NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203) 666-6911

April 1, 1985

Docket No. 50-423
B11497

Director of Nuclear Reactor Regulation
Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Reference: (1) U. S. Nuclear Regulatory Commission, "Safety Evaluation Report Related to the Operation of Millstone Nuclear Power Station, Unit No. 3, Docket No. 50-423 (NUREG-1031)," July, 1984.

Dear Mr. Youngblood:

Millstone Nuclear Power Station, Unit No. 3
Power Systems Branch Electrical (PSBE)
SER Confirmatory Items 44, 45, 46 and 50

Attached are three (3) copies of revisions to Sections 8.2 and 8.3 of the Millstone Unit No. 3, FSAR. These revisions close SER Confirmatory Items 44, 45, 46, and 50 (Reference 1). All information contained in the FSAR revisions has been discussed with your Mr. John Knox, Power Systems Branch Electrical, and was provided in our responses to NRC questions 430.4, 430.5, 430.7, and 430.9, corresponding to SER Confirmatory Items 44, 45, 46 and 50, respectively. The attached revisions respond to Mr. Knox's request for the information to be incorporated in the FSAR text. Revisions are provided as they will appear in Amendment 13 of the FSAR.

If you have any concerns related to the information contained herein, please contact our licensing representative directly.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY
et. al.
BY NORTHEAST NUCLEAR ENERGY COMPANY
Their Agent

W. G. Counsil

W. G. Counsil
Senior Vice President

B001
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STATE OF CONNECTICUT)
) ss. Berlin
COUNTY OF HARTFORD)

Then personally appeared before me W. G. Counsil, who being duly sworn, did state that he is Senior Vice President of Northeast Nuclear Energy Company, an Applicant herein, that he is authorized to execute and file the foregoing information in the name and on behalf of the Applicants herein and that the statements contained in said information are true and correct to the best of his knowledge and belief.

Lorraine J. D'Amico
Notary Public

My Commission Expires March 31, 1988

8.2 OFFSITE POWER SYSTEM

8.2.1 Description

The offsite power system is designed to provide reliable sources of power to the onsite ac power distribution system adequate for the safe shutdown of the unit in compliance with General Design Criterion 17 (GDC-17). Details of the offsite power system are shown on the following figures:

1. Exclusion Area (Figure 1.2-1)
2. Plot Plan (Figure 1.2-2)
3. Transmission Map (Figure 8.1-2)
4. 345 kV Switchyard (Figure 8.1-3)

The switchyard, which is configured in a breaker and a half arrangement, busses together four 345 kV transmission line circuits, three generator circuits and three station service circuits

The four transmission line circuits to be terminated at the switchyard are:

1. Millstone to Card (Line No. 383)
2. Millstone to Montville (Line No. 371)
3. Millstone to Southington (Line No. 348)
4. Millstone to Manchester (Line No. 310) - inservice in 1985

These circuits connect the station to the system transmission grid and follow a common right-of-way from Millstone to Hunts Brook Junction (9.0 miles). For the first 1.7 miles of this right-of-way, the construction consists of two double circuit steel-pole transmission lines. For the next 2.4 miles, the construction consists of one double circuit steel-pole transmission line (Line Nos. 348 and 310) and two single circuit wood-pole H-frame transmission lines (Line Nos. 371 and 383). For the remaining 4.9 miles, single circuit wood-pole H-frame construction is used for all four circuits.

At Hunts Brook junction, the four transmission line circuits diverge along three separate rights-of-way. The 371 line consisting predominantly of wood-pole H-frame construction, follows an easterly right-of-way for approximately 3.6 miles to the Montville substation. The 348 line consisting almost entirely of wood-pole H-frame construction with only a few exceptions where steel structures are utilized, follows a westerly right-of-way for 44 miles to the Southington substation. The 310 and 383 lines utilizing primarily single circuit wood-pole H-frame construction proceed along a

northerly right-of-way for 38 miles and 20 miles to the Manchester and Card substations respectively.

insert A
Q430.4

Separate and independent structures are provided for each of the six 345 kV transmission lines connecting generators 1, 2 and 3 and reserve station service transformers 1, 2 and 3 to the switchyard.

insert B
Q430.5

The inspection and testing of the 345-kV circuit breakers and the transmission line protective relaying are done on a routine basis, without removing the generators, transformers, and transmission lines from service. The insulating oil for the transformers is sampled and tested on a routine basis. During these routine inspections and tests, the operability and functional performance of the electric systems are in compliance with General Design Criterion 18, "Inspection and Testing of Electric Power Systems."

8.2.2 Analysis

The possibility of power failure due to faults in the connections to the system and the associated switchyard is minimized by the following arrangements:

1. The connections to the system have been designed to comply with the Northeast Power Coordinating Council "Basic Criteria for the Design and Operation of Interconnected Power Systems" and the "Reliability Standards for the New England Interconnected Power Pool" adopted by that pool. Compliance with these criteria ensure that the supply of offsite power will not be lost following severe faults in the interconnected transmission system. Transient stability studies have been performed to verify that widespread or cascading interruptions to service will not result from these contingencies. In addition, the loss of Millstone 3 or the loss of any other generating plant in the system will not result in cascading system outages and thus will not cause loss of offsite power to the units.

   The 345 kV circuit breakers are air blast type and are pneumatically operated. Electrical controls are provided for both local and remote (Millstone 1 control room) operation. Each power circuit breaker has a separate pneumatic supply unit capable of operating the breaker for five close-open operations after the loss of the compressor. Each pneumatic compressor is supplied from a separate feeder at the switchyard essential ac panel. The circuit breakers are equipped with a closing solenoid and two trip solenoids. A standard anti-pump and trip-free control scheme is used.

   Primary and backup relaying are both high speed protective schemes. Primary and backup protective relays are used, along with breaker failure relaying to provide redundant protective relaying for the switchyard.

Two 125V dc batteries are located in the switchyard control and relay enclosure for switchyard relaying and control. Each battery has its own charger and dc distribution panel. The redundant batteries and protective relaying systems are physically and electrically separate. The essential ac station service for the power circuit breaker pneumatic supply units and the other switchyard requirements is supplied from one of two separate sources.

2. The 345-kV system is protected from lightning and switching surges by overhead electrostatic shield wires, surge arrestors on main buses, and rod gaps on the disconnect switches.

3. Primary and backup relaying is provided for each circuit along with circuit breaker failure backup protection. These provisions permit the following:

   a. Any circuit can be switched under normal or fault conditions without affecting another circuit.

   b. Any single circuit breaker can be isolated for maintenance without interrupting power or protection of any circuit.

   c. Short circuits on any section of a bus are isolated without interrupting service to any element other than those connected to the faulty bus section.

   d. The failure of any circuit breaker to trip initiates the automatic tripping of the adjacent breaker or breakers and thus may result in the loss of a line or generator for this contingency condition; however, power can be restored to the good element in less than 1 hour by manually isolating the fault with appropriate disconnect switches.

Complete battery failure is considered highly unlikely since two independent 125V dc battery systems are provided. Failure of a single battery system results only in a momentary loss of one set of protective relays until the DC is manually transferred to the other battery. Therefore, no single failure could negate the effectiveness of the relaying to clear a fault.

Physical separation of the offsite power sources, switchyard protection, redundancy, and transmission system design based on load flow and stability analyses minimize the possibility of simultaneous failure of power sources (normal station service supply, reserve station service supply and standby ac emergency generators) in compliance with General Design Criterion No. 17 "Electric Power Systems."

The 345 kV transmission system supplying offsite power to Millstone is normally operated at 357 kV at Millstone. This system voltage is

controlled by varying the reactive power generation on the Millstone units. The Millstone 1 and 2 operators control the unit excitation as specified by CONVEX Operation Instruction No. 6913. When Millstone 3 is placed in service, it will be included in the voltage regulation scheme. The unit operators are required to balance the reactive power output of the units.

The CONVEX system operator supervises the system reactive power dispatch. He directs the loading of all of the reactive power sources in CONVEX to balance the reactive supply. He keeps the Millstone reactive power generation in balance with the Eastern Area requirements so that the effect on the system of voltage variations is minimized when a unit is lost.

One objective of the reactive power dispatch is to prevent the voltage at Millstone from going below the minimum required by Millstone 1 reserve station service transformer. The maximum allowable voltage at Millstone is 362 kV based on equipment ratings.

If abnormal system conditions result in voltages approaching minimum levels, the "Guidelines for Dispatch of Reactive Power on the Northeast Utilities System" directs the CONVEX operator to take specific corrective actions to restore voltage. Many of these actions will also be taken when the Millstone reactive power output reaches 400 MVAR (with two units in service).

Actual experience and system simulations show that the CONVEX operator is able to control the system voltages within the desired limits.

The Millstone plant is connected to the transmission system by four 345-kV circuits (described in Section 8.2.1). For a short distance, these lines are on double circuit steel poles. Stability studies show that the plant remains in synchronism with the rest of the system, even if two 345-kV circuits are lost simultaneously as a result of a 3-phase fault.

Q430.1 2 The loss of any single 345 kV circuit will have a negligible effect on the Millstone units. Hence, no single circuit is critical to the operation of the units, the switchyard, the transmission system and the supply of offsite power. Furthermore, the loss of a second 345 kV circuit has been analyzed (i.e., after one has already been switched out of service) and results show that the loss will not result in instability of the Millstone units and will not cause facilities remaining in service to be loaded beyond acceptable limits.

The loss of a Millstone unit will not affect system stability. insert C Q430.7

The Millstone units are connected to the large interconnected transmission system in the eastern half of the United States. The interconnected system frequency is a 60± 0.03 Hz. Loss of large amounts of generation result in frequencies of as low as 59.94 Hz which recover to 60 Hz within a few minutes.

In order to have large frequency deviations at Millstone, it is necessary to isolate the plant with a large excess of load. The only possible system separation which would accomplish this would be to isolate the State of Connecticut. This requires the overlapping loss of three 345 kV, one 138 kV, and one 115 kV circuit at a time when Connecticut is importing power.

If the 138 kV and 115 kV ties are neglected and assume that the outage of the three 345 kV ties are statistically independent events, one occurrence every 1.4 million years could be expected. Since the three 345 kV transmission circuits are more than 20 miles apart, statistical independence is a reasonable assumption. However, even if we assume that only two of the three events are statistcially independent, we would expect the occurrence to be only one in 1,148 years could be expected.

The occurrence of a large Connecticut import at the same time has not been included in the statistical calculations. Including the probability of a large import at the time the three 345 kV circuits were lost would increase the time between events.

insert D Q430.7
p. 2→6.

Insert A

The four lines emanating from the Millstone Switching Station will be in compliance with the staff position that no other transmission lines cross over these four lines and that the four lines be physically separate and independent so that no single event such as a tower falling or line breaking will be able to simultaneously affect all circuits in such a way that none of the four circuits can be returned to service in time to prevent fuel design limits or design conditions of the reactor coolant pressure boundary from being exceeded. Figure 8.2-1, taken from the Connecticut Siting Council Docket No. 25, Application for the Millstone to Manchester 345 kV line, shows the right-of-way cross sections between Millstone and Hunts Brook Junction. The double circuit steel pole structures between Millstone and I-95 average 120 feet above ground while the wood pole H-frame structures between Daniels Avenue and Hunts Brook Junction average 85 feet above ground.

In the event of a structure failure between Millstone and Hunts Brook Junction, the worst probable longer-than-momentary outage would be a loss of two circuits; i.e., the two circuits on a common steel pole or an H-frame structure falling into an adjacent line.

At Hunts Brook Junction, the four lines split (see Figure 8.2-2). The 348 line turns west to Southington Substation, the 383 and new 310 lines continue north to Card Street and Manchester Substation respectively, and the 371 line turns east to Montville Substation. One aerial crossover of a line from Millstone exists at this junction (383 crosses 371). But, at worst, only two of the four circuits from the Millstone Switching Station would be removed from service should a structure collapse.

Insert B

The Millstone design provides two immediate access off-site circuits between the switchyard and the 4.16 kV Class IE buses. The design of two off-site circuits from the 345 kV switchyard to the 4.16 kV Class 1E buses is via separate transformers (main/normal station service and reserve station service). FSAR Figure 8.1-1 shows the tie lines, transformer and bus arrangement connections.

The tie lines to the main/normal station service transformers and to the reserve station service transformer are physically separate and electrically independent. The main/normal station service transformers and the reserve station service transformers are located at opposite ends of the plant. The connection from the normal station service transformers and from the reserve station service transformers to the 4.16 kV Class 1E buses is via physically separate and electrically independent underground duct lines. FSAR Figure 1.2-1 shows the tie line routes from the switchyard to the main/normal and to the reserve station service transformers. FSAR Figure 1.2-2 shows the physical separation between the normal station service and the reserve station service transformers. FSAR Figure 8.3-7, Sheets 1 and 2, shows the embedded conduit duct lines as they enter the redundant switchgear rooms in the control building.

The control power for these buses is from different dc panels and batteries. The breakers in the Class 1E buses (34C and D) are independently protected with separate relaying.

These circuits are completely redundant and separated so that no single failure can disable both off-site power supplies to the Class 1E buses; therefore, the design is in compliance with General Design Criterion 17, Electrical Power Systems.

Insert C

By careful design of the switchyard and protective relays, NU has practically eliminated the possibility of the simultaneous loss of three units at Millstone. Nevertheless, the loss of the Millstone plant and all four transmission circuits has been simulated in design studies. The transmission circuits were outaged along with the station in order to simulate worst case conditions, and this outage was simulated both with and without a fault.

The stability analysis indicates that the rest of the system will remain in synchronism after the loss of the entire output of the Millstone station. The system was modelled for one set of operating conditions; hence, it is possible that a similar test under heavy transfer conditions within the interconnected system might result in instability. However, we are certain that the probability of losing all three units simultaneously is extremely small because of the preventive measures discussed in the following paragraphs. Accordingly, NU believes it is reasonable to count upon onsite power sources to supply the necessary station service power requirements in the very remote event that all three Millstone units should be lost at once accompanied by the total loss of the transmission supply to the station.

A primary objective in designing the connection of the Millstone Nuclear Power Station to the 345 kV transmission network in Connecticut has been to prevent the loss of the entire station output. The reliability criteria of the Northeast Power Coordinating Council (NPCC) and the New England Power Pool (NEPOOL) are a fundamental part of this design process. The following are the most severe outages which the system has been designed to survive in order to minimize the possibility of a total plant outage:

a. With any one of the four Millstone 345 kV transmission circuits out of service, the plant remains stable for any three-phase fault normally cleared (four cycles) or any one-phase fault normally cleared (four cycles) or any one-phase fault with delayed clearing (nine cycles). These tests are done with maximum generation at Millstone to simulate worst case conditions.

b. The reliability criteria further requires testing to determine if the loss of two circuits on a common structure can be tolerated. The event which is used to test the loss of the two circuits is a simultaneous line to ground fault on different phases of the two circuits. With all lines in service, the system remains stable for this two circuit disturbance. It should be recognized that the four circuits leaving the Millstone switchyard are paired on two rows of double circuit structures for only a short distance, and, hence the exposure to this outage is small.

c. Also, the simultaneous loss of two Millstone circuits on common structures following a previous (nonsimultaneous) outage of either of the other Millstone circuits (or any other critical element) must not result in instability. All of the critical outages of this type effectively result in the loss of three of the four Millstone circuits and leave the Millstone station weakly tied to the transmission grid. To prevent instability for these extremely severe (and highly improbable) disturbances, it is necessary to reduce output after the initial line outage and before the loss of the two circuits on common structures takes place and/or install an automatic generation rejection scheme.

Insert D

Because of the significant economic penalties involved, the reduction of generation after the initial line outage is considered a highly undesirable solution to the potential stability problems identified in Item (c) above and should be avoided to the extent possible. Therefore, a post disturbance generation curtailment scheme has been provided. This system continuously monitors the individual state of six critical system components together with the generation output at the Millstone complex. Should the system condition arise where 1) any one of the six critical lines or elements is unavailable, 2) the generation at Millstone is above a predetermined MW level and 3) two specific transmission circuits are forced out, then generation will automatically be curtailed at Millstone. Stability studies indicate that during maximum output conditions (2640 MW), Millstone Units 1 and 3 can be successfully tripped and system stability maintained leaving Millstone Unit 2 in synchronism with the transmission network. The tripping of these units results in a generation reduction of up to approximately 1,810 MW with 870 MW remaining synchronized. This generation reduction scheme is called a Severe Line Outage Detection (SLOD).

The operation of the Millstone generation rejection scheme is based on the outage of combinations of certain transmission circuit elements. The scheme has been named Severe Line Outage Detection (SLOD).

This system will continuously monitor the individual status of six critical transmission elements in the area of the Millstone Station together with the generation output of the Millstone complex.

Generation will be curtailed automatically if a system condition arises where any of ten combinations of the six elements are outaged, and generation at Millstone is above 1,200 MW.

To monitor the status of the 345 kV system, SLOD equipment has been required at the Millstone and at Montville switchyards. In addition, it will be necessary to install high speed back-up relay protection with a permissive overreaching audio-tone scheme on both ends of the Millstone to Manchester and the Millstone to Southington lines.

At Millstone, three logic packages will be provided. The operation of any two logic units will provide a tripping output. The current detecting devices of each logic package will sense the available state of each of the four transmission circuits emanating from the Millstone switchyard. Signals indicating the availability state of two remote components (the Montville 345 kV tie breaker and the Montville - Haddam Neck line) will be transmitted to Millstone. The megawatt output from each of the Millstone units will be measured and summed to provide an indication of the total megawatt output of the Millstone units. Should the comparative logic in the SLOD package indicate that any one of the combinations of transmission outages listed below exist, and the generation level at the Millstone Station is above 1,200 MW, then Millstone Units 1 and 3 will be curtailed immediately.

INSERT D

The combinations of unavailable components which must be monitored are:

1. Necessary to meet NPCC and NEPOOL criteria:

   Millstone - Manchester, Millstone - Card and Millstone - Montville

   Millstone - Southington, Millstone - Card and Millstone - Montville

   Millstone - Montville, Millstone - Manchester and Millstone - Southington

   Millstone - Card, Millstone - Manchester and Millstone - Southington

   Montville - Haddam Neck, Millstone - Manchester and Millstone - Southington

   Montville 345 kV tie breaker, Millstone - Manchester and Millstone - Southington

2. Also included to simplify the SLOD package logic but not required to meet NPCC and NEPOOL criteria are:

   Millstone - Southington, Millstone - Card and Montville - Haddam Neck

   Millstone - Manchester, Millstone - Card and Montville - Haddam Neck

   Millstone - Southington, Millstone - Card and Montville 345 kV tie breaker

   Millstone - Manchester, Millstone - Card and Montville 345 kV tie breaker

As mentioned above, signals indicating the availability status of the two remote components at Montville are required at Millstone. To monitor the status of the 345 kV circuit breaker at Montville, and the availability of the Montville-Haddam Neck line, three logic units will be required at Montville. The three independent logic packages will supply information to the Millstone logic packages via an independent transfer trip tone transmitter.

Since the operation of the generation rejection scheme should take place in less than 12 cycles to maintain stability, all transmission line faults must be cleared at high speed. This will require the addition of high speed back-up protection using permissive overreaching audio-tone equipment on the Millstone-Manchester line and the Millstone-Southington line at both terminals.

With the generation rejection scheme in service, it will be permissible to operate with high Millstone Station output when any one of six critical transmission elements is out of service. As a member of NEPOOL and the NPCC, the Applicant will be required to comply with either of the following operability requirements with one line out of service:

1. have SLOD fully operational, or

2. reduce load to a total station output of 1,200 MW within 4 hours.

These instructions will be documented as part of the Connecticut Valley Electric Exchange (CONVEX) operating instructions for the Millstone switchyard and will be regulated by CONVEX. To facilitate regulation, CONVEX is aware of the condition of all lines and the status of the SLOD scheme via an annunciator located at CONVEX (CONVEX is an operating division of NEPOOL).

The operability requirements specified above ensure that, upon loss of a double circuit line with a third line out of service and generation in excess of 1,200 MW, offsite power will be available for safe shutdown; maintaining system stability minimizes the probability of coincident loss of both offsite supplies. This is consistent with the requirements of General Design Criterion (GDC) 17.

GDC 17 also requires that the probability of losing an offsite supply coincident with loss of the nuclear power unit be minimized. Because of the necessity for SLOD to complete its function within 12 cycles, SLOD trips Millstone 3 by tripping the switchyard breakers instead of the generator breaker (this eliminates the extra time required for relay and communication channel operation in a transfer trip scheme). Under these conditions, station auxiliary loads high speed transfer to the reserve station service transformers, and the normal station service transformer (which is tripped when SLOD trips Unit 3) can be reenergized by closing a switchyard breaker. Therefore, both offsite supplies will be available to ensure safe shutdown of the unit in accordance with GDC 17.

The SLOD scheme was manufactured to be a reliable unit. Each line is monitored by a logic package which utilizes redundant channels (two-out-of-three logic) in case of a failure of one channel. Each logic package alarms in the event of a channel failure and triggers a SLOD trouble alarm in the Millstone Unit 1 control room and at CONVEX. Also, a failed channel causes arming of the logic, indicating the monitored system component to be out of service. Additionally, every 8 hours, the SLOD scheme automatically tests one channel, yielding a complete scheme verification once every 24 hours. In the event of failure, a SLOD trouble alarm is actuated in the Millstone Unit 1 control room and at CONVEX. Upon receiving the SLOD trouble alarm, the operator will dispatch a person to the Millstone switchyard control house to evaluate the condition of the system. In the event that one line is out of service and the SLOD system is not operating in one hour, CONVEX will reduce station output to 1,200 MW or below during the next 3 hours. The continual channel surveillance and periodic (8 hours) functional tests that are run automatically ensure conformance to GDC 18.

Additional testing was carried out for possible but improbable (PBI) events which are specified in the NPCC and NEPOOL reliability criteria. The one PBI event which could have a serious effect at Millstone is a three-phase fault followed by delayed clearing due to a three-phase stuck circuit breaker. This results in the Millstone units losing synchronism. This stability problem has been eliminated by designing the protective relay schemes and circuit breaker installations so that at most, one pole will fail to clear. The breakers which are designed to meet this criteria are classified as having independent pole tripping.

NU insures independent pole tripping by installing breakers with mechanically independent poles and two separate methods of tripping the circuit breaker. These installations include two sets of relays and trip coils. There are two sets of current and potential transformers, the wiring for the relay packages are installed in separate duct banks, the relay packages are physically separated in the control house and two separate dc supplies are provided.

The 345 kV switchyard at Millstone is designed so that the loss of more than one transmission circuit due to a failure of a breaker to trip requires at least two circuit breakers to simulataneously fail to operate. The failure of even one circuit breaker is very unusual. At least three circuit breakers would have to fail before three transmission lines would be lost due to malfunctions in the switchyard. At that point, the generation rejection scheme would operate to keep one unit in service. In order to lose the entire station, at least four circuit breakers must fail.

To summarize: The Company is taking extensive precautions to prevent the sudden loss of the three generating units at Millstone Station and the simultaneous loss of off-site power. We believe these measures make the probability of such an occurrence extremely small.

TYPICAL RIGHT-OF-WAY CROSS SECTIONS

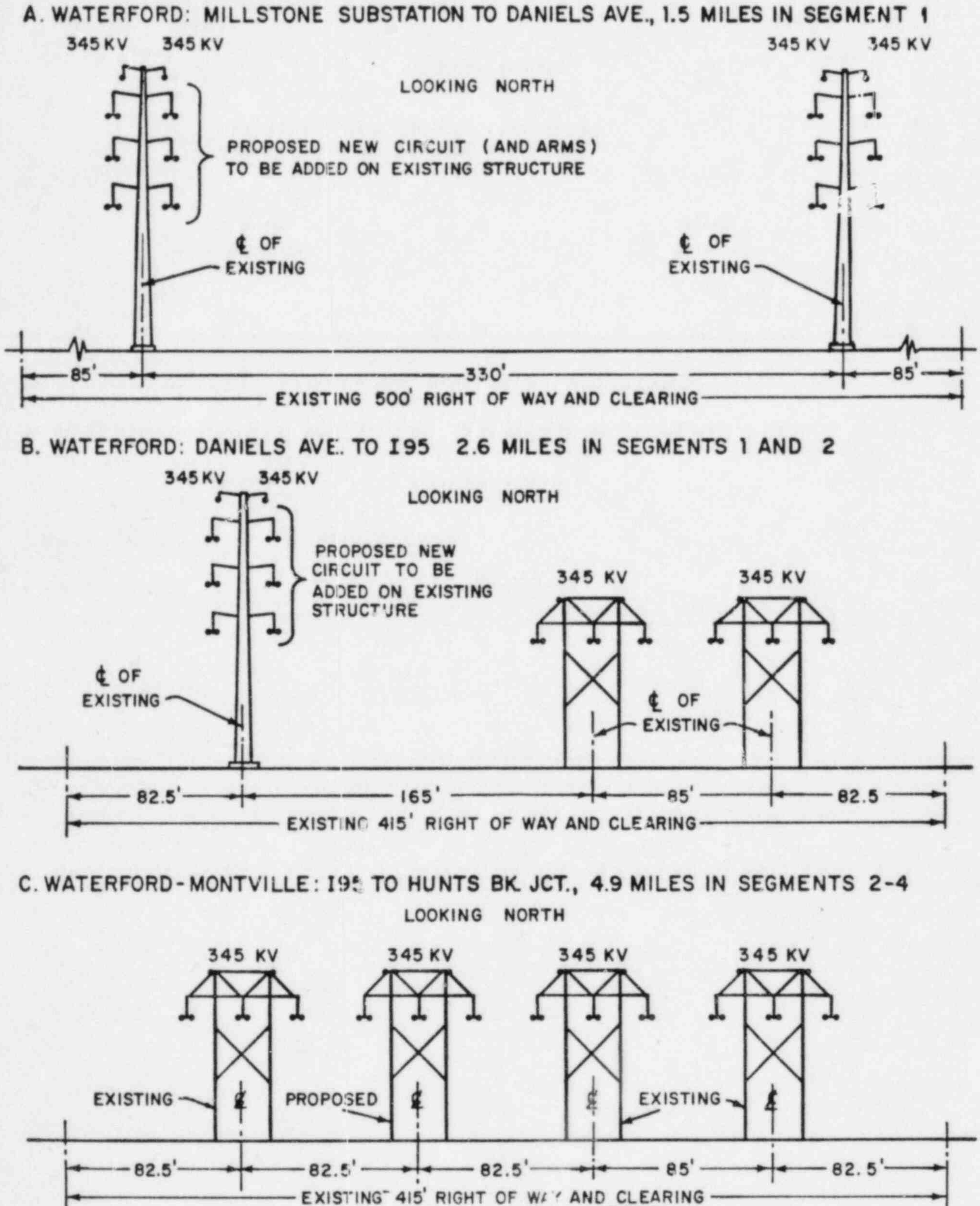
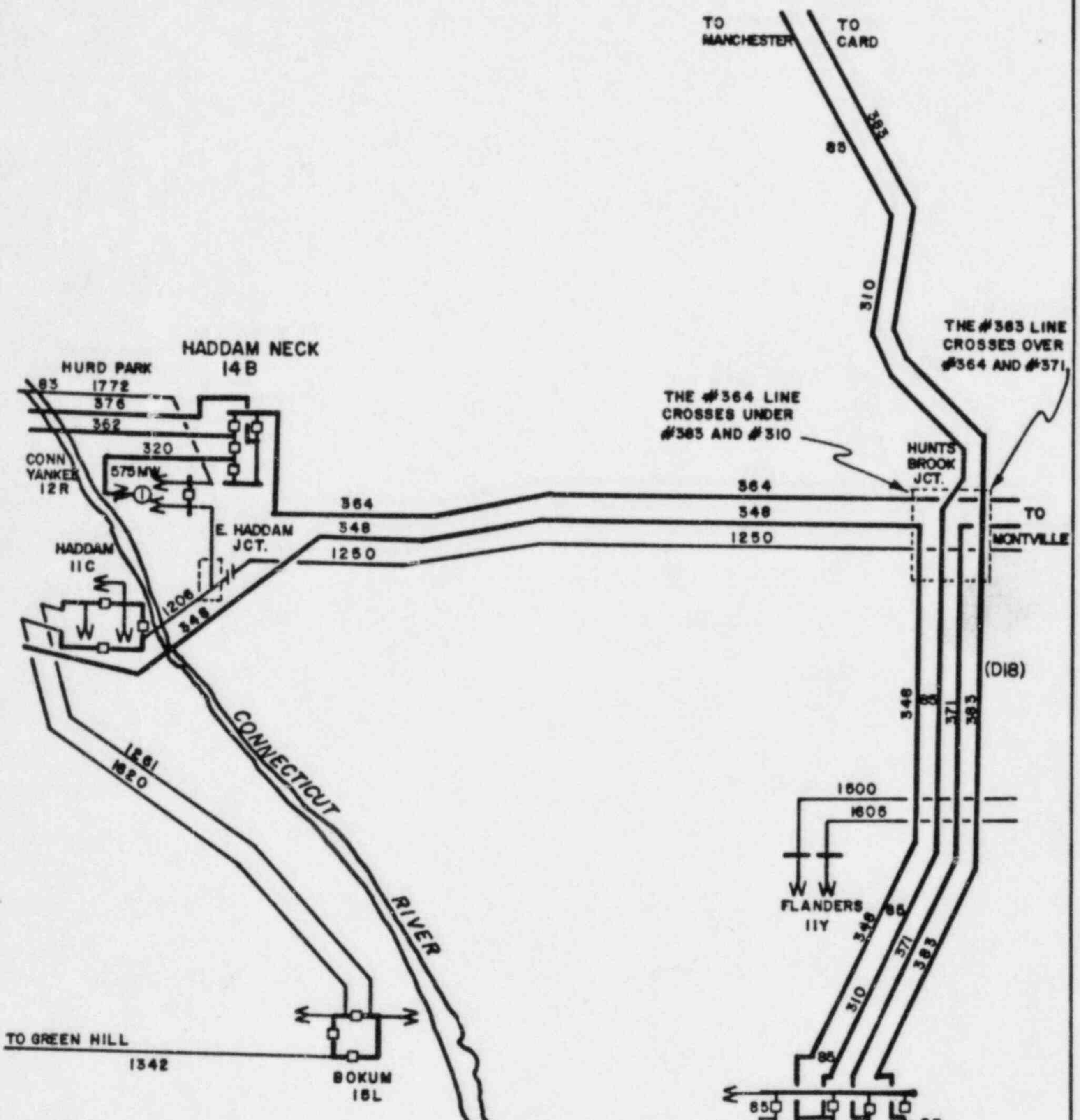


FIGURE Q 430.4-1 8.2-1

MILLSTONE-MANCHESTER 345KV LINE
MILLSTONE NUCLEAR POWER STATION
UNIT 3
FINAL SAFETY ANALYSIS REPORT



PLANNING ONLY
DO NOT USE FOR DESIGN

FIGURE Q430.4-2 8.2-2

HUNTS BROOK JUNCTION

MILLSTONE NUCLEAR POWER STATION
UNIT 3
FINAL SAFETY ANALYSIS REPORT

Time-overcurrent relays are provided for the reserve station service supply (i.e. alternate source) breakers. These relays provide protection against overload, low energy multiphase, and phase-to-ground faults. Additionally, instantaneous directional phase overcurrent and ground overcurrent relays are provided for these supply breakers. These relays provide protection against (i.e. by isolating the emergency bus) multiphase and ground faults external to the emergency bus by isolating the emergency bus.

b. Differential Bus Protection, Emergency Switchgear - Each emergency 4.16 kV bus is protected against multiphase-to-phase and phase-to-ground faults by high impedance differential relays. Under accident condition when emergency bus is being fed by the emergency generator, sequential tripping is introduced for ground faults. The generator neutral breaker is tripped first which will clear ground faults by ungrounding the system.

c. Undervoltage Bus Protection, Emergency Switchgear - Each emergency 4.16 kV bus is furnished with two undervoltage detection schemes.

Loss of voltage scheme with two-out-of-four logic is provided to detect voltage drop below acceptable level. After sufficient time delay to coordinate with overcurrent fault protection, this scheme will start the diesel generator, trip motors through the sequencer, and load the emergency generator as required.

Degraded voltage scheme with two-out-of-four logic is provided to detect prolonged voltage drop to the level which could be detrimental to operation of the emergency equipment if allowed to continue. Under accident conditions when the emergency generator is ready to accept load, this scheme will trip motors through the sequencer and load the emergency generator as required. Under normal conditions this scheme will start the emergency generator and, when it is ready to accept load, will trip motors through the sequencer and load the emergency generator as required.

← insert X Q430.9

d. Emergency Generator, Emergency Switchgear - The design of the electrical protective trip circuits of the emergency generator is consistent with minimizing the likelihood of false emergency generator trips during emergency conditions, as described in Section 8.3.1.1.3.

Insert X

The degraded voltage scheme with two-out-of-four logic provided for each 4.16 kV Class 1E bus is described in the following drawings, and logic and elementary diagrams (refer to FSAR Section 1.7):

One Line Drawings

12179-EE-1K
12179-EE-1M

Logic Diagrams

12179-LSK-24-3C, D, H, J, K
12179-LSK-24-4A, B

Elementary Diagrams

12179-ESK-5BD, BE, BF, BG
12179-ESK-7J, L

The Millstone 3 design complies with the guidelines of Position 1 of Branch Technical Position PSB-1 of NUREG-0800 in the following manner:

The second level of protection is in addition to the undervoltage scheme which also employs a two-out-of-four coincidence logic to prevent spurious trips of the offsite power source. Two separate time delays are incorporated in the degraded voltage scheme. The first time delay establishes the existence of a sustained degraded voltage on the bus. Following the delay, an alarm in the control room alerts the operator to the degraded condition. The subsequent occurrence of an accident signal (SIS or CDA) will immediately separate the Class 1E distribution system from the offsite power system. The second time delay is of a limited duration such that the permanent connected Class 1E loads will not be damaged. Following the delay, if the operator has failed to restore adequate voltages, the Class 1E distribution system is automatically separated from the offsite power system. No bypasses are incorporated in the scheme.

The Class 1E voltage sensors are physically located and electrically connected to the Class 1E switchgear. Test and calibration of the voltage sensors during power operation can be performed on an individual relay basis.

The Technical Specification will include limiting condition for operation, surveillance requirements, trip setpoints, and allowable values for the second-level voltage protection sensors and associated time delay devices.