personnel who have specific job assignments in this area.

Located within the screenwell pumphouse are four (4) service water pumps (one required for safe shutdown), four circulating water pumps, two fire water pumps, and all associated valving and piping.

The four service water pump motors are all located side-by-side at elevation 21'6" as shown on Photo #1.

Please note service water pumps A & D are 23 feet apart. The specific exemption for this fire zone (P-1) is an exemption from the automatic suppression requirement of III.G.2.b.

At elevation 8'0" the power cables (enclosed in conduit) to the service water pumps all run in fire zone P-2. Proposed modification #2 will enclose the power cables of service water pumps A & D. The specific exemption for fire zone P-2 is an exemption from the automatic suppression requirements of III.G.2.c.

The screenwell pumphouse is relatively free of fixed combustibles. For fire zones P-1 and P-2 the only potential fire source is the diesel fire water pump (diesel fuel). The diesel fuel oil tank for this pump is located in fire zone P-3 and fuel is transferred to the fire pump through a guarded piping system. A guarded piping system involves a primary pipe encapsulated within a second pipe to assure no leakage. A one-foot high curb has been installed around the diesel fire pump and a drainage system installed around the diesel fire pump and a drainage system installed to assure that any fuel oil accumulation is removed. An automatic water suppression system has been provided for the diesel pump and curbed area. The noted modifications to the diesel fire pump are in accordance with CYPACO's SER Items 3.1.5 and 3.1.18.

The only other in-situ combustible that can burn would involve an electric motor fire. Because of the physical spacing of service water pump motors A & D with no intervening combustibles, it was concluded that such a fire could not affect more than one pump.

The above discussion focused on in-situ combustibles and concluded that in-situ combustible hazards have been properly addressed.

Proposed modification #1 is intended to prevent a flammable/combustible liquids spill form damaging both redundant service water pumps A & D. This modification to install a dike/curb is shown on attached Sketch 1.

Sectionalizing through curbing and existing drainage does assure that redundant service water pumps A & D will not be damaged by the postulated transient liquid type fire. Proposed modification #2 is intended to provide protection to service water cables at the lower elevation 8'0". The cables to service water pumps A & D will be enclosed in accordance with Appendix R Section III.G.2.c. Please note in attached Photo #2 that there is negligible combustible loading in this fire zone.

In addition to fire protection features discussed above and those proposed, the screenwell pumphouse also has an ionization detection system in accordance with CYAPCO's SER Item 3.1.1. A water hose station was also installed in this area per CYAPCO's SER Item 3.1.4.

CYAPCO requests an exemption to the automatic suppression requirement for both fire zones P-1 and P-2. Automatic suppression systems involving gaseous agents would not be effective because gas concentrations could not be maintained. Water suppression would be effective but indiscriminately spraying water throughout the screenwell pumphouse is not desirable because of electric motors and fire pump controller equipment.* CYAPCO concludes that automatic suppression could only provide marginal protection. Ionization detection would provide early alarm and manual fire extinguishment would be performed by fire brigade. A summary of those features that contribute to equivalent protection for this area is a follows.

1. Negligible in-situ combustibles.

2. Adequate physical separation.

3. Proposed curb/dike would restrict flammable liquid spills.

4. Enclosing conduit runs in one hour rated barriers for service water pumps A & D provides partial compliance with Section III.G.2.c.

5. Ionization detection is installed in both Fire Areas P-1 and P-2.

6. Restricted traffic-card access--separate building.

7. Diesel fire pump has a water suppression system.

8. Diesel fire pump has a one foot curb with drainage.

9. Hose station has been installed within the building.

CYAPCO concludes that with the incorporation of the proposed Appendix R modifications, and the existing features noted above, equivalent protection has been provided. Strict compliance with the requirements of Section III.G.2.b or c of Appendix R would be deterimental to overall facility safety. Therefore this exemption is requested with particular emphasis on 10 CFR 50.48(c)(6).

Reference Drawings

FE 53A 16103-34028

*Attached please find a report addressing the spraying of water on or near service water pump motors.

USE OF SPRINKLER SYSTEM IN VICINITY OF SERVICE WATER PUMP MOTORS AT CONNECTICUT YANKEE

This position paper represents Connecticut Yankee Atomic Power Company's (CYAPCO's) position with respect to the use of fire protection sprinkler systems in the vicinity of the Service Water Pump Motors at Connecticut Yankee. These motors have a drip-proof type of enclosure.

National Electric Manufacturers Association (NEMA) Standards provide guidelines with respect to electrical equipment including motors and generators. NEMA-MG 1-1.25 (Classification According to Environmental Protection and Methods of Cooling) specifically states:

> "A. Drip-Proof Machine
>
> A drip-proof machine is an open machine in which the ventilating openings are so constructed that successful operation is not interfered with when drops of liquid or solid particles strike or enter the enclosure at any angle from 0 to 15 degrees downward from the vertical.*"

The footnote accompanying this definition describes a means to test for acceptability of an enclosure design as follows:

> "* A method for demonstrating successful operation is: (1) by exposing the machine, with the motor at rest, to a spray of water at the specified angle and at a rate no greater than 1 inch per hour for 1 hour, and (2) after exposure, by subjecting the windings to a high-potential test of 50 percent of the normal high-potential test followed by a 15-minute no-load operation at rated voltage.

The key points to consider are:

A) The angle of water impingement on the enclosure is important - a drip-proof enclosure limits that angle to 15 degrees off the vertical.

B) The proof test is conducted on a new motor which will inherently have a more tightly sealed winding than one that has operated for an extended period and,

   1) Is conducted with the motor at rest, and

   2) With a drip rate which would amount to a one inch accumulation of water per hour, that rate continued for a period of one hour, and,

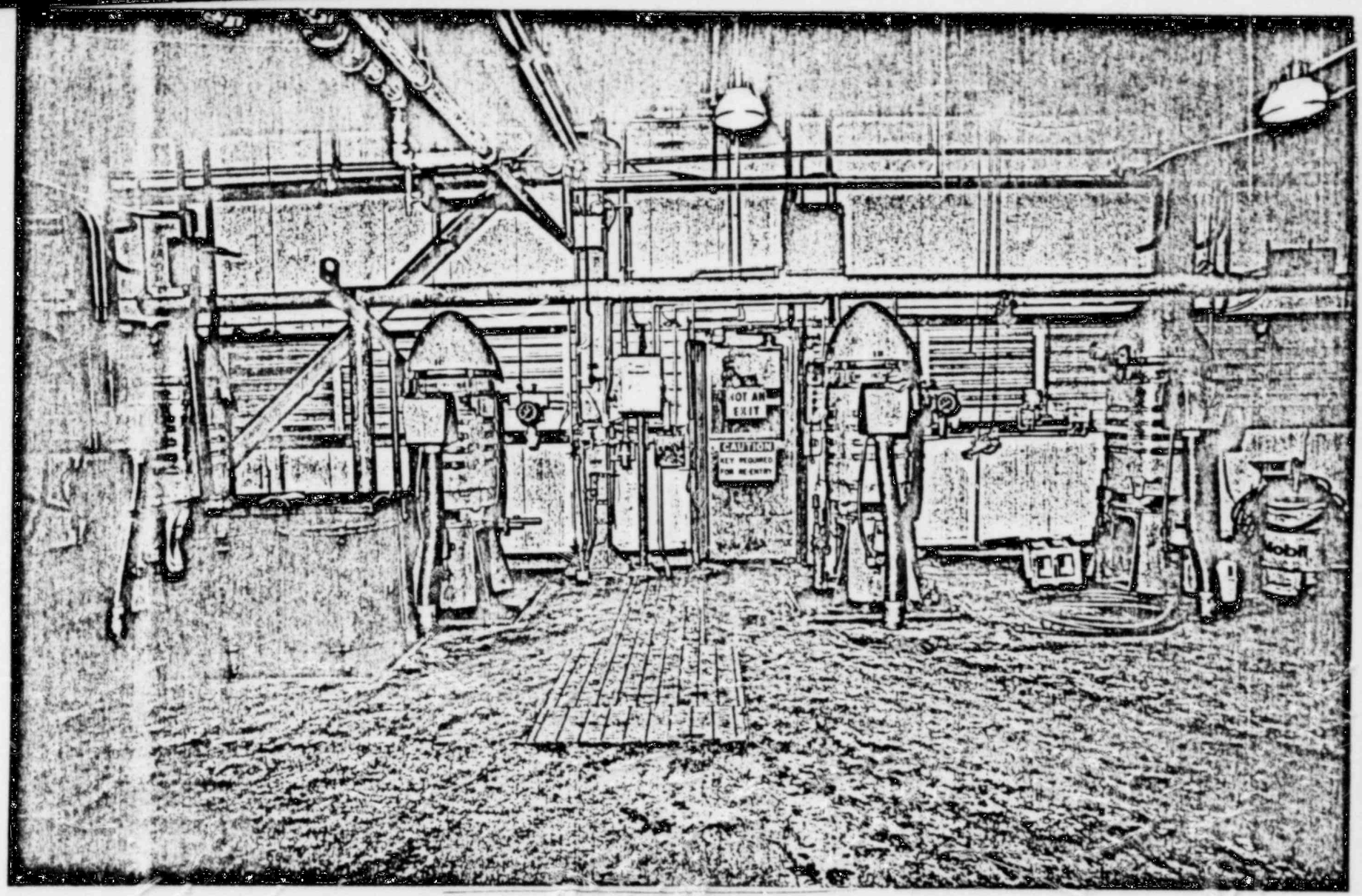
   3) The subsequent high potential test is conducted at a value equal to 50% of the normal "Hy-Pot" value.

From the above it is evident that a drip-proof enclosure is not very protective of the electrical winding which is extremely sensitive to moisture. It is conceivable that with a high enough room ceiling, a sprinkler system could be designed which results in a near-vertical spray impinging upon the motor, however, this is not the case at Connecticut Yankee.

General Electric (G.E.) in Schenectady, New York, was contacted to seek an opinion on the advisability of installing sprinklers near motors with drip-proof enclosures. G.E. indicated that they would not provide a drip-proof motor for an application where a sprinkler system is used. They would recommend a weather-protected Type II enclosure for this application, and, with careful consideration of the sprinkler system design, would possibly agree to the use of a weather-protected Type I design. (See attached NEMA excerpts for definition of these enclosure types.)

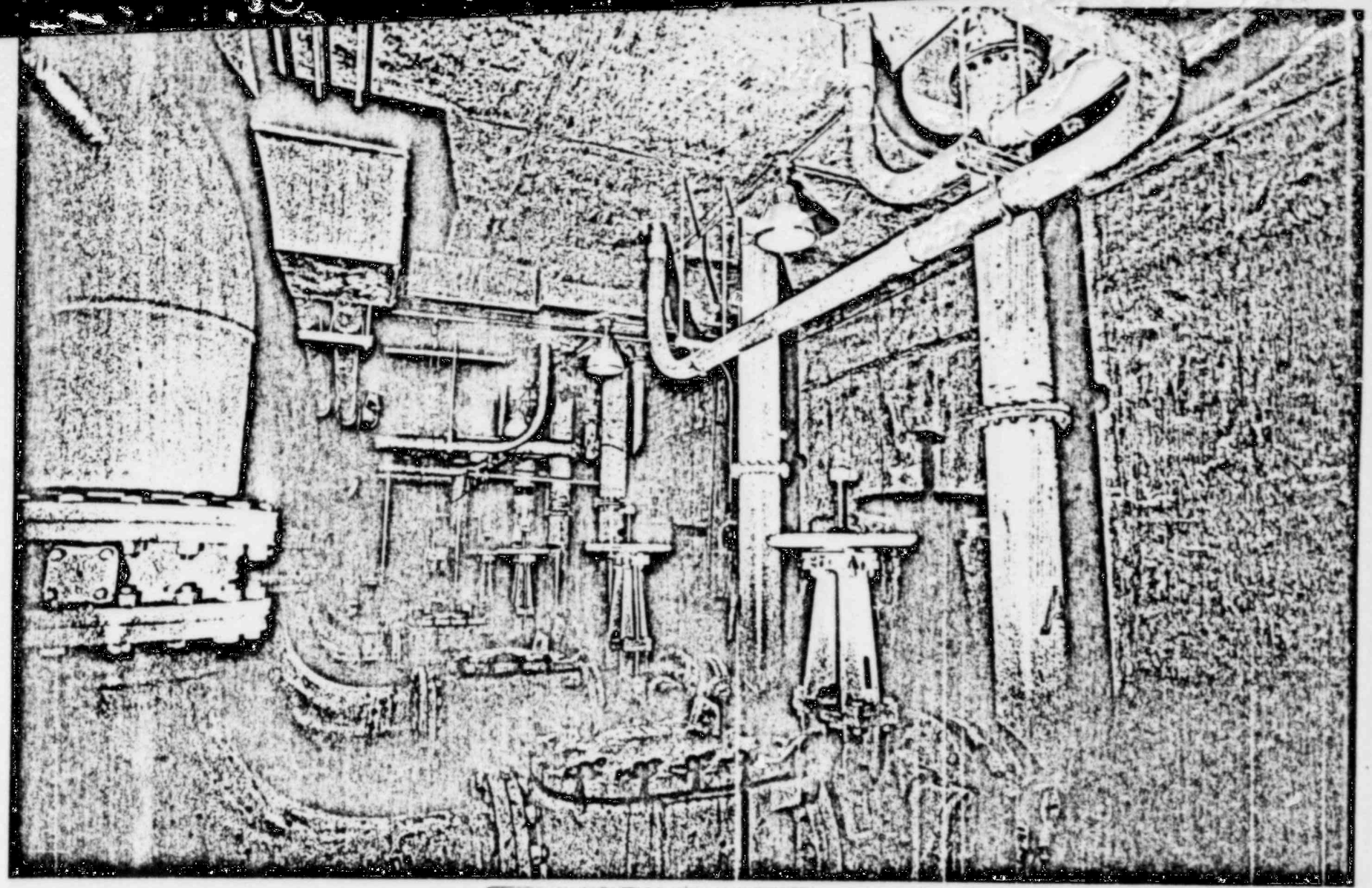
In summary, there is considerable evidence which highlights the inadvisability of using sprinkler systems in the vicinity of motors of the type used in the service water pump application at Connecticut Yankee. It is incumbent upon CYAPCO to assure the continued operability of at least one of the service water motors during and following all events including fires and water sprays. It is CYAPCO's conclusion that the net effect would be to create a negative safety impact if we were to comply with the requirements of Appendix R and install a water suppression system in this fire area. Use of any other suppression agent is not feasible for this application.

In reaching this conclusion, CYAPCO recognizes that fire brigade members may by design or inadvertently spray water on to service water pump motors in the process of fighting a fire in this area. While such circumstances may render one or more pumps inoperable, this potential does not support installation of a water suppression system which, by design, has a high potential for rendering inoperable all four service water pumps. In evaluating this issue, many other factors beyond the fire protection area must be considered. An evaluation from this broader perspective is a crucial input in arriving at our conclusion as stated above.

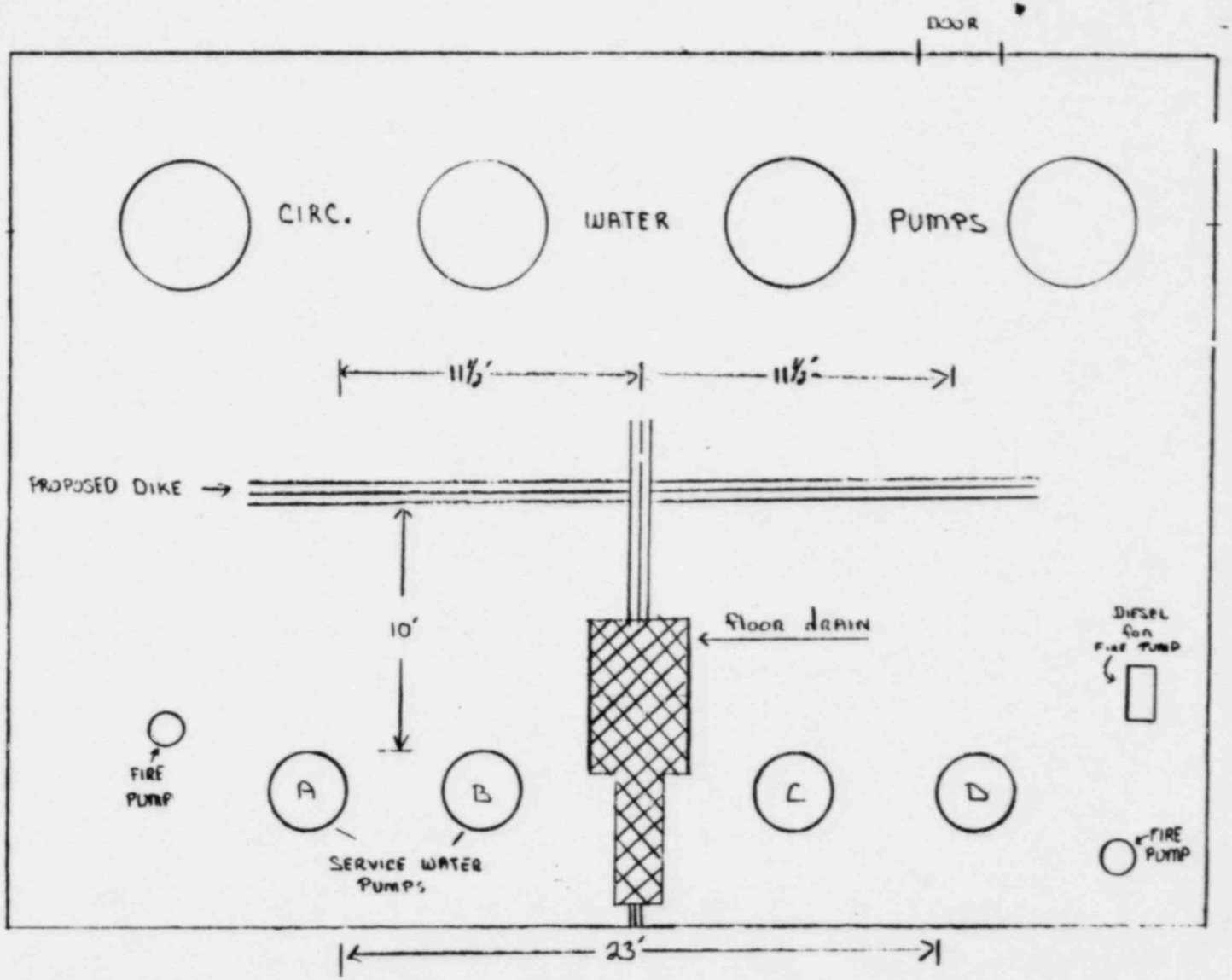


SCREENWELL PUMP HOUSE - FIRE ZONE P-1
ELEVATION 21'0"

Service Water Pumps



SCREENWELL PUMP HOUSE - FIRE ZONE P-2
ELEVATION 8'0"



JOSEPH McHRITT & CO.

NO	DATE	REVISIONS	BY	CHK	APP	APP

NORTHEAST UTILITIES SERVICE CO.

FOR

TITLE

CONN. YANKEE

SCREENWELL PUMPHOUSE - P1/P2

SCALE	BY TNP	CHKD	APP
P.A.#	DATE 6.1.83	DATE	DATE
DWG NO		APP	APP
		DATE	DATE

CONNECTICUT YANKEE
SAFE SHUTDOWN FIRE ZONE ANALYSIS

Elevation 8'0"
Service Water Pump Cable Duct Bank

Safe Shutdown Equipment

Service Water Pump Cables in conduit.

Discussion

Service water pump power cables run in conduit in a duct bank from the turbine building to the screenwell pumphouse at elevation 8'0". The cables are contained in conduit throughout the run with the exception of one area where access is provided through a manhole for the purposes of cable pulling. This duct bank has previously not been identified as a fire area under the reviews required for Appendix R.

CYAPCO requests an exemption from the requirements for automatic suppression and detection required by Section III.G.2.c of Appendix R for the service water duct bank between the turbine building and the screenwell pumphouse.

The basis for CYAPCO's exemption request is that it is not credible to postulate a fire wherein the four service water pump cables, located in separate conduits several feet underground, would become inoperable. In the manhole area where the cabling is exposed for cable pulling purposes, CYAPCO will provide one hour rated barriers around one set of redundant cables.

APPENDIX B

FIRE RETARDANT COATING
FLAME TESTING RESULTS

DOCKET NO. 50-213

JULY, 1982

Kerite Flame Testing

It is CYAPCO's contention that cabling coated with Flamemastic is equivalent to IEEE-383 cable with regards to ignition and fire propogation characteristics.

To support this postiion, the following information is provided which describes how Flamemastic protects cables and the flame tests conducted on cable and raceway systems typical of those found at the Haddam Neck Plant.

Flamemastic is composed of a polyvinyl acetate binder, flame retardant additives and inorganic fillers and fibers. The polyvinyl acetate binder forms a tough, weather-resistant, permanent coating that ensures that fire protective coating will be in place when needed. The fire retardant additives include antimony oxide, chlorinated hydrocarbons and a phosphate plasticizer. These materials function synergistically to inhibit the flammability of the binder and all flammable substrates to which the coating is applied.

When exposed to a fire, the coating functions as a heat and fire barrier through a combination of the following processes:

1. An ablative process, consisting of dehydration and other endothermic chemical reactions coupled with the formation of a carbonaceous char, reduces the heat transmission to the protected object.

2. The carbonaceous char and the inorganic components of the coating form a surface of high heat emmissivity that results in the radiation of a significant amount of heat away from the protected object.

3. Although the coating has been designed to offer limited insulation at room temperature in order to minimize ampacity derating effects on cables, it functions as an effective heat insulator at high temperatures to reduce the heat transferred to the protected object.

4. The fire retardant additives form products in the fire which inhibit the combustion process and minimize the flammability of materials in the vicinity of the fire.

5. The coating itself and the inorganic fibrous residue that remains after the organic binder has been pyrolized form a barrier that effectively prevents the access of oxygen to the flammable materials that are being protected.

Basically, Flamemastic protection involves the encapsulation of cabling with a coating that will not propagate flame, that is, it will not burn in the ordinary sense of the term. Flamemastic prevents the process that allows "non-burning" cables to support each others combustion when grouped in trays or bundles.

In addition, CYAPCO commissioned testing at the Kerite Company to demonstrate that cables and raceways would not propogate a fire when exposed to an IEEE - 383 (1974) flame source.

The cables used were 7/C #12 and 4/C #10, 1,000 V polyethylene insulated conductors and PVC jacketed cables which are representative, in every respect, of the type of cable orignally installed at the Haddam Neck Plant.

The cable/tray arrangement used for the tests was also typical of those arrangements found at the Plant. Two layers of 10 feet lengths of test cable were mounted in the tray with no cable spacings in between. Each layer consisted of fifteen cables, half from each conductor make-up, placed in alternating sequence, for a total of thirty cables. The following tray arrangements were used in the tests.

A) Steel vent rib tray, uncovered

B) Steel vent rib tray, with vent rib covers

C) Steel vent rib tray, with solid bottom covers

D) Steel vent rib tray, with solid top and bottom covers.

Arrangement B, C, and D were tested with and without the application of Flamemastic. Additionally, the location of the flame source was changed so that it would impinge on both the top and the bottom of the tray for different tests.

A 240 V power source was used to monitor the electrical integrity of the cables during the tests. Six cables were chosen at random for each test, three from each layer, and they were energized with the 240 V power source.

The only substantive difference between the standard test procedure (IEEE 383) and the Kerite tests was the cable spacing in the tray. CYAPCO has determined that the cable spacing arrangement for the tests is more representative of actual plant conditions and is therefore, more realistic. Additionally, approximations to installed conditions are permitted by the standard.

Attached is a summary of the flame tests conducted for CYAPCO. It has been concluded from the test results that PE/PVC cables coated with Flamemastic do not propagate a fire when exposed to an IEEE Standard 383 flame source, that the physical damage sustained by a coated cable is equal to or less than that sustained by an uncoated 383 cable and that, therefore, in a fire event, coated cables, should be considered the equal of uncoated IEEE Standard 383 qualified cables.

Attached are the reports of two flame tests conducted by Kerite. Photographs of the testing are also provided. The Reference No. 3 test was conducted with cables and raceways coated with Flamemastic. The Reference No. 8 test did not include any Flamemastic coating. Table 1 presents a summary of the results of these two tests.

FIRE PROTECTION - APPENDIX "R" - HADDAM NECK PLANT CABLES

CERTIFIED FLAME TEST REPORTS

SUMMARY TABLE

[Cable Size/Type - 7C #12 & 4C #10/1 KV, PE - PVC]

Tray	Flamemastic	Test #	Flame Source	Auto Ignition	Damage	Breakdowr (G)
A	N	1	Back L	Y	31"	4 minutes
A	N	1A	Back	Y	31"	19 "
B	N	8	Front	Y	Total	4 "
B	Y	3	Front L	Y	48"	9 "
B	Y	3A	Front	Y	46"	19 "
B	Y	2	Back L	Y	29"	15 "
B	Y	2A	Back	Y	33"	6 "
C	N	4	Back	N	18"	None
C	N	4A	Back	N	18"	None
C	Y	5	Back	N	None	None
C	Y	5A	Back	N	21"	None
D	Y	9	Front L	N	6"	None
D	N	6	Back	N	18"	None
D	N	6A	Back L	N	21"	None
D	Y	7	Back L	N	5"	None
D	Y	7A	Back	N	13"	None

G - Line to ground
H - High Temperature > 1500°F
L - Low Temperature < 1250°F
N - No; Y - Yes

the kerite company

REPORT ON FLAME TEST CONDUCTED ON CABLE AND RACEWAY SYSTEM

October 19, 1977

TEST NO. 77 VG-48-C
Ref. No. 3

A. OBJECTIVE

The objective of this flame test is to demonstrate that the cable and raceway, as tested, will not propagat e a fire when exposed to an IEEE 383-74 flame source.

B. CABLE AND RACEWAY TESTED

7/c #12 and 4/c #10, 1 KV, polyethylene insulation, PVC jacketed cable installed in a steel vent tray with a steel rib cover (to simulate vent rib tray). The cables, tray, and cover were coated with Flamemastic.

C. TEST FACILITY

The test was conducted on September 6, 1977 at The Kerite Company Fire Test Facility. An American Gas Furnace Company ten-inch wide ribbon burner was used to provide the flame source. A direct readout Omega pyrometer was used in conjunction with a thermocouple to monitor flame temperature throughout the test. A laboratory timer was used to measure the duration of the test. The test specimen was installed in the 12-inch wide, 3-inch deep, 11-foot high tray. A 240 volt power source was used to monitor the electrical integrity during the test.

D. TEST PROCEDURE

Two layers of 10 foot lengths of test cable were mounted in the tray with no cable spacings. Each layer consisted of 15 cables, half from each make-up, placed in an alternating sequence, for a total of 30 cables. Six cables were chosen at random, three from each layer, and energized with the 240 volt power source.

The flame source was adjusted so that the temperature was approximately 1500° F and approximately 15 inches in length. Under dynamic conditions, the following manometer readings were recorded for both air and fuel in centimeters of water:

Air	Fuel
4.7	2.8

These pressures were measured for both air and fuel at the inlet of the mixer.

The flame source was placed on the front side of the tray at a three-inch distance from the cables and allowed to burn for twenty minutes. At the end of twenty minutes, the flame source was shut off and the cables allowed to burn until they self-extinguished or were totally consumed. All pertinent data was recorded. The temperatures indicated in the next section were measured by a thermocouple located 2-7/8" from the burner face.

E. TEST DATA

1.	Time for specimen to ignite:	Within the first three minutes
2.	Time specimen continued to burn after removal of flame source:	5 minutes
3.	Maximum length of sample damage:	48 inches
4.	Time for electrical breakdown:	9 minutes, 33 seconds (line one to ground)
5.	Heat input	61,300 BTU/hr.

(E - Test Data - Continued)

6.

Minutes	Flame Impingement Temperature (° F)
Start	1400
1	1450
2	1350
3	1300
4	1250
5	1250
6	1250
7	1250
8	1250
9	1250
10	1250
11	1250
12	1250
13	1250
14	1250
15	1250
16	1250
17	1250
18	1250
19	1250
20	1250

F. ATTESTATION

The above test was personally witnessed by the undersigned and the data presented above is accurate and complete to the best of my knowledge and belief.

John V Osborn
John V. Osborn, Technician

JVO:mc

APPROVED Paul D. Basconi
Paul D. Basconi, Mechanical Eng.

Subscribed and sworn to before me this 25 day of October, 1977.

Jane Hill
Notary Public

My Commission
Expires March 31, 1979

the kerite company

REPORT ON FLAME TEST
CONDUCTED ON CABLE AND RACEWAY SYSTEM

October 19, 1977

Test No. 77 VG 58-C
Ref. No. 8

A. OBJECTIVE

The objective of this flame test is to demonstrate that the cable and raceway, as tested, will not propagate a fire when exposed to an IEEE 383-74 flame source.

B. CABLE AND RACEWAY TESTED

Seven conductor No. 12 and four conductor No. 10, 1 KV, polyethylene insulation, PVC jacketed cable, installed in a steel vent tray with a vent rib cover (to simulate steel vent rib tray).

C. TEST FACILITY

The test was conducted on September 9, 1977 at The Kerite Company Fire Test Facility. An American Gas Furnace Company 10-inch wide ribbon burner was used to provide the flame source. A direct readout Omega pyrometer was used in conjunction with a thermocouple to monitor flame temperature throughout the test. A laboratory timer was used to measure the duration of the test. The test specimen was installed in a 12-inch wide, 3-inch deep, 11-foot high tray. A 240 volt power source was used to monitor the electrical integrity during the test.

D. TEST PROCEDURE

Two layers of 10 foot lengths of test cable were mounted in the tray with no cable spacings. Each layer consisted of fifteen cables, half from each makeup, placed in an alternating sequence, for a total of thirty cables. Six cables were chosen at random, three from each layer, and energized with the 240 volt power source.

Test No. 77 VG 58-C
Ref. No. 8

The flame source was adjusted so that the temperature was approximately 1500°F and approximately 15 inches in length. Under dynamic conditions, the following manometer readings were recorded for both air and fuel in centimeters of water:

Air	Fuel
4.5	2.9

These pressures were measured for both air and fuel at the inlet of the mixer.

The flame source was placed on the front side of the tray at a 3-inch distance from the cables and allowed to burn for twenty minutes. At the end of twenty minutes, the flame source was shut off and the cables allowed to burn until they self-extinguished or were totally consumed. All pertinent data was recorded. The temperatures indicated in the next section were measured by a thermocouple located 2 7/8" from the burner face.

E. TEST DATA*

1. Time for specimen to ignite:	Within the first three minutes.
2. Time specimen continued to burn after removal of flame source:	Was not recorded.
3. Maximum length of sample damage:	Cable samples totally consumed.
4. Time for electrical breakdown:	4 minutes, 45 seconds (Line two to ground) 5 minutes, 1 second (Line one)
5. Heat input	63,000 BTU/hr.

*Because of the severity of the smoke and fire, the test was halted at 15 minutes.

(Test Data cont'd)

6.

Minutes	Flame Impingement Temperature (^{o}F)
Start	1450
1	1150
2	1150
3	1225
4	1250
5	1250
6	1225
7	1225
8	1275
9	1275
10	1225
11	1225
12	1300
13	1350
14	1400
15	1450

F. ATTESTATION

The above test was personally witnessed by the undersigned and the data presented above is accurate and complete to the best of my knowledge and belief.

John V. Osborn
John V. Osborn, Technician

JVO/dm

APPROVED Paul D. Basconi
Paul D. Basconi, Mechanical Engineer

Subscribed and sworn to before me this 25 day of October, 1977.

Jane Hill
Notary Public
My Commission
Expires March 31, 1979

TABLE I

FIRE PROTECTION - APPENDIX "R"; HADDAM NECK PLANT

CERTIFIED FLAME TEST REPORTS (KERITE)

COMPARATIVE SUMMARY TABLE

	IEEE Standard 383 (1974)	Test Reference No. 3	Test Reference No. 8
Grouped Cables	Yes	Yes, 30 samples	Yes, 30 samples
Cable Spacing	1/2 diameter	None	None
Cable Type	Table 1	PE/PVC	PE/PVC
Cable Sizes	" "	7/C #12 & 4/C #10	7/C #12 & 4/C #10
Cable Coating	-	Flamemastic	None
Vertical, Metal, Ladder Tray	Yes	Simulated	Simulated
Tray Dimensions	3" D X 12" W X 8' L	3" D X 12" W X 11' L	3" D X 12" W X 11' L
Power Source	-	240 V	240 V
Ribbon Gas Burner	Yes	Yes	Yes
Propane	Yes	Yes	Yes
Gas Pressure (cm H20)	2.6 ± 0.3	2.8	2.9
Air Pressure (cm H20)	4.3 ± 0.5	4.7	4.5
Flame Length	15"	15"	15"
Flame Temperature (Max.)	1,500°F	1,450°F	1,450°F
Burn Time	20 mins.	20 mins.	15 mins.*
Thermocouple (Dist. from Burner	2 7/8"	2 7/8"	2 7/8"
Time for Specimen to Ignite		3 min.	3 min.
Specimen Burnout Overtime		5 min.	- *

*Because of the severity of the smoke and fire, the test was halted at 15 minutes.

TABLE 1

FIRE PROTECTION - APPENDIX "R"; HADDAM NECK PLANT
CERTIFIED FLAME TEST REPORTS (KERITE)
COMPARATIVE SUMMARY TABLE

	IEEE Standard 383 (1974)	Test Reference No. 3	Test Reference No. 8
Maximum Length of Specimen Damage		48"	Total
Time for Electrical Breakdown (L-G)		9 mins. 33 secs.	4 mins. 45 secs.
Heat Input		61,300 BTU/hr.	63,000 BTU/hr.
Evaluation	Pass/Fail	Cable Passed	Cable Failed

6/9/82

APPENDIX C
INTERVENING COMBUSTIBLES

DOCKET NO. 50-213

JULY, 1982

GENERAL POSITION ON INTERVENING COMBUSTIBLES

Appendix R, Section III.G.2.b provides an NRC acceptable option which will assure that one redundant safety train is free of fire damage. It states:

> "Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area."

The intent of this option is obvious--provide assurance that a fire cannot spread to redundant safety divisions by propagating through the mechanism of intervening combustibles.

The term "intervening combustibles" has not, to our knowledge, been specifically defined in any NRC publications, either in the form of regulation or guidance documents. In absence of clear definitions or guidelines on the subject of intervening combustibles, it was necessary for CYAPCO to develop and apply its own methods and criteria for utilizing Option III.G.2.b of Appendix R.

In developing these criteria, the most conservative approach was first evaluated. For this case it was postulated that safety systems components/cables could be located literally hundreds of feet apart with a 1/4" diameter telephone cable connecting or extending to a point within the 20 feet allowed separation. A strict interpretation of Option III.G.2.b would conclude that this telephone cable was an intervening combustible and therefore the regulation would not recognize this situation as an acceptable configuration. Since this type of conservatism is built into Appendix R, then this Option III.G.2.b is effectively useless within the availability and use of a rational exemption evaluation process. From a realistic and practical viewpoint, it can be concluded that a fire involving one safety division will not propagate hundreds of feet via the referenced intervening combustible to damage its redundant counterpart.

As discussed above, a strict interpretation of intervening combustibles could render this option useless and therefore reasonable judgment should be applied during the exemption review process. The intent of Appendix R Option III.G.2.b is to assure that fire will not damage a safe shutdown system and then propagate through intervening combustibles and damage a redundant division located 20 feet or more apart.

With this clarification the following are the guidelines/parameters used by CYAPCO during its Appendix R review involving NRC Option III.G.2.b.

1. Intervening combustibles are assumed to be installed (in-situ) combustibles. Considerations of transient combustibles renders Section III.G.2.b option useless as intervening transient combustibles can be postulated for any situation; thus, we have concluded that in-situ combustibles represent a reasonable interpretation.

**2. Electrical cables classified as "flame retardant" and having been demonstrated to successfully pass the flame test specified in IEEE Standard 383 can be considered to be "intervening combustibles," but are recognized as fire retardant and represent a significantly reduced threat to safe shutdown integrity.

**3. Non-fire retardant cables such as PE/PVC insulated and jacketed cables which are protected with a flame retardant mastic (such as (Flammastic) applied per approved procedures are considered the equal of IEEE Standard 383 qualified fire retardant cables, and as such can be "intervening combustibles," but are considered fire retardant as discussed above for IEEE 383 cables.

4. Cabling installed in conduit is not considered "intervening combustibles" regardless of the fire retardant characteristics of the cable insulation and jacketing system.

**Additional information to support guidelines #2 and #3 is attached.

THE MERITS OF 383 CABLE AS A FLAME RETARDANT

IEEE Standard 383 (1974) prescribes the method for testing grouped cables via the vertical tray flame test to determine relative ability to resist fire. Specifically, the flame test is intended to demonstrate that a test specimen does not propagate fire under conditions of installation, even if its outer covering and insulation have been destroyed in the area of flame impingement. Please note this test represents worst case condition by testing cables in a vertical position.

Cables which propagate the flame and burn the total height of the tray above the flame source fail the test (total height is six feet above the flame source). Cables which self-extinguish when the flame source is shut off are allowed to burn out in order to determine the extent of damage. If the damage extends beyond six feet, the cables fail the test.

Therefore, IEEE 383 qualified cables installed in a vertical tray, can withstand severe localized fire damage without danger of excessive fire propagation along their lengths, once the source of fire is removed/extinguished.

Independent tests have demonstrated that when IEEE 383 qualified cables are installed in horizontal trays, fire propagation is even less credible. More significantly, tests have also demonstrated that the fire retardant characteristics of IEEE 383 cables permit them to maintain electrical circuit integrity for up to ten minutes into the most severe fire condition.

Based on IEEE 383 testings, it is concluded that cabling qualified by the 383 test can be considered fire retardant and that it does restrict or retard fire propagation. Typically, there is little threat to the integrity of safe shutdown capability by the presence of such qualified cables in an "intervening" configuration.

An American National Standard

IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations

1. General Provisions

1.1 Scope

1.1.1 This standard provides direction for establishing type tests which may be used in qualifying Class IE electric cables, field splices, and other connections for service in nuclear power generating stations. General guidelines for qualifications are given in IEEE Std 323-1974, Standard for Qualifying Class IE Electric Equipment for Nuclear Power Generating Stations. Categories of cables covered are those used for power control and instrumentation services.

1.1.2 Though intended primarily to pertain to cable for field installation, this guide may also be used for the qualification of internal wiring of manufactured devices.

1.1.3 This guide does not cover cables for service within the reactor vessel.

1.2 Definitions[1]

cable type. A cable type for purposes of qualification testing shall be representative of those cables having the same materials, similar construction, and service rating, as manufactured by a given manufacturer.

Class IE. The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling and containment, and reactor heat removal or otherwise are essential in preventing significant release of radioactive material to the environment.

connection. A cable terminal, splice, or hostile environment boundary seal at the interface of cable and equipment.

containment. That portion of the engineered safety features designed to act as the principal barrier, after the reactor system pressure boundary, to prevent the release, even under conditions of a reactor accident, of unacceptable quantities of radioactive material beyond a controlled zone.

design basis events. Postulated abnormal events used in the design to establish the performance requirements of the structures, systems, and components (IEEE Std 323-1974).

field splice. A permanent joining and reinsulating of conductors in the field to meet the service conditions required.

installed life. The interval from installation to removal, during which the equipment or component thereof may be subject to design service conditions and system demands (IEEE Std 323-1974).

NOTE: Equipment may have an installed life of 40 years with certain components of the equipment changed periodically; thus, the installed life of the components would be less than 40 years.

qualified life. The period of time for which satisfactory performance can be demonstrated for a specific set of service conditions. (IEEE Std 323-1974).

type tests. Tests made on one or more units to verify adequacy of design (IEEE Std 380-1972).

1.3 Type Tests As Qualification Method. As described in IEEE Std 323-1974, type tests are the preferred method to demonstrate or assist in demonstrating that electric equipment is capable of meeting performance requirements under service conditions which include normal and design basis event environments. To perform type tests for cable, field splices, and connections requires: (1) description (identification) of cable, (2) description of significant aspects of the environment, and (3) description of cable performance required. These,

[1] Other definitions related to this document may be found in IEEE Std 100-1972, (ANSI C42.100-1972), Dictionary of Electrical and Electronics Terms, IEEE Std 323-1974, and IEEE Std 380-1972, Definitions of Terms Used in IEEE Nuclear Power Generating Stations Standards.

then, with engineering knowledge and experience in insulating materials and systems form a basis for designing type tests to demonstrate the capabilities. Qualification of one cable may permit extrapolation of results to qualify other cables of the same type, with consideration being given to cable dimensions and probable modes of failure.

A sample field splice or connection or both must be type tested with the cable to demonstrate its electrical, mechanical, and chemical compatibility in the environments.

1.3.1 *Cable Description.* This description or specification should include as a minimum:

1.3.1.1 Conductor — material identification, size, stranding, coating.

1.3.1.2 Insulation — material identification, thickness, method of application.

1.3.1.3 Assembly (multiconductor cables only) — number and arrangement of conductors, fillers, binders.

1.3.1.4 Shielding — tapes, extrusions, braids, or others.

1.3.1.5 Covering — jacket or metallic armor or both, material identification, thickness, method of application.

1.3.1.6 Characteristics — voltage and temperature rating (normal and emergency). For instrumentation cables — capacitance, attenuation, characteristic impedance, microphonics, insulation resistance, as applicable.

1.3.1.7 Identification — manufacturer's trade name, catalog number.

1.3.2 *Field Splice or Connection Description or Both.* This description or specification should include as a minimum:

1.3.2.1 Whether factory or field assembled to cable.

1.3.2.2 Conductor connection — type, material identification, and method of assembly.

1.3.2.3 Items from Sections 1.3.1.2 through 1.3.1.7.

1.3.3 *Description of Significant Environmental Conditions.* Both normal operating and design basis event conditions, as well as their sequence and duration, are relevant for type testing. Separate requirements for post design basis event conditions may be required in recognition of momentary or accumulative changes in material properties due to aging, radiation, heat, and steam exposure. Environmental factors, the limits of which may be significant to the cable's operation are as follows:

1.3.3.1 *Atmosphere.* Maximum and average ambient or normal operation condition and design basis event condition or profile for the following:

(1) Gas composition and velocity
(2) Moisture content
(3) Temperature
(4) Pressure

1.3.3.2 *Radiation.*

(1) Normal dose rate and type
(2) Total normal installed life dosage
(3) Design basis event dose rate. Maximum dose rate and approximate profile
(4) Total design basis event dosage
(5) Total for the installed life plus design basis event

1.3.3.3 *Chemicals*

(1) Type of chemicals and concentration
(2) Spray or immersion rate and time
(3) Temperature of exposure

1.3.3.4 *Mechanical.* Normal operating condition and design basis event condition for the following:

(1) Bending or flexing
(2) Vibration
(3) Tension
(4) Sidewall pressure

1.3.3.5 *Fire*

1.3.4 *Operating Requirements*

1.3.4.1 *Meeting Service Conditions.* The cable, as installed, should be suitable for operation at maximum ambient temperature, radiation, and atmospheric conditions and normal electrical and physical stresses for its installed life, as specified. Evidence of this suitability may be based on compliance with appropriate published industry standards, past documented operating experience, component tests, or a combination of these.

The total station may be subdivided into zones with substantially different ambient conditions, and if segregation of cables to certain areas is assured, a cable need only be suitable for meeting service conditions in those zones in which it is located.

1.3.4.2 *Design Basis Event Conditions for Qualifying Cables*

1.3.4.2.1 *Design Basis Event — Loss-of-Coolant Accident (LOCA) (for cables in containment only).* The cable, field splices, and connections should throughout their normal lives be capable of operating through postulated environmental conditions re-

sulting from a LOCA. Conditions of loading and signal levels shall be assumed to be those most unfavorable for cable operation which may be anticipated under such circumstances.

1.3.4.2.2 *Design Basis Event — Fire.* The cable should not propagate fire under conditions of installation.

1.3.4.2.3 *Other Design Basis Events.* These should also be considered in case they represent different types or more severe hazards to cable operation.

1.3.5 *Type Test Conditions and Sequences*

1.3.5.1 *General.* Type tests are used primarily to indicate that the cables, field splices, and connections can perform under the conditions of a design basis event. Because the design basis events may occur at any time in the station life, the thermal and radiation aging required in type tests to simulate these conditions may at the same time indicate the ability of cable types to operate under the normal service conditions within the station.

1.3.5.2 *Aging.* The effect of normal operating conditions with time may either add to or reduce the ability of cable, field splices, and connections to withstand the extreme environments and loads imposed during and following a design basis event. Thus, the type testing for design basis event conditions shall involve both aged and nonaged samples. *Aging* pertains to temperature, radiation, and atmospheric effects applied in sequence or simultaneously in an accelerated manner.

The basis for establishing time and temperature conditions for aging of samples to simulate their qualified life may be that of Arrhenius plotting (IEEE Std 1-1969, General Principles for Temperature Limits in the Rating of Electric Equipment, IEEE Std 98-1972, Guide for the Preparation of Test Procedures for the Thermal Evaluation and Establishment of, Temperature Indices of Solid Electrical Insulating Materials, IEEE Std 99-1970, Guide for the Preparation of Test Procedures for the Thermal Evaluation of Insulation Systems for Electric Equipment, and IEEE Std 101-1972, Guide for Statistical Analysis of Thermal Life Test Data) or other method of proven validity and applicability for the materials in question.

1.3.5.3 *Test Design Basis Event.* Type tests for design basis event conditions should consist of subjecting nonaged and aged cables, field splices, and connections to a sequence of environmental extremes which simulate the most severe postulated conditions of a design basis event and specified conditions of installation. Type tests shall demonstrate margin by application of multiple transients, increased level, or other justifiable means. Satisfactory performance of the cable will be evaluated by electrical and physical measurements appropriate to the type of cable during or following the environmental cycle or both.

The values of pressure, temperature, radiation, chemical concentrations, humidity, and time in Section 2 do not represent acceptable limitations for all nuclear power stations. The user of this guide should assure that the values used in the required type tests represent acceptable limits for the service conditions in which the cable or connections will be installed.

1.4 Documentation

1.4.1 *General.* Type test data used to demonstrate the qualification of cables should be organized in an auditable form. The documentation should include:

1.4.1.1 Description or specification of cable.

1.4.1.2 Description or specification of field splice or connection.

1.4.1.3 Identification of the specific environmental features.

1.4.1.4 Identification of the specific performance requirements to be demonstrated.

1.4.1.5 The test program outline.

1.4.1.6 The test results.

1.4.1.7 Approving signature and date.

1.4.2 *Test Program Outline.* For cable and connections, this outline shall include:

1.4.2.1 The physical arrangement of the cable and test equipment description.

1.4.2.2 Time program and sequence of all environmental factors.

1.4.2.3 The type and location of all environmental and cable monitoring sensors for each variable.

1.4.2.4 The voltages or currents programmed in conjunction with Section 1.4.2.1 above.

1.4.2.5 The electrical, thermal, or mechanical tests to be performed during environmental exposure.

1.4.2.6 Testing or examinations subsequent to environmental cycle.

1.4.3 *Test Results.* Test results should demonstrate that:

1.4.3.1 The intended environmental sequences were achieved.

1.4.3.2 The cable or field splice (or connection) or both was capable of performing its intended function.

1.4.4 *Test Evaluation.* An evaluation of data should be made to demonstrate the adequacy of cable performance as outlined in Section 1.4.1.4.

1.5 Modifications. When modification in the materials or design of cables or in the conditions of installation or in the postulated environments are made, prior type tests shall be reviewed to determine the effect on the cable qualification. This evaluation shall indicate whether or not new type tests are required. The analysis of data and evaluation that demonstrates the effect of the modification on the equipment performance shall be added to the qualification documentation.

2. Examples of Type Tests

2.1 Introduction. Type tests described in this document are examples of methods which may be used to qualify electrical cables, field splices and connections for use in nuclear power generating stations. Tests of the cable or connection assembly, as applicable, should then supplement the cable tests in order to qualify the connections and other aspects unique to planned usage.

The values of pressure, temperature, radiation, chemical concentrations, humidity, and time used do not represent acceptable limits for all nuclear power generating stations. The user of this guide should assure that the values used in the required type tests represent acceptable limits for the service conditions in which the cable or connections, or both will be installed.

Results of prior tests that are being used as the bases for the present tests should be referenced in the documentation.

2.2 Type Test Samples. The samples tested should contain the conductor, insulation, fillers, jacket, binder tape, overall jacket, shielding, and field splices which are representative of the cable category being qualified. Table 1 lists sizes which have been considered representative of these categories. The sample lengths should be sufficient to permit reliable test readings and evaluation consistent with good testing practice.

2.3 Testing to Qualify for Normal Operation

2.3.1 *Temperature and Moisture Resistance.* Evidence of qualification for normal operation may be demonstrated by providing certified evidence that the cable has been manufactured and tested and passed in accordance with the provisions of one or more of the following industry standards or criteria.

ANSI C83.21-1972 Requirements for Solid Dielectric Transmission Lines

ANSI C96.1-1964 (R1969) Temperature Measurement Thermocouples

ANSI C1-1971 National Electrical Code, NFPA 70-1971, Sections on Types RHH, RHW, and XHHW[4]

IPCEA S-19-81 Rubber-Insulated Cable

IPCEA S-66-524 Cross-Linked-Polyethylene-Insulated Cable

IPCEA S-68-516 Interim Standards for Ethylene-Propylene-Rubber-Insulated Wire and Cable. Number 1, Cables Rated 0-35 000 V. Number 2, Cables Rated 2000 V, Integral Insulation and Jacket.

AEIC 5-71 Specifications for Polyethylene and Cross-Linked-Polyethylene-Insulated, Shielded Power Cables rated 5000–35 000 V

AEIC 6-73 Specifications for Ethylene-Propylene-Rubber-Insulated Shielded Power Cables Rated 5–46 kV

2.3.2 *Long-Term Physical Aging Properties.* Aging data should be submitted to establish long-term performance of the insulation. Data may be evaluated using the Arrhenius technique. A minimum of 3 data points, including 136°C and two or more others at least 10°C apart in temperature, should be used.

2.3.3 *Thermal and Radiation Exposure.* The following test sequence may be used to demonstrate that the cable will be operational after exposure to simulated thermal and radiation aging.

[4]Cable types RHH, RHW, and XHHW, as specified in the National Electrical Code should meet the requirements established by the applicable standards of Underwriters' Laboratories, Inc or other recognized agencies.

Table 1
Represensentative Cables for Type Tests

Type	Test	Section	Size
Up to 2000 V multiconductor control cable or Shielded multiconductor signal cable (see list below for individual component) or Single conductor power cable	temperature and moisture resistance	2.3.1	1/C — 14 or 12 AWG
	thermal and radiation exposure	2.3.3	1/C or M/C — 14 or 12 AWG
	design basis event simulation	2.4	1/C or M/C — 14 or 12 AWG 1/C — 6, 4 or 2 AWG
	vertical flame test singles from cable assembly	2.5.6	1/C — 14 or 12 AWG
	vertical tray flame test	2.5.4	7/C — 16, 14 or 12 AWG
Shielded pairs, triple or quad from multiconductor signal cable	temperature and moisture resistance	2.3.1	1 pair shielded 16 AWG or actual cable
	thermal and radiation exposure	2.3.3	
	design basis event simulation	2.4	
	vertical flame test	2.5.6	
Coaxial, triaxial or special instrument cable	temperature and moisture resistance	2.3.1	actual size
	thermal and radiation exposure	2.3.3	
	design basis event simulation	2.4	
	vertical flame test singles from cable assembly	2.5.6	
Single pair thermocouple extension cable	temperature and moisture resistance	2.3.1	2/C — 20 AWG or actual size if smaller
	thermal and radiation exposure	2.3.3	
	design basis event simulation	2.4	
	vertical tray flame test	2.5.4	
	vertical flame test singles from cable assembly	2.5.6	
2001—15 000 V power cable 1/C triplexed and multiconductor	vertical tray flame test	2.5.4	6 AWG (2-5kV) 2/O or 4/O or 4/O (2-15kV)

2.3.3.1 Form suitable lengths of insulated conductor which conform to the applicable standards into test coils so that the effective section of each coil under test will be not less than 10 ft.

2.3.3.2 Subject the coils to circulating air oven aging at a temperature and time developed by plotting data using the Arrhenius technique or other method of proven validity to simulated installed life.

2.3.3.3 The specimens with conditioning as covered in Section 2.3.3.2 should be subjected in air to gamma radiation from a source such as ^{60}Co to a dosage of 5×10^7 rd at a rate not greater than 1×10^6 rd per hour.

2.3.3.4 After the radiation exposure of Section 2.3.3.3 the specimen should be straightened and recoiled with an inside diameter of approximately 20 times the cable overall diameter and immersed in tap water at room temperature. While still immersed, these specimens should pass a voltage withstand test for 5 minutes at a potential of 80 V/mil ac or 240 V/mil dc.

2.4 Testing for Operation During Design Basis Event

2.4.1 *General.* This section is predicated upon a loss of coolant accident (LOCA) but not necessarily limited thereto.

Prepare two sets of specimens in accordance with the following.

2.4.1.1 One set to be unaged.

2.4.1.2 The other set to be heat aged specimens in accordance with Sections 2.3.3.1 and 2.3.3.2.

NOTE: The requirements of Sections 2.3.3.3 and 2.3.3.4 may be omitted if Section 2.4 is followed as a guide since the requirements of Section 2.4 exceed those of Sections 2.3.3.3 and 2.3.3.4.

2.4.2 *Radiation Exposure — Total.* Exposure specimens to the maximum total cumulative radiation dosage expected over the installed life (see Section 2.3.3.3) plus one LOCA exposure to radiation for the particular installation involved as covered in IEEE Std 323-1974 Appendix A or B. The rate of exposure shall not be greater than 1×10^6 rd per hour. This restriction is removed when simulation of the LOCA profile requires a greater dose rate.

2.4.3 *LOCA Simulation.* Test irradiated specimens in a pressure vessel so constructed that the specimens can be operated under rated voltage and load while simultaneously exposed to the pressure, temperature, humidity and chemical spray of a LOCA event. Chamber designs should have provisions for monitoring and varying temperature and steam pressure, for recycling chemical spray, and for electrically loading the specimens as specified herein.

2.4.3.1 After conditioned specimens are installed inside the pressure vessel they should be energized at rated voltage and loaded with rated service current while under the average normal operating condition. The energized specimens should be exposed to one cycle of the environmental extremes according to the schedule postulated for the particular installation, see IEEE Std 323-1974.

2.4.3.2 The cable should function electrically throughout its exposure to the environmental extremes within the specified electrical parameters.

2.4.4 *Post LOCA Simulation Test.* Upon completion of the LOCA simulation, the specimens should be straightened and recoiled around a metal mandrel with a diameter of approximately 40 times the overall cable diameter and immersed in tap water at room temperature. While still immersed, these specimens should again pass the same voltage withstand test performed under Section 2.3.3.4.

NOTE: The post LOCA simulation test demonstrates an adequate margin of safety by requiring mechanical durability (mandrel bend) following the environmental simulation and is more severe than exposure to two cycles of the environment.

2.5 Flame Tests

2.5.1 *General.* This section describes the method for type testing of grouped cables via the vertical tray flame test to determine their relative ability to resist fire.

2.5.2 *Criteria*

2.5.2.1 The fire test should demonstrate that the cable does not propagate fire even if its outer covering and insulation have been destroyed in the area of flame impingement.

2.5.2.2 The fire test should approximate installed conditions and should provide consistent results.

2.5.3 *Test Specimens*

2.5.3.1 The tests proposed are for power, control, and instrumentation cables.

2.5.3.2 Sizes recommended for type tests may be as listed in Table 1 but not necessarily limited thereto.

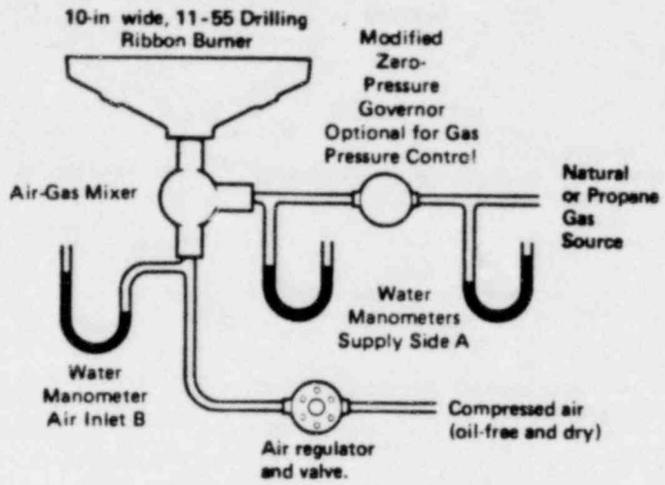
2.5.4 *Fire Test Facility and Procedure*

2.5.4.1 Test should be conducted in a naturally ventilated room or enclosure free from excessive drafts and spurious air currents.

2.5.4.2 The vertical tray configuration is recommended as the best arrangement to establish whether or not a cable could propagate a fire. The tray should be a vertical, metal, ladder type, 3 in deep, 12 in wide, and 8 ft long. The tray may be bolted at the bottom to a length of horizontal tray for support.

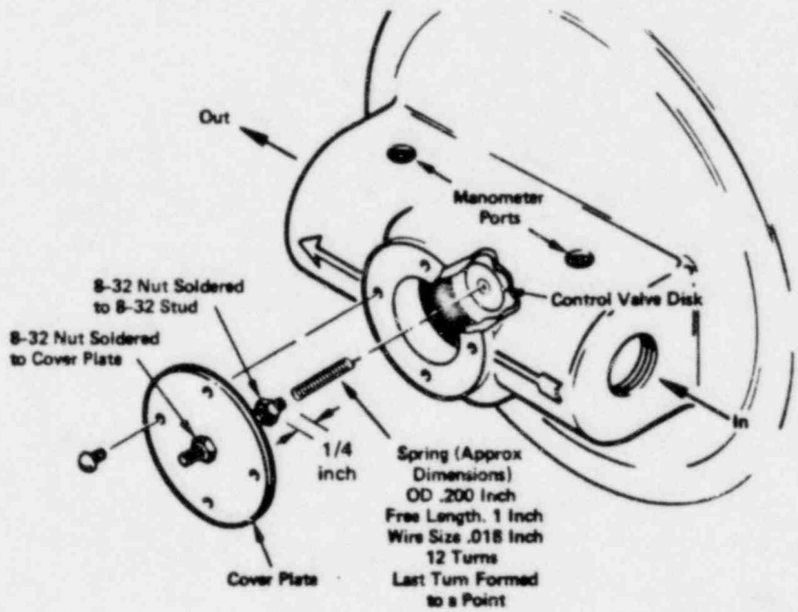
2.5.4.3 Test sample arrangement — multiple lengths of cable should be arranged in a single layer filling at least the center six inch portion of the tray with a separation of approximately 1/2 the cable diameter between each cable. The test should be conducted 3 times to demonstrate reproducibility using different samples of cable.

2.5.4.4 Flame source, when specified, the procedure detailed below shall be followed:



NOTE: All pressures measured under dynamic conditions.

A Schematic Drawing



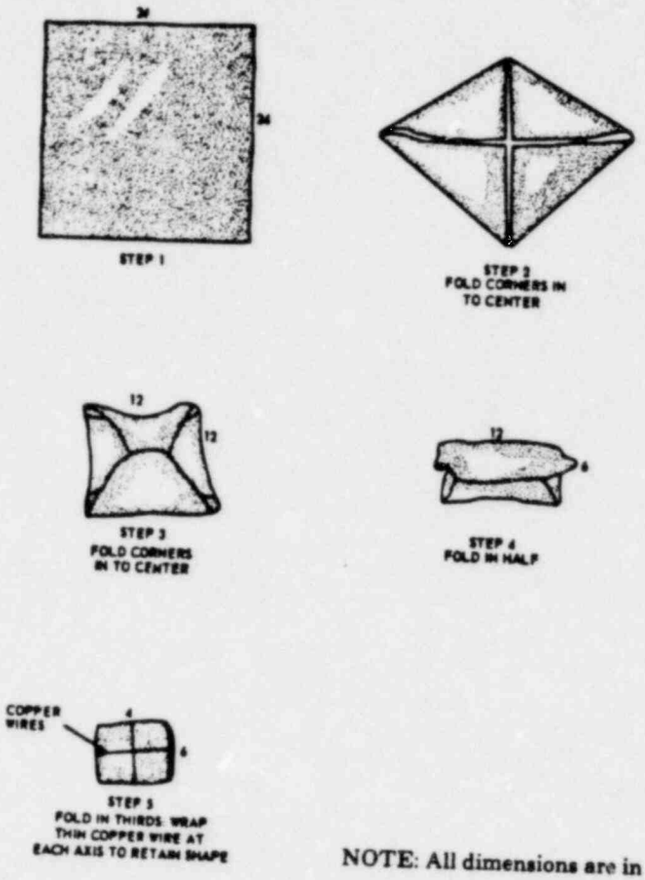
B Detail Drawing of Zero Pressure Governor Modification

Fig 1
Flame Source

2.5.4.4.1 The ribbon gas burner[3] shall be mounted horizontally such that the flame impinges on the specimen midway between the tray rungs, and so that the burner face is 3 in behind and approximately 2 ft above the bottom of the vertical tray. Because of its uniform heat content natural grade propane is preferred to commercial gas.

2.5.4.4.2 The flame temperature should be approximately 1500°F when measured by a thermocouple located in the flame close to, but not touching the surface of the test specimens (about 1/8 in spacing).

[3] An American Gas Furnace Co 10 in, 11-55 drilling, ribbon type, catalog no 10X 11-55 with an air-gas Venturi mixer, catalog no 14-18 (2 lbf/in² max gauge pressure) is the only presently available model that has been found satisfactory for purposes of these tests.



NOTE: All dimensions are in inches.

Fig 2
Burlap Folding Sequence

2.5.4.4.3 For the schematic arrangement see Fig 1. Under dynamic conditions, if propane gas is used the pressure shall be −2.6±0.3 cm of water at the supply side A to the Venturi mixer. If commercial gas is used the pressure shall be −0.9±0.1 cm of water when measured at the supply side of the Venturi mixer. For propane gas, the air pressure should be 4.3±0.5 cm of water. For commercial gas it shall be 5.6±0.5 cm of water, measured at the air inlet B to the mixer. In practice the flame length will be approximately 15 in when measured along its path.

2.5.4.4.4 Gas-burner procedure — ignite the burner and allow it to burn for 20 minutes. Record temperatures at point of impingement throughout the duration of the test, length of time flame continues to burn after gas burner is shut off, jacket char distance, and distance insulation is damaged.

2.5.4.5 Alternative flame source, oil or burlap — when specified, the procedure detailed below shall be followed.

2.5.4.5.1 Use a 24 in square piece of 9 oz per square yard burlap, folded as shown in Fig 2 into a bundle 4 in × 4 in × 6 in. Wrap with fine copper wire as shown, to retain the shape of the bundle. Immerse in a container of oil[4] for 5 minutes. Remove, hang free in air, allow to drain for approximately 15 minutes. The burlap ignitor is weighed before immersion and after draining, and the fuel pickup should be 160±5 g. The repeatability of this test is derived from constant fuel pickup in ignitors of constant size and weight. Temperature should be monitored at point of maximum flame impingement upon the test cables.

2.5.4.5.2 After draining, the ignitor should be placed in front of and approximately 2 ft above the bottom of the tray with the 4 in × 6 in face of the ignitor held in place against the cables by a suitable metal wire or band.

[4]Such as Mobilect 33.

2.5.4.5.3 Ignite the oil soaked burlap. The applied flame should be allowed to burn itself out naturally.

2.5.5 *Evaluation.* Cables which propagate the flame and burn the total height of the tray above the flame source fail the test. Cables which self-extinguish when the flame source is removed or burn out pass the test. Cables which continue to burn after the flame source is shut off or burns out should be allowed to burn in order to determine the extent.

2.5.6 *Instrument Cable and Single Conductors from Multiconductor Assembly.* A specimen of each type of instrument cable or the individually insulated or insulated and jacketed conductors removed from each multiconductor control cable which is type tested should pass a flame resistance test in accordance with ASTM D2220-68, Vinyl Chloride Plastic Insulation for Wire and Cable, Section 5 (IPCEA Standard S-19-81, Section 6.19.6), except the weight may be omitted if the specimen is securely clamped.

2.6 Documentation of Type Testing. Following the procedures outlined in this guide, provide data necessary to document satisfactory compliance. Certification of prior test results will be provided when required.

Section
2.3.1 Temperature and Moisture
2.3.2 Long-Term Physical Aging Properties
2.3.3 Thermal and Radiation Exposure
2.4 Testing for Operation During Design Basis Event (LOCA)
2.5.1 Flame Test on Grouped Cables in Vertical Tray
2.5.6 Flame Test on Single Conductor

3. References

IEEE Std 1-1969, General Principles for Temperature Limits in the Rating of Electric Equipment

IEEE Std 98-1972, Guide for the Preparation of Test Procedures for the Thermal Evaluation, and Establishment of Temperature Indices of Solid Electrical Insulating Materials

IEEE Std 99-1970, Guide for the Preparation of Test Procedures for the Thermal Evaluation of Insulation Systems for Electric Equipment

IEEE Std 100-1972 (ANSI C42.100-1972), Dictionary of Electrical and Electronics Terms

IEEE Std 101-1972, Guide for the Statistical Analysis of Thermal Life Test Data

IEEE Std 279-1971 (ANSI N42.7-1972), Criteria for Protection Systems for Nuclear Power Generating Stations

IEEE Std 308-1974, IEEE Standard Criteria for Class IE Power Systems for Nuclear Power Generating Stations

IEEE Std 317-1971, Electrical Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations

IEEE Std 323-1974, Standard for Qualifying Class IE Electric Equipment for Nuclear Power Generating Stations

IEEE Std 334-1971, Type Tests of Continuous Duty Class I Motors Installed Inside the Containment of Nuclear Power Generating Stations

IEEE Std 336-1972 (ANSI N45.2.4-1972), Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations

IEEE Std 380-1972, Definitions of Terms Used in IEEE Nuclear Power Generating Stations Standards

ASTM D2220-68, Vinyl Chloride Plastic Insulation for Wire and Cable

FLAMEMASTIC - AS AN EFFECTIVE FIRE RETARDANT

Flamemastic is composed of a polyvinyl acetate binder, flame retardant additives and inorganic fillers and fibers. The polyvinyl acetate binder forms a tough, weather-resistant, permanent coating which encapsulates the cable. The fire retardant additives include antimony oxide, chlorinated hydrocarbons and a phosphate plasticizer. These materials function synergistically to inhibit the flammability of the binder and all flammable substrates to which the coating is applied.

When exposed to a fire, the coating functions to provide fire retardant properties through a combination of the following series of actions:

1. An ablative process, consisting of dehydration and other endothermic chemical reactions coupled with the formation of a carbonaceous char, which reduces the heat transmission to the protected object.

2. Radiation of a significant amount of heat away from the protected object emanating from the carbonaceous char and the inorganic components of the coating which form a surface of high heat emmissivity.

3. A heat insulation effect provided by the coating of high temperatures to reduce the heat transferred to the protected object. Although the coating has been designed to offer limited insulation at room temperature in order to minimize ampacity derating effects on cables, it functions as an effective heat insulator.

4. The fire retardant additives form products in the fire which inhibit the combustion process and minimize the flammability of materials in the vicinity of the fire.

5. The coating itself and the inorganic fibrous residue that remains after the organic binder has been pyrolized form a barrier that effectively prevents the access of oxygen to the flammable materials that are being protected.

Basically, Flamemastic protection involves the encapsulation of cabling with a coating that will not propagate flame, that is, it will not burn in the ordinary sense of the term. Flamemastic prevents the process that allows 'non-burning' cables to support each others combustion when grouped in trays or bundles. In many independent tests, both in this country and abroad, it has been shown that a fire source that will cause unprotected grouped cables to ignite, burn completely and propagate fire, will cause little or no damage to Flamemastic protected grouped cables. In a situation where a large heat source impinges directly on Flamemastic coated cables, the cables will ultimately be destroyed at the point of flame impingement but the coating will completely prevent propagation of flame away from the point.

Some fire tests have shown that a 1/16 inch coating of Flamemastic on randomly grouped cables in a cable tray will not cause the cables to heat excessively when operated in accordance with the current limitations specified by the National Electric Code for such conditions.

Other fire tests have shown that a self spreading fire will not occur in cables installed in either horizontal or vertical cable trays which are coated with Flamemastic and exposed to a fire of moderate intensity.

Flamemastic complies with Factory Mutual requirements and it is approved for the protection of grouped combustible insulated cables against a self-spreading fire originating within the cables or from exposure to an external ignition source of moderate intensity.

The United States Testing Company performed standard flame spread, smoke density and fuel contributed tests on a 1/4 inch Johns Manville Flex-board coated with a 1/16 inch (dry) film thickness of Flamemastic fire barrier coating in accordance with ASTM Designation E-84, "Standard Method of Test for Surface Burning Characteristics of Building Materials". The results showed that Flamemastic has a flame spread rating of 10, a fuel contribution of 0 and a smoke density classification of 30. (See copy of Test Report No. LA12396).

Attached are copies of two certified test reports for tests conducted at the Kerite Company fire test facility in 1977. The objective of the tests was to demonstrate that the cables and raceways, as tested, would not propagate a fire, even if the outer covering and insulation of the cables had been destroyed in the area of flame impingement, when exposed to an IEEE Standard 383 (1974) flame source.

The cables used were 7/C and 4/C #10, 1,000 V, polyethylene insulated conductors and PVC jacketed cables which are representative, in every respect, of the type of cable originally installed at the Haddam Neck Plant.

The tray arragement used for the tests was also typical of those arrangements found at the Plant. Two layers of ten feet lengths of test cable were mounted in the tray with no cable spacings in between. Each layer consisted of fifteen cables, half from each conductor make-up placed in alternating sequence, for a total of thirty cables. The tray arrangement was tested with (test Reference No. 3) and without (test Reference No. 8) the application of Flamemastic. Six cables were chosen at random for each test, three from each layer, for energizing with a 240V power source which was also used to monitor the electrical integrity of the cables during the tests.

The only difference between the standard test procedure (IEEE 383) and the Kerite tests, was the cable spacing in the tray which is more representative of conditions at the Plant. However, approximations to installed conditions are permitted by the standard.

It is NNECO's conclusion that the Flamemastic material provides exceptional protection for cables subjected to a direct flame. Also that the Flamemastic material effectively prevents fire from spreading in the horizontal direction. Finally that the protective system offers an excellent warning system both visually (white smoke) and by odor.

EST. 1880

United States Testing Company, Inc.

California Division

8656 TELEGRAPH ROAD, LOS ANGELES, CALIFORNIA 90040
TELEPHONE: LOS ANGELES—213/723-7181
FROM SAN FRANCISCO—415/928-5858

REPORT OF TEST

The Flamemaster Corporation
11120 Sherman Way
Sun Valley, California 91352

FLAME SPREAD CLASSIFICATION
SMOKE AND FUEL CONTRIBUTION

Flamemastic 77 Coating

November 16, 1981

TEST REPORT NO. LA 12396

SIGNED FOR THE COMPANY

P. McCullen
Pat McCullen
Test Technician

BY James H. Heywood
James H. Heywood
Test Engineer

of 5 lr

REFERENCE

Client's Purchase Order No. 7948 per Mr. Samuel L. Engel, Sr.

REQUIREMENT

Perform standard flame spread, smoke density and fuel contributed classification tests on the panel supplied by the Client in accordance with ASTM Designation E-84, "Standard Method of Test for Surface Burning Characteristics of Building Materials".

SAMPLE IDENTIFICATION

The sample tested was submitted and identified by the Client as: Flamemastic 77, a water based, fire barrier coating applied to 1/4" Johns Manville Flex-board at a rate of 1/8" wet film thickness. (1/16" DRY)

PREPARATION AND CONDITIONING

The panels provided were self supporting and pre-cut to meet the tunnel dimensions. The sample panels were placed in the conditioning room (maintained at a dry-bulb temperature of 73.4 ± 5°F. and a relative humidity of 50 ± 5%) and allowed to come to equilibrium.

TEST PROCEDURE

The sample was tested following calibration and pre-heating. The evaluation was performed in conformance with the specifications set forth in ASTM Designation E-84, "Standard Method of Test for Surface Burning Characteristics of Building Materials", both as to equipment and test procedure. The foregoing test procedure is comparable to UL 723, NFPA No. 255, and UBS No. 42-1.

SUMMARY OF TEST RESULTS

Because of the possible variations in reproducibility, the results are adjusted to the nearest figure divisible by 5.

Sample Identification	Flame Spread	Fuel Contribution	Smoke Density
Flamemastic 77	10	0	30

In order to obtain the Flame Spread Classification, the above results should be compared to the following table:

NFPA CLASS	UBC CLASS	FLAME SPREAD
A	I	0 through 25
B	II	26 through 75
C	III	76 through 200
D	---	201 through 500
E	---	Over 500

BUILDING CODES CITED

1. National Fire Protection Association, NFPA No. 101, "Life Safety Code".

2. Uniform Building Code, 1979 edition, Part VIII, "Fire Resistive Standard for Fire Protection", Chapter 42- Interior Wall and Ceiling Finish, Sections 4201-4203.

UNITED STATES TESTING COMPANY, INC.

LA 12396

ASTM E-84 TEST DATA SHEET

CLIENT: The Flamemaster Corp. DATE: November 16, 1981

SAMPLE: Flamemastic 77 Coating

THICKNESS: 1/8" Wet film

FLAME SPREAD:

Ignition 58 Seconds

Flame Front 2 1/2 ft. max. Time to Max. Spread 1 Minute 57 Seconds

Calculation 21.67 X .515 = 11.16 Test Duration 10 Minutes

SUMMARY

FLAME SPREAD BY: ASTM E-84-80	10
FUEL CONTRIBUTION:	0
SMOKE DENSITY	30

OBSERVATIONS

Considerable bubbling of the coating surface preceded a sample ignition time of 58 seconds. A maximum flame front advance of 2½' was observed about 1 minute after ignition. Total delamination of the coating in the flame impingement area occurred shortly after 2 minutes, but did not enhance the flame front. No afterburning noted at test conclusion.

the kerite company

REPORT ON FLAME TEST CONDUCTED ON CABLE AND RACEWAY SYSTEM

October 19, 1977

TEST NO. 77 VG-48-C
Ref. No. 3

A. OBJECTIVE

The objective of this flame test is to demonstrate that the cable and raceway, as tested, will not propagate a fire when exposed to an IEEE 383-74 flame source.

B. CABLE AND RACEWAY TESTED

7/c #12 and 4/c #10, 1 KV, polyethylene insulation, PVC jacketed cable installed in a steel vent tray with a steel rib cover (to simulate vent rib tray). The cables, tray, and cover were coated with Flamemastic.

C. TEST FACILITY

The test was conducted on September 6, 1977 at The Kerite Company Fire Test Facility. An American Gas Furnace Company ten-inch wide ribbon burner was used to provide the flame source. A direct readout Omega pyrometer was used in conjunction with a thermocouple to monitor flame temperature throughout the test. A laboratory timer was used to measure the duration of the test. The test specimen was installed in the 12-inch wide, 3-inch deep, 11-foot high tray. A 240 volt power source was used to monitor the electrical integrity during the test.

D. TEST PROCEDURE

Two layers of 10 foot lengths of test cable were mounted in the tray with no cable spacings. Each layer consisted of 15 cables, half from each make-up, placed in an alternating sequence, for a total of 30 cables. Six cables were chosen at random, three from each layer, and energized with the 240 volt power source.

The flame source was adjusted so that the temperature was approximately 1500° F and approximately 15 inches in length. Under dynamic conditions, the following manometer readings were recorded for both air and fuel in centimeters of water:

Air	Fuel
4.7	2.8

These pressures were measured for both air and fuel at the inlet of the mixer.

The flame source was placed on the front side of the tray at a three-inch distance from the cables and allowed to burn for twenty minutes. At the end of twenty minutes, the flame source was shut off and the cables allowed to burn until they self-extinguished or were totally consumed. All pertinent data was recorded. The temperatures indicated in the next section were measured by a thermocouple located 2-7/8" from the burner face.

E. TEST DATA

1.	Time for specimen to ignite:	Within the first three minutes
2.	Time specimen continued to burn after removal of flame source:	5 minutes
3.	Maximum length of sample damage:	48 inches
4.	Time for electrical breakdown:	9 minutes, 33 seconds (line one to ground)
5.	Heat input	61,300 BTU/hr.

REPORT ON FLAME TEST CONDUCTED ON CABLE AND RACEWAY SYSTEM

3.

TEST NO. 77 VG-48-C

October 19, 1977

(E - Test Data - Continued)

6.

Minutes	Flame Impingement Temperature (° F)
Start	1400
1	1450
2	1350
3	1300
4	1250
5	1250
6	1250
7	1250
8	1250
9	1250
10	1250
11	1250
12	1250
13	1250
14	1250
15	1250
16	1250
17	1250
18	1250
19	1250
20	1250

F. ATTESTATION

The above test was personally witnessed by the undersigned and the data presented above is accurate and complete to the best of my knowledge and belief.

John V Osborn
John V. Osborn, Technician

JVO:mc

APPROVED Paul D. Basconi
Paul D. Basconi, Mechanical Eng.

Subscribed and sworn to before me this 25 day of October, 1977.

Jane Hill
Notary Public

My Commission
Expires March 31, 1979

REPORT ON FLAME TEST
CONDUCTED ON CABLE AND RACEWAY SYSTEM

October 19, 1977

Test No. 77 VG 58-C
Ref. No. 8

A. OBJECTIVE

The objective of this flame test is to demonstrate that the cable and raceway, as tested, will not propagate a fire when exposed to an IEEE 383-74 flame source.

B. CABLE AND RACEWAY TESTED

Seven conductor No. 12 and four conductor No. 10, 1 KV, polyethylene insulation, PVC jacketed cable, installed in a steel vent tray with a vent rib cover (to simulate steel vent rib tray).

C. TEST FACILITY

The test was conducted on September 9, 1977 at The Kerite Company Fire Test Facility. An American Gas Furnace Company 10-inch wide ribbon burner was used to provide the flame source. A direct readout Omega pyrometer was used in conjunction with a thermocouple to monitor flame temperature throughout the test. A laboratory timer was used to measure the duration of the test. The test specimen was installed in a 12-inch wide, 3-inch deep, 11-foot high tray. A 240 volt power source was used to monitor the electrical integrity during the test.

D. TEST PROCEDURE

Two layers of 10 foot lengths of test cable were mounted in the tray with no cable spacings. Each layer consisted of fifteen cables, half from each makeup, placed in an alternating sequence, for a total of thirty cables. Six cables were chosen at random, three from each layer, and energized with the 240 volt power source.

Test No. 77 VG 58-C
Ref. No. 8

The flame source was adjusted so that the temperature was approximately 1500°F and approximately 15 inches in length. Under dynamic conditions, the following manometer readings were recorded for both air and fuel in centimeters of water:

Air	Fuel
4.5	2.9

These pressures were measured for both air and fuel at the inlet of the mixer.

The flame source was placed on the front side of the tray at a 3-inch distance from the cables and allowed to burn for twenty minutes. At the end of twenty minutes, the flame source was shut off and the cables allowed to burn until they self-extinguished or were totally consumed. All pertinent data was recorded. The temperatures indicated in the next section were measured by a thermocouple located 2 7/8" from the burner face.

E. TEST DATA*

1. Time for specimen to ignite:	Within the first three minutes.
2. Time specimen continued to burn after removal of flame source:	Was not recorded.
3. Maximum length of sample damage:	Cable samples totally consumed.
4. Time for electrical breakdown:	4 minutes, 45 seconds (Line two to ground) 5 minutes, 1 second (Line one)
5. Heat input	63,000 BTU/hr.

*Because of the severity of the smoke and fire, the test was halted at 15 minutes.

Test No. 77 VG 58-C
Ref. No. 8

(Test Data cont'd)

6. Minutes	Flame Impingement Temperature (°F)
Start	1450
1	1150
2	1150
3	1225
4	1250
5	1250
6	1225
7	1225
8	1275
9	1275
10	1225
11	1225
12	1300
13	1350
14	1400
15	1450

F. ATTESTATION

The above test was personally witnessed by the undersigned and the data presented above is accurate and complete to the best of my knowledge and belief.

John V. Osborn
John V. Osborn, Technician

JVO/dm

APPROVED Paul D. Basconi
Paul D. Basconi, Mechanical Engineer

Subscribed and sworn to before me this 25 day of October, 1977.

Jane Hill
Notary Public
My Commission
Expires March 31, 1979

APPENDIX D

PLANT OPERATION OUTSIDE CONTROL ROOM

DOCKET NO. 50-213

JULY, 1982

APR 0 8 1982

PLANT OPERATIONS REVIEW COMMITTEE APPROVAL

Connecticut Yankee
Abnormal Operating Procedure
No. AOP 3.2-8

APPROVED BY STATION SUPERINTENDENT

EFFECTIVE DATE 4-8-82

PLANT OPERATION OUTSIDE CONTROL ROOM

1.0 DISCUSSION

1.1 This procedure outlines operator actions to be taken in the event where the main control room becomes uninhabitable and cannot be reentered with self contained breathing apparatus. It outlines steps to be taken to maintain the plant in a safe condition from outside the control room.

2.0 SYMPTOMS

2.1 Control room must be evacuated immediately due to fire, smoke, terrorists, etc.

3.0 AUTOMATIC ACTIONS

NONE

4.0 PROCEDURE

4.1 Trip reactor and turbine

4.1.1 Reactor trip/turbine trip can be accomplished manually at head end of turbine if power level above P-7.

4.1.2 Can be accomplished in switchgear room by manually opening trip breakers, opening breakers on MG sets or on busses 7 and 4 rod drive power supplies, open switches on three vital bus inverters etc.

4.2 Setup an emergency control point in cable vault penetration area.

4.2.1 Portable instrument for measuring pressurizer level and pressurizer is in cable vault area. Follow directions on box to obtain readings on these parameters.

4.3 Emergency Borate R.C. System by Opening BA-V-369 and BA-MOV-366. Start boric acid pump by opening breaker for boric acid pump on MCC-8. Open cubicle door and reclose breaker. Push relay buttons closed and hold closed to operate pump. Pump should be run until at least 1000 gallons of strong boric acid has been injected into R.C.S. Boric Acid Mix Tank Level can be read locally.

4.4 Reactor temperature may be determined by connecting a direct reading temperature gage to any of several incore thermocouples as containment penetration area. Follow directions posted at thermocouple penetrations.

4.5 Steam generator levels may be determined in cable vault by using volt meter at penetration area. Both wide range level and narrow range level outputs operate on a one to 9 volt D.C. range, so that mid scale would be 50% level in steam generator. 1 VOLT = 0% 9 VOLTS = 100% Level

Auxiliary steam generator feed pumps may be operated manually from Terry Turbine Room per AOP 3.2-9. Maintain steam generator levels at feedwater station by closing air supplies to feedwater bypass valves and controlling flow with manual feedwater bypass valve. Main steam generator feed pumps may be shut down at breakers in switchgear room. Emergency feed to steam generators may be established by opening FW-MOV-35 in Terry Turbine.

4.6 To insure adequate boron concentration shift charging pump suction to RWST by amnually opening CH-MOV-373 and CH-MOV-32. Close volume control tank outlet, CH-MOV-257. Feed and bleed to reactor coolant may be accomplished by throttling CH-V-286 (Charging Isolation) and letdown isolation (LD-V-221).

4.7 When turbine is on turning gear, break vacuum and isolate steam to turbine gland seals and air ejectors. Use hogging jet steam valves for atmospheric vent.

4.8 Commence cooldown by stopping all reactor coolant pumps from switchgear room. Open all pressurizer heater switches in cable vault.

Open steam valves to hogging jets. Lineup low point drains to blowdown tank. Open steam generator blowdown valves under sample room to increase bleed on steam generators. Maintain steam generator levels per step 4.5. Steam generator pressure may be read on local gage on main steam header in turbine building. Maintain pressurizer level as cooldown progresses to prevent core cooling actuation. When cooldown progresses to point where there is insufficient steam pressure to operate terry turbine, use condensate pump to continue feed to steam generators.

4.9 Place RHR system in service when reactor coolant pressure < 300 psig and temperature less than 300°F.

4.9.1 Open service water MOV's 5 and 6 to 1500 gpm flow as read on local indicator.

4.9.2 Close RH-MOV-21 manually.

4.9.3 Open RH-MOV-803, RH-MOV-804, RH-MOV-781 and RH-MOV-780 from MCC-5. Place ammeter on lead to valve in breaker cubicle. Hold top relay in closed position. A sharp increase in amerage will be indicated when valve is full open. Release relay and open breaker switch (valves have ∿ 50 sec. travel time).

4.9.4 Manually close discharge valves on both pumps. Open one discharge valve ∿ 1/2 turn and start that pump by manually closing breaker on 480V bus. Regulate RHR flow with pump discharge valve and regulate service water flow to RHR heat exchangers to maintain desired cooldown rate. Cool RCS to 150°F (± 25°F) as read on an incore thermocouple.

4.10 When primary system is depressurized, stop charging pump and close #1 RCP seal return MOV's from MCC-5.

*NOTE: On all MOV breakers, top relay is opening circuit and bottom relay is closing circuit.

Close CH-MOV-273 and CH-MOV-32 and reopen volume control tank outlet. This will maintain VCT pressure on RCS and insure system is solid at a slight pressure.

5.0 When steam stops issuing from hogging jets, stop steam generator feed and bleed.

5.1 To initiate core cooling outside control room.

5.1.1 Open 4 safety injection stop valves (SI-MOV-861A, B, C, & D) and core deluge valves (CD-MOV-871A & B) at MCC-5.

5.1.2 For each motor operated valve: Open valve control switch breaker open breaker cubicle door, close control switch, place tong ammeter on line to MOV, push closed top relay in cubicle and hold closed. Valve will take approximately 10 secs. to open at which time amperage reading will rise sharply. This indicates valve is open. Open control switch on breaker.

5.2 To start high pressure safety injection pumps, low pressure safety injection pumps and charging pumps.

5.2.1 Open breaker for selected pump on Bus 8 or 9 in Emergency Diesel Rooms.

5.2.2 Place jumper in cubicle as per instructions inside breaker cabinet. This jumpers cell switch allows pump start with use of test switch.

5.2.3 Turn test switch on breaker panel to closed position.

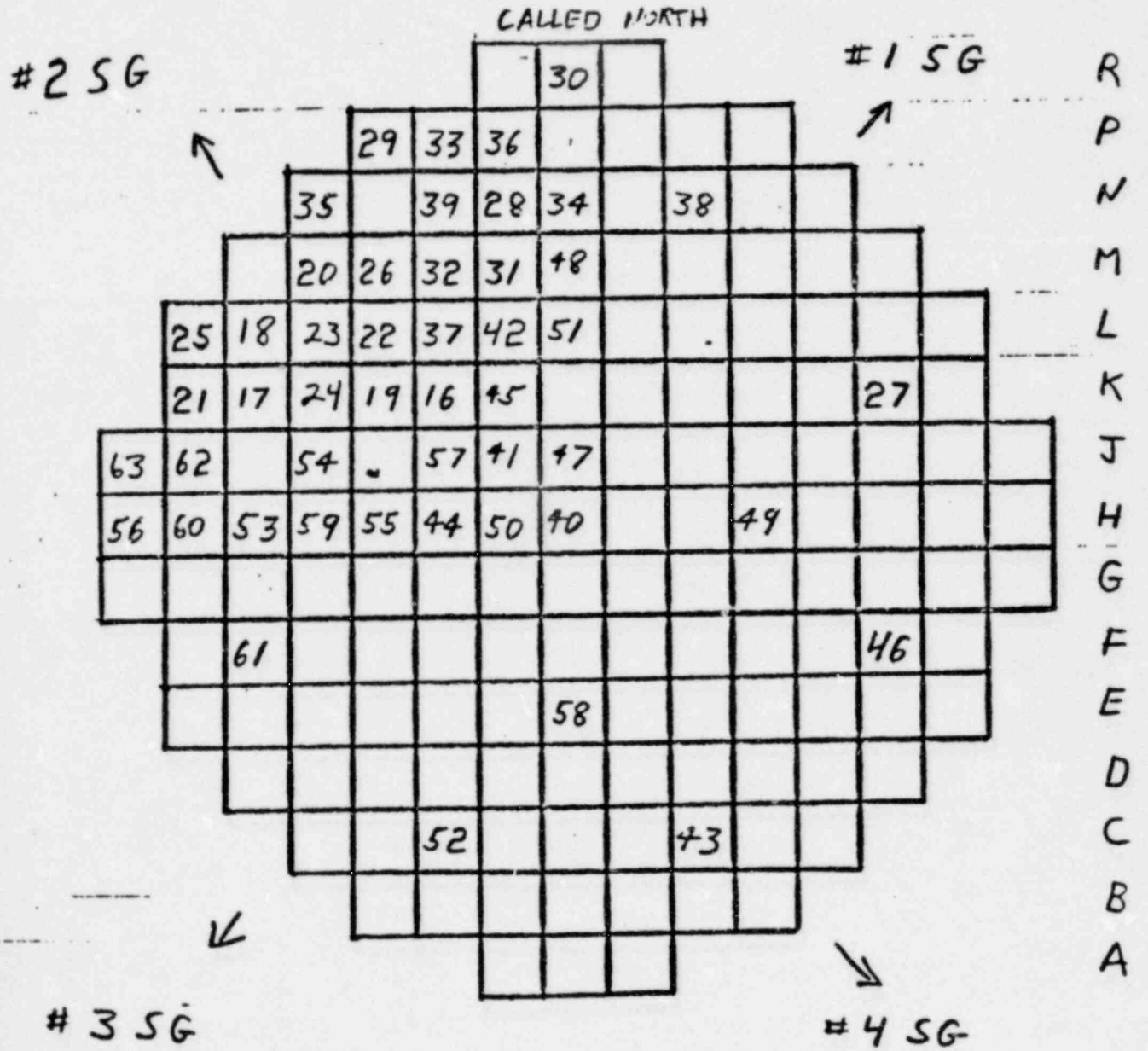
ATTACHMENT A

AOP 3.2-8
Revision 1

APR 0 8 1982

THERMOCOUPLE LOCATIONS

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1



NUMBERS IN ASSEMBLY LOCATIONS ARE MPX NUMBERS ON PENETRATION WIRES PREFIXED BY 00.

ATTACHMENT B

APR 0 8 1982

EOP 3.1-'2 READING LOCATIONS

ITEM	CHANNEL	LOCATION
Pressurizer Level 1	LT 401-1	27C 5 14&15
Pressurizer Level 2	LT 401-2	19C 4 2&3
Pressurizer Level 3	LT 401-3	13C 7 12&13
Pressurizer Level 4	LT 401-4	7A 4 10&11
Pressurizer Level Cold	LT 402	7A 4 8&9
Pressurizer Pressure 1	PT 401-1	27C 5 11&12
Pressurizer Pressure 2	PT 401-2	19C 2 18&19
Pressurezer Pressure 3	PT 401-3	13C 7 9&10
Loop 4 Pressure	PT 403	19C 4 5&6
Loop 4 Pressure	PT 404	27C 5 17&18
Steam Gen. #1 Wide Range Level	LT 1302-1	7A 2 3&4
Steam Gen. #2 Wide Range Level	LT 1302-2	7A 4 2&3
Steam Gen. #3 Wide Range Level	LT 1302-3	7A 4 18&19
Steam Gen. #4 Wide Range Level	LT 1302-4	7B 2 13&14
Steam Gen. #1 Nar. Range Level	LT 1301-1	7A 2 15&16
Steam Gen. #2 Nar. Range Level	LT 1301-2	7A 6 7&8
Steam Gen. #3 Nar. Range Level	LT 1301-3	7A 7 6&7
Steam Gen. #4 Nar. Range Level	LT 1301-4	7B 2 17&18

EOP 3.1-42 READING LOCATIONS IN-CORE THERMOCOUPLES

CORE LOCATION	MPX (Penetration #)	CORE LOCATION	MPX (Penetration #)
Hea Thermocouple (TE-415)	0015		
R-8	0030	K-11	0019
P-11	0029	K-10	0016
P-10	0033	K-9	0045
P-9	0036	K-3	0027
N-12	0035	J-15	0063
N-10	0039	J-14	0062
N-9	0028	J-12	0054
N-8	0034	J-10	0057
N-6	0038	J-9	0041
M-12	0020	J-8	0047
M-11	0026	H-15	0056
M-10	0032	H-14	0060
M-9	0031	H-13	0053
M-8	0048	H-12	0059
L-14	0025	H-11	0055
L-13	0018	H-10	0044
L-12	0023	H-9	0050
L-11	0022	H-8	0040
L-10	0037	H-5	0049
L-9	0042	F-13	0061
L-8	0051	F-3	0046
K-14	0021	E-8	0058
K-13	0017	C-10	0052
K-12	0024	C-6	0043

APPENDIX E

COMPLIANCE STATUS

DOCKET NO. 50-213

JULY, 1982

CONNECTICUT YANKEE

COMPLIANCE STATUS WITH APPENDIX R

FIRE ZONE	CURRENT COMPLIANCE	WILL COMPLY	EXEMPTION REQUESTED	PROPOSED MODIFICATIONS
A-1A	-	✓	-	Reroute RHR pump 1B cable outside this fire zone. Reroute cable for MOV 373 outside this fire zone.
A-1B	-	✓	-	Cables for MOV 373 will be rerouted outside this fire area. Cables for one of the RHR pumps will be rerouted outside this fire area.
A-1C	-	✓	-	One RHR pump cable to be rerouted outside fire zone. Install a pipe that would connect the clean recycled primary water storage tank to the auxiliary feed pump suction.
A-3	-	✓	-	MOV 292B will be deenergized to eliminate its susceptibility to hot shorts.
	-	✓	-	Cables for MOV 373 will be rerouted to eliminate common runs for the alternate charging path isolation valves.
A-4	-	✓	-	MOV 292C will be deenergized to eliminate its susceptibility to hot shorts.

CONNECTICUT YANKEE

COMPLIANCE STATUS WITH APPENDIX R

FIRE ZONE	CURRENT COMPLIANCE	WILL COMPLY	EXEMPTION REQUESTED	PROPOSED MODIFICATIONS
A-6	-	✓	-	Reroute one RHR pump cable outside this fire zone.
A-14	-	✓	-	Install curbing to access of RHR pump room. Seal access hatchways in fire zone A-1C.
A-15	-	✓	-	Install curbing to access of RHR pump room. Seal access hatchways in fire zone A-1C.
A-18	✓	-	-	None.
A-19	✓	-	-	None.
D1 & D2	✓	-	-	None.
S-1	-	-	✓	Customized administrative controls will be implemented to minimize introduction of flammable liquids in the control room. Install ramp in front of auxiliary panels to divert flammable liquid spill away from cabinets. Provide fire rated dampers for louvered openings in cabinets. Provide local electrical control for closing necessary 4.16 KV circuit breakers.

CONNECTICUT YANKEE

COMPLIANCE STATUS WITH APPENDIX R

FIRE ZONE	CURRENT COMPLIANCE	WILL COMPLY	EXEMPTION REQUESTED	PROPOSED MODIFICATIONS
S-8	-	-	✓	Move one of the station batteries to the south end of the switchgear room to provide a minimum of 20' separation. Move one battery charger and DC bus to the south end of the switchgear room to provide a minimum of 20' separation. Move two of the static inverters to the south end of the switchgear room to provide a minimum of 20' separation from the other two inverters. Reroute two channels (one division) of the instrumentation cable identified for safe shutdown for Appendix R. The cable to be rerouted originates in the control room and terminates in the cable vault. Instrumentation cable separation improvements will be realized in fire zones S-1, S-8, S-17, and R-1. Install new 480 volt load center for Division B switchgear. Install new MCC to power Division B equipment. Provide one hour fire barrier to required cables.

CONNECTICUT YANKEE

COMPLIANCE STATUS WITH APPENDIX R

FIRE ZONE	CURRENT COMPLIANCE	WILL COMPLY	EXEMPTION REQUESTED	PROPOSED MODIFICATIONS
S-9	-	-	✓	None (See Discussion in Section VII of Reference (1)).
S-17	-	-	✓	Customized administrative controls will be implemented to minimize introduction of flammable liquids in the cable spreading area. Extend the existing automatic water suppression systems to include steam generator level instrumentation cables. Reroute one division of required instrumentation cables. Reroute MOV 373 cables. Reroute cables for one RHR pump.
R-1	-	-	✓	Reroute two channels of the instrumentation cables required for Appendix R. Redundant cables (conduit runs) having a physical separation less than 20' will be enclosed in a one hour fire rated barrier.
R-2	-	✓	-	Reroute two channels of the instrumentation cables required for Appendix R. Redundant cables having a physical separation less than 20' will be separated by a radiant energy shield.

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COMPLIANCE STATUS WITH APPENDIX R

	FIRE ZONE	CURRENT COMPLIANCE	WILL COMPLY	EXEMPTION REQUESTED	PROPOSED MODIFICATIONS
	R-4	✓	-	-	None.
	R-5	-	-	✓	Install early warning detection.
	P-1/P-2	-	-	✓	Enclose each service water pump with curb/ dike.
					Enclose cable runs for two service water pumps at elevation 8'.
	Service Water Pump Cable Chase			✓	Enclose exposed cable runs with a 1 HR fire barrier.