JAN 5 1970

50-247

R. T. Carlson, Senior Reactor Inspector
Region I, Division of Compliance

QC TASK FORCE INSPECTION "FEEDER" REPORT: INDIAN POINT NO. 2 PLANT

Attached is our report covering the Indian Point No. 2 Plant inspection of December 15-19, 1969. We appreciated the opportunity to work with G. L. Madsen and the other people of the task force. Should you have any questions on the report, please contact us.

Original signed by
Olan D. Parr

Olan D. Parr
Instrumentation & Power
Technology Branch
Division of Reactor Licensing

RT-955A
DRL:I&PTB:ODP

/s/

Vincent D. Thomas
CO:HQ
Division of Compliance

Enclosure:
Report of Inspection

cc: J. P. O'Reilly, CO:HQ
H. R. Denton, CO:HQ
G. L. Madsen, CO I

Distribution:
Suppl.
DRL Reading
AD/RT Reading
I&PTB Reading

bcc: S. Levine
R. DeYoung
V. Moore
V. Thomas
O. Parr

8111140496 700105
ADOCK 05000247

OFFICE ▶	DRL:I&PTB	CO:HQ				
SURNAME ▶	ODP OParr:ese	VDT VThomas				
DATE ▶	1/5/70	1/5/70				

Form AEC-318 (Rev. 9-53)

U.S. GOVERNMENT PRINTING OFFICE : 1966—O-214-629

JAN 5 1970

U.S. ATOMIC ENERGY COMMISSION

DIVISION OF REACTOR LICENSING

Report of Inspection

Licensee: Indian Point 2

Consolidated Edison

Docket No. 50-247

Date of Inspection: December 15 - 19, 1969

Inspected by: _____ _____

O. D. Parr, I&PT Branch

_____ _____

V. D. Thomas, CO:HQ

Proprietary Information: None

SCOPE

An announced inspection was performed at the Indian Point 2 Plant of the Consolidated Edison Company located near Buchanan, New York.

The inspection was a task force effort involving other inspectors. This report is limited to those electrical areas examined by Messrs. V. D. Thomas and O. D. Parr, and is intended as a supplement for the use of the regular assigned reactor inspector in his overall performance analysis of the licensee.

Since time did not permit, the instrumentation aspects of the protective systems mentioned in the supplement list (Memorandum - Denton to Carlson of December 10, 1969) were not inspected.

This inspection was made more difficult than expected because the WEDCO organization is not in full operation nor do all parties involved fully understand WEDCO's methods of operation.

Consolidated Edison stated that the electrical cable installation was 66 per cent complete as of November 1, 1969.

SUMMARY

Significant Items

1. Electrical Installation Control - Four areas of concern were noted as follows:

   a. The United Engineers construction drawings do not specify how cables are to enter or exit wireways, enter or exit nodes, or change wireways or direction. The protection of redundancy (separation) at these points is left to the trades. There are many violations of acceptable cable separation at these points. Control room floor slots are not identified.

   b. The conduit and cable schedule is a computer printout. The

computer was not programmed to identify redundant protection system cables in the same wireways. Further, the use of the computer was discontinued, except inside containment, when the cable trays reached 70% fill.

c. The identification of protection system cables is minimal - The cable markers being installed do not uniquely identify protection system cables. While individual conductor markers are to be added, none are presently installed. WEDCO stated the nuclear instrumentation conduits would be color coded.

d. It appears that no one has actually checked the Westinghouse/ United Engineers design of cable runs as to redundancy. (separation). Con Ed Engineering (New York City) assured the writers that they would undertake this area of concern.

2. Battery Room - The details of the ventilation system for the battery rooms show a common discharge fan. Further, fluorescent lighting fixtures are used.

3. QA-QC - WEDCO, United Engineers and Fischbach and Moore, Inc. are not presently performing an effective, independent QA-QC review of the electrical installation. WEDCO appears to have tightened up their scheduling. This, however, should have only a minor effect on their QA-QC activities. Con Ed QA-QC has begun a checkout of installed cables.

4. Electrical Installation Housekeeping was poor in the control and diesel rooms.

5. Splices are used in electrical cables in two cases: at the electrical penetrations and for joining above and below ground cables.

6. Several items were identified which DRL will investigate further.

Management Interview

As G. L. Madsen of your office was present at both the initial and exit interviews, we will make no comments on either of those meetings or provide a list of the personnel contacted.

DETAILS

ELECTRICAL INSTALLATION CONTROL

United Engineers and Constructors Inc. of Philadelphia working from information provided by Westinghouse Electric Corporation of Pittsburgh prepares electrical construction drawings (conduit and cable schedules) for the site. These drawings consist of the following:

Report A	Cable Pulling Schedule
Report B	Cable Connection Schedules
Report C	Conduit Schedules
Report D	Tray Loading

Report E	Conduit - Bill of Material
Report F	Tray - Bill of Material
Report G	Wire and Cable - Bill of Material
Report H	Raceway Templates
Report I	Cable Templates

Initially a computer was used to aid in the conduit and cable schedules specifically to monitor for tray fill. United Engineers discontinued the use of the computer except for inside containment when tray fills of 70% were reached as the computer attempted to reroute cables already installed. At no time was the computer programmed to check for violations of redundancy.

Copies of the conduit and cable schedules are provided to WEDCO and Con Ed. WEDCO provides copies of the schedules to their electrical subcontractor, Fischbach and Moore, Inc. F and M converts the information contained in the schedules into cable pulling slips, Figure 1, which provide greater ease for field installation. For example, all the cables for a given wireway are provided on one cable pulling slip. The cable pulling slips are provided to the F and M cable pulling crews who make up cable markers for both ends of each cable. These markers do not uniquely identify protection system cables. The cables are pulled in and the cable markers are attached. The cable installation is indicated as complete by the cable pulling crew entering the actual cable length on the cable pull slip. The cable pull slips

are returned to the F and M field office where the information is extracted and entered on the United Engineers conduit and cable schedules.

The cables are terminated by the F and M terminating crews. They determine that the proper cable is installed between the proper two destinations or "nodes." They do not check the cable routing. They check each conductor of each cable for continuity and then make the connections at each "node" using wiring diagrams and/or cable schedules for connections. The foreman red lines the wiring diagram and completes a F and M terminations completed field report, Figure 2.

As stated above, each cable has cable markers attached to each end. While all parties interviewed stated that individual cable conductor markers would be used, none were observed by the writers to have been installed.

The F and M test group makes a 100% visual check of the connected cables. They then ring out each conductor using schematic and wiring diagrams. They do not check the cable routing. F and M will perform some meggering as indicated on the WEDCO motor test and date record, Figure 3.

The F and M field manager stated that the men working in their various electrical field groups are interchanged depending on the work load. Thus a particular man may pull cables on one day and make electrical connections on another day and then later do checkout test work. F and M does not perform any independent checking of their own

installation work.

WEDCO's involvement up to this point appears to have been limited to monitoring of paper work. They receive daily, weekly and monthly reports of cable installation progress from F and M. We read one of the daily reports, and it was not clear what information was being conveyed. Fortunately F and M provides WEDCO with monthly reports on cable terminations. Further, WEDCO extracts information from the F and M pull slips on a monthly basis. WEDCO electrical construction personnel utilizing the above information provides the required input to the WEDCO planning and scheduling group.

WEDCO has recently begun a system of scheduling based on systems. Using the test dates provided by the WEDCO startup and test group, the WEDCO electrical construction group has worked backwards and determined required dates for each system. The systems are then broken down to cables, panels, instruments, etc. Copies of these system lists were then provided to F and M and F and M was requested to indicate on the lists which items were completed. Subsequently WEDCO should be able to tell which items of which systems are outstanding.

The actual responsibility of WEDCO as far as electrical construction QC is not clear. The WEDCO electrical construction group stated that they perform sufficient electrical checks using schematics, wiring diagrams against the actual installation to provide reasonable assurance that equipment is ready to function in its intended manner. The

WEDCO startup and test group confirms the work that was performed by their electrical construction group, evaluates the work and decides what additional work if any should be accomplished by construction and then proceeds with the test program.

The WEDCO startup and test group maintains a punch list which contains all the outstanding items by system. Inputs to this list may come from WEDCO, construction or test, or from Con Ed.

The test program will consist of three phases:

Phase I - Construction Tests (Flush and Hydro)

Phase II - Preops - To include hot functional

Phase III - Post core

Buff tags are displayed on the equipment during the three phases to indicate which group on site has control of the equipment.

UNITED ENGINEERS QC

United Engineers appears to still have some QC responsibility in the electrical area although it was quite apparent that their effort was half hearted. Their stated responsibility is to receive, inspect, test, store, install and connect equipment procured by United Engineers. They stated that they cleared up any equipment discrepancies through their Philadelphia purchasing group and then arranged for WEDCO to handle the actual installation.

ONSITE RECEIVING OF ELECTRICAL AND INSTRUCTION EQUIPMENT

WEDCO now receives all electrical and instrumentation equipment, inspects it for shipping damage and places it in storage. Receiving papers are created and copies provided to the WEDCO construction group or United Engineers as appropriate. Equipment designated for site testing is called out by engineering, tested and returned to storage. Information for these tests is normally taken from the WEDCO equipment lists or from the vendor's specification. The receiving, inspection and testing discussed here is excellent.

CONSOLIDATED EDISON ONSITE QUALITY ASSURANCE ORGANIZATION (ELECTRICAL)

The organization of the Con Ed Onsite QA (Electrical) is shown on Figure 4. This group began an audit of installed electrical cables sometime prior to this Compliance Inspection. Eighty cables were selected at random and they were traced through the plant. This check was performed to see that the cables were installed per the United Engineers conduit and cable schedules. Con Ed recognized that a random check of cables would not necessarily provide confidence as to proper installation of protection system redundant cables. They therefore selected 58 additional cables for checking. Many of these cables were redundant to the first 80 cables. Of these 138 cables checked one cable was found to differ slightly in routing from that specified by the conduit and cable schedules. A copy of a telecon memorandum between United Engineers - Philadelphia and the F and M site group approving

this field modification was provided to the writers. Further, two cables were found to terminate in apparently the wrong nodes.

It should be noted that while this audit by Con Ed appears to be good, they are concentrating on checking the as-installed cables against construction drawings. This does not necessarily provide a good check of redundancy.

INSPECTION OF SPECIFIC AREAS LISTED IN CO I LETTER

1. Nuclear Instrument and Safeguards Cable Separation and Tray Loading

a. Nuclear Instruments

The installation of the triax cables for the nuclear instrumentation is good. Four 4-inch conduits are installed from the control room, through the tunnel to the outside of the electrical penetration area. The conduits are attached to the outside of the wireways, Figure 5. Each conduit carries the cables for one channel of nuclear instrumentation; cables for one source range (S/R), one intermediate range (I/R) and an upper and a lower power range (P/R) detectors are in two of the conduits and cables for an upper and a lower P/R detector are in the second two of the conduits. The conduits stop just short of the electrical penetrations. Preamplifiers (ungrounded) are provided for the S/R channels. The 4-inch

conduits begin again inside containment and protect the cables to a point of installation convenience (pull box) at which point the 4-inch conduits are each changed to two 2 1/2-inch conduits which proceed on to the point of the detector installation. No cables were installed. WEDCO stated that the conduits would be color coded.

b. Safeguards Cable Separation

Our inspection of the cable separation was primarily a paper inspection. Working with the United Engineers conduit and cable schedule, we checked the following cables of the safety injection system:

(1) Power cables from the three 480 volt buses to the three pumps.

(2) Power cables from two of the three 480 volt buses to two MCC and then to the safety injection system valves.

(3) The manual control system to the safety injection system pumps and valves.

(4) The automatic actuation signals to the pumps and valves.

We found no violations of the cable separation during our installation drawing review. DRL will pursue the actual design which connects two of the boron injection tank valves to a common MCC.

We then began an actual checkout of these cables using a pulsed signal source on the cable to be traced out and following along the wireways using a signal detector. We were able to check out only one cable before the pulsed signal transmitter failed. It could not be repaired until the next day; consequently, we actually checked out only one cable using this method.

Several things became apparent from our check of the safety injection system:

(1) The United Electric conduit and cable schedules do not specify how cables should enter or exit wireways, or enter or exit nodes. Further, there are no instructions provided for cables changing directions or wireways. This work is left to field installation and good engineering practice. As a result redundant cables were found to pass over each other and even occupy the same slot in the control room floor. We do not believe that such judgment should be left to field installation personnel. We do believe that the United Engineers drawings should be changed to reflect this information. Further, it was found that the control room floor slot drawings do not provide slot numbers. These numbers should be added and become part of the United Engineers conduit and cable schedule.

(2) It appears that no group has made a thorough check of the protection system cable separation. The Con Ed QA Group, as noted above, has checked 138 cables. This check was primarily a check of installed cables against the drawings. Con Ed Engineering (New York City) assured the writers that they would undertake a follow-up on cable separation (redundancy). (At a meeting at Bethesda on December 30, 1969, Con Ed appeared to be reluctant to meet this commitment.) WEDCO (Mr. Dombrowski) stated they were prepared to make this check.

(3) In one case a cable in the tunnel was found to change trays and in doing so passed over all three sections of a divided tray. A check of the drawings indicated that a second cable was to be installed similarly. Con Ed immediately had the improperly installed cable removed and stopped the installation of the second cable.

c. Tray Loading

Cable tray loading does not appear to be a problem in this plant although the cable installation was only 66% complete at the time of inspection. It was noted that 480 volt power cables which were specified to be in trays no more than two layers deep were actually tied together in groups of three cables each. This resulted in the

cables being in approximately 2 1/2 layers; however, this arrangement is believed to provide better ventilation and is considered acceptable.

2. Loading of One Electrical Penetration

All cables enter containment through hemetically sealed feed throughs. Further, the feed throughs are provided with factory installed "pig tails" except for the 6900 volt units. The 6900 volt units use bolted connections directly to the feed throughs. All cables, except for the 6900 volt and nuclear triax cables, are spliced to the "pig tails." The 6900 volt cables use bolted connections and the triax cables use connectors.

Our check of the electrical penetration area disclosed only one apparent violation of the drawing. Con Ed pointed out an unspecified splice in a cable in the penetration area. Con Ed stated at Bethesda on December 30, 1969, that the cable containing the splice would be replaced.

DRL will pursue the overall design adequacy of the electrical penetration area.

3. One 480 Volt Bus

Con Ed identified the fact that steam lines, fire mains, and station or instrument air lines were designed to pass through the

room which houses the 480 volt essential buses. The steam lines were rerouted earlier in plant construction. The fire mains were stubbed off at one side of the 480 volt switchgear room. Con Ed agreed that a partial wall and door would be erected to separate the fire mains from the 480 volt switchgear room. No changes were made to the instrument air lines or the compressor which is connected to the lines.

There were no apparent violations of the installation criteria with respect to the 480 volt switchgear.

DRL will pursue the leaving of the instrument lines and the compressor in their present location.

4. Electrical Tunnel

a. Tray Loading Criteria

As noted above cable tray loading does not appear to be a problem in this plant.

b. Cable Separation Criteria

The cable separation criteria specify separate wireways, divided wireways or conduit. Our review of the installation drawings did not disclose any violations of the cable separation criteria. Our review did disclose that the drawings do

not cover entry and exit from wireways or cable change of wireway or direction. These items were discussed above.

c. Fire Detection Coverage

None of the fire detection and/or fire fighting equipment for the tunnel was installed. We, therefore, have no comments.

d. DRL will pursue the adequacy of the overall tunnel design.

5. Separation of Redundant Cables Between Trays and Control Room Panels

a. Between Trays

See paragraph 4 b above.

b. Control Room Panels

As stated above our review of the United Engineers conduit and cable schedule disclosed that the drawings do not specify the control room floor slots to be used but rather leave this choice to the field installation group. As a result it was found that protection system redundant cables enter panels (the SIS manual actuation panels SI-1 and SI-2) through common slots in the floor. Further, redundant cables were noted to terminate on adjacent terminal strips.

DRL will pursue the adequacy of the design of the SIS manual actuation panels.

6. Battery Room

Three items were noted during our inspection of the battery room.

a. The ventilation system was not installed. Our review of the drawings disclosed that while each room has its own air intake and exhaust, a common exhaust fan is used. We believe that Con Ed should be notified that the use of a common exhaust fan is unacceptable.

b. Fluorescent lighting fixtures are used in the battery rooms. We believe that Con Ed should be requested to justify the use of fluorescent fixtures in the battery rooms.

c. Wooden safety signs (do not smoke) are installed in the battery rooms. Con Ed stated that these signs were removed.

7. Emergency Diesel Arrangement

The installation of the three emergency diesel generators in a common sheet metal building was noted. Our inspection of this installation disclosed only one violation of installation criteria. While the power leads from the generators to the 480 volt essential buses are inclused in ventilated bus duct, the control leads are contained in conduit. The conduits leave the common control panel and penetrate an 18-inch wall into the electrical tunnel. The

conduits are terminated at this point. The control cables drop into the electrical tunnel wireways with no apparent regard for separation. Con Ed should be notified that this lack of separation is unacceptable.

DRL will pursue the adequacy of the common diesel generator room.

8. Review of Cable Splicing

Our review of cable splicing indicated that splices are specified at two points, the electrical penetrations and at the point at which above and below ground cables are joined. These splices are acceptable to DRL. As stated above Con Ed reported one violation of the cable splicing criteria. They have agreed to replace the cable containing the splice.

The cable installation practices used for the rod drive cables at the penetrations is poor. It appears tension is being applied to the penetrations. Further the cable dressing (coiling) was poor.

OBSERVATIONS AND COMMENTS

1. Installation Housekeeping

While it is recognized that housekeeping (any protection or lack of protection provided for electrical equipment and cabling

during and following installation) criteria do not exist by which Compliance can judge a plant, we did express our concern to Con Ed with regard to the large number of cables pulled into the control and diesel rooms and left on the floor, where it can be walked on. We recognize that most of this cable will be cut off when the cables are connected, some portion, however, will be retained.

2. Protection for Process Sensor Lines

WEDCO stated protection will be provided for the process sensing lines at all points at which the lines are susceptible to damage.

3. Items for Review by DRL

Several items were identified during this inspection which should be investigated in greater depth by DRL. They are:

a. Providing of power for SIS boron injection tank valves.
b. Design of electrical penetration area.
c. Design of 480 volt switchgear room.
d. Design of the electrical tunnel.
e. Design of SIS manual actuation panels (SB-1 and SB-2).
f. Design of the diesel generator room.
g. Lack of protection between engineered safety feature pumps (e.g., safety injection pumps).

FISCHBACH and MOORE INC. — H.G. MARTIN INC.

CABLE PULLING

LOCATION:

CABLE #	SPEC #	INSUL. TYPE	CONDUCT. & SIZE	LENGTH CALC.	LENGTH INST.	PULL DATE	ROUTING
FROM			TO				
FROM			TO				
FROM			TO				
FROM			TO				
FROM			TO				
FROM			TO				
FROM			TO				

JAN 5 1970

FIGURE 1

FISCHBACH and MOORE INC. – H. G. MARTIN INC.

DATE ____ / ____ / ____

TERMINATIONS COMPLETED FIELD REPORT

JAN 5 1970

Building & Elevation _____

Panel / Junct. Box Name _____ Node Number _____

UEC Termination Drawing Number _____ Revision Number _____

NOTE: List ONE Panel, Box or Control Per Sheet

CABLE	NUMBER CONDUCTORS & CABLE SIZE	CABLE		QUANTITY		
		LEAD	ASB.	TERMINATIONS	SPARE	JUMPERS

FOREMAN _____

FIGURE 2

WEDCO

Indian[illegible]int Generating Station - Units [illegible] 2 & 3

Motor Test and Data Record For

JAN 5 1970

SYSTEM/DWG # _____ Motor Name and No. _____

Location Bldg _____ Elevation _____

Name Plate Data: Manufacturer _____ Ser. No. _____

H. P. _____ Volts _____ Amps _____ Phase _____ HZ _____

RPM _____ Duty _____ Serv Fac _____ Frame _____ Installation Type _____

Installation Data:

Motor	Date	"Megger" Reading (Megohms) A to B	B to C	C to A	A to Grd	B to Grd	C to Grd	"Megger" Test Set No. Voltage	Serial #	Foreman
First Test										
Second Test										
Third Test										

Cable Only Cable No. _____

First Test										
Second Test										
Third Test										

Cable and Motor

First Test										
Second Test										
Third Test										

Installation Checked (Date) _____ Termination Checked (Date) _____

Grounding Checked (Date) _____ Starter Size _____ Fuse Size _____ Overload Heater Size _____

Bumped For Rotation Date _____ Rotation Viewed From Outboard End: CW CCW

Control Circuit (c/o) Completed _____ / _____ Data/Marked Dwg. Attached (Yes) (No)
Date

Comments: (Yes) (No) Use Attached Sheet For Comments

_____ F&M _____ Date _____ Construction WEDCO _____ Date

Startup Data

Lubrication Checked (Date) _____ Type AMP Meter Used _____

Inrush AMP _____ No Load AMPS _____ Full Load AMPS _____

Vibration Data Attached (Yes) (No) Comments: (Yes) (No) Use Attached Sheet

Startup _____ Date _____

FIGURE 3

CONSOLIDATED EDISON
CONSTRUCTION DEPARTMENT
INDIAN POINT ON-SITE
QUALITY ASSURANCE ORGANIZATION
(ELECTRICAL)

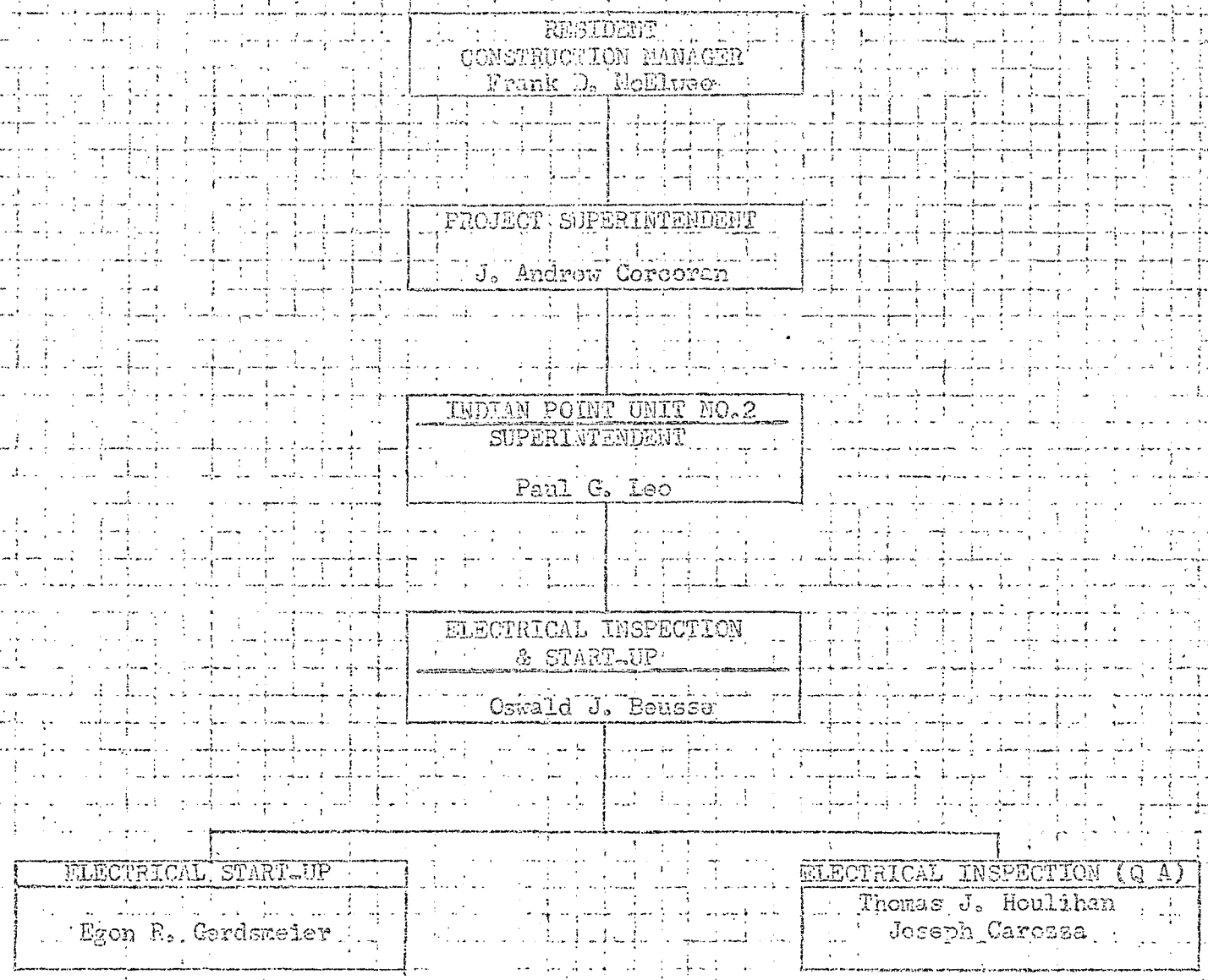
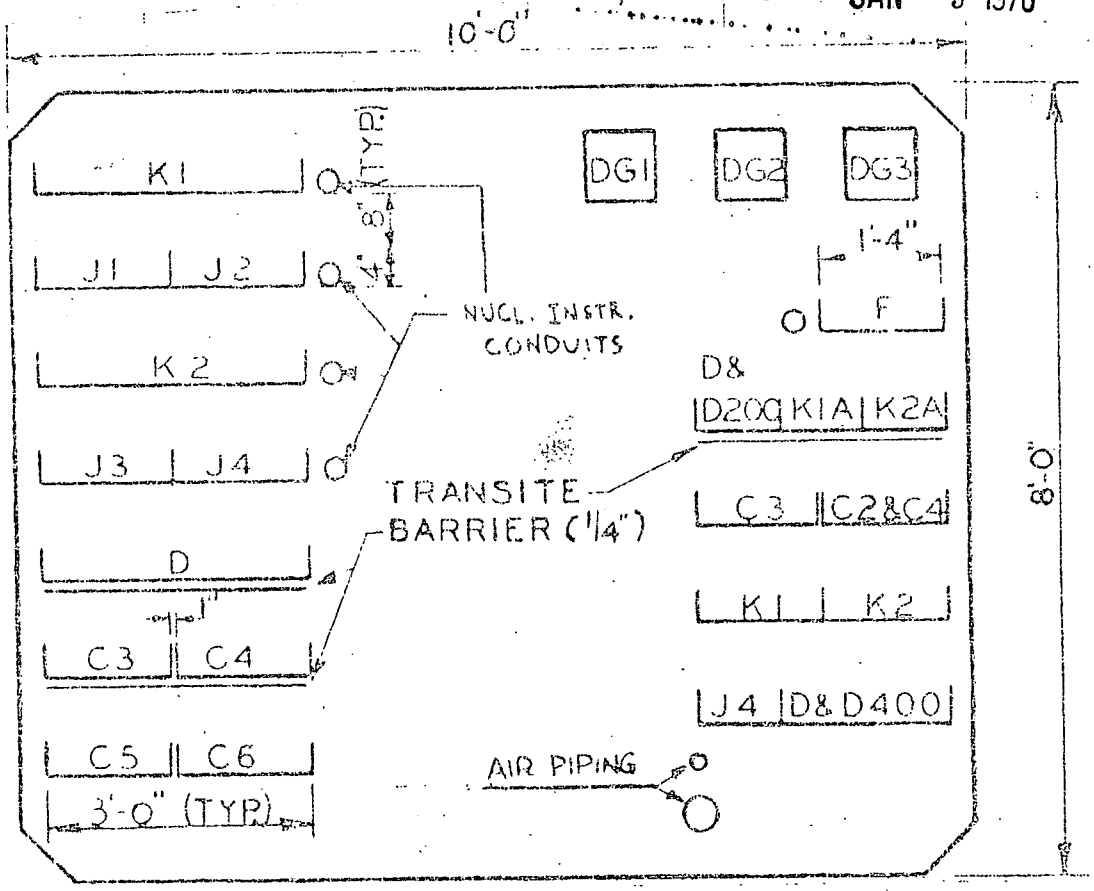


FIGURE 4

JAN 5 1970

JAN 5 1970



TYPICAL SECTION CABLE TUNNEL

K1	Control Tray One Channel (For Valve Control) Etc.
J1-J2	2 Instr Trays With Barriers - 2 Channels
K2	Control Tray One Channel (For Valve Control) Etc.
J3 & J4	2 Instr Trays With Barriers - 2 Channels
D	Max #12 Wire For Small Power & One Control Channel
C4	(480V Heavy Power) Cont Recirc Fan 21 SAF Inj Pump 21 Recirc Pump 21
C3	(480V Heavy Power) Cont Recirc Fan 25 Res Ht Rem Pump 22 SAF Inj Pump 23 Cont Recirc Fan 23
C6	(480V Heavy Power) Cont Recirc Fan 22 SAF Inj Pump 22
C5	(480V Heavy Power) Recirc Pump 22 Res Ht Rem Pump 21 Cont Recirc Fan 24
F	2nd Channels for "F" Cables D C Supply (Normal) Diesel Gen Cont PNL 22
F	(1st Channel) D C Supply (Emerg) Diesel Gen Cont PNL 23 Ltg & Motor Feeders
D & D200- K1A-K2A	Diesel Gen Control 3 Channels
C3	(480V Heavy Power) Comp CLG Pump 23 MCC27 Feeder MCC 26B Feeder Ltg Swgr Transf 22 Charging Pump 22 Charging Pump 23 Cont Spray Pump 22
C2	(480V Heavy Power) D C Emerg Ltg Feeder
C4	Cont Spray Pump 21 Comp Cooling Pump 21 Comp Cooling Pump 22 MCC 26A Feeder Ltg Swgr Transf 23 Charging Pump 21
K1-K2	Control, 2 Channels
J4	Instr 1 Channel
D & D400	Misc Small Power & Control 1 Channel

FIGURE 5

DEC 1 0 1969

R. T. Carlson, Senior Reactor Inspector
Region I, Division of Compliance

QC AUDIT OF PROTECTION AND ESF INSTRUMENTATION
INDIAN POINT 2

Your memorandum of November 18, 1969, identified certain electrical areas for inspection during the forthcoming QC audit of Indian Point 2. In addition, we have compiled, from section 7 of the Indian Point 2 FSAR, a list of the areas we consider of particular significance in an audit of instrumentation aspects of the protective systems and engineered safety features of Westinghouse facilities. This list is enclosed, and consists of excerpts from the FSAR in 32 areas. I recognize that all of these areas cannot be covered in an audit of any one Westinghouse facility and that some relate to preoperational testing. However, I recommend that arrangements be made with the licensee so that Vince Thomas of this branch can inspect, to the extent practical, the following areas from the enclosure:

Item	FSAR Page	Comments
9	7.2-12	Examine the scram reset feature to verify that it will not prevent a protective action from going to completion.
14	7.2-18	Observe a demonstration of the channel alarm via the protection rack accessibility feature. This test only involves the opening and closing of the protection racks.
16	7.2-22	Verify the manual trip feature provided.
20, 21, and 22	7.4-4, 7.4-7, and 7.4-9	Examine the required physical separation on the nuclear panel and console.
25	7.5-2	Examine the installation and location of the pressure transmitters associated with the safety injection pumps.

DEC 1 0 1969

Item	FSAR Page	Comments
29	7.7-3	Examine the control room layout, cable penetration into the control room, internal wiring in switchboards and instrument racks and the fire and smoke detection system in the cable spreading room.
32	7.7-8	Observe and verify if the controls provided outside the control room to maintain the plant in a safe shutdown condition are as stated in the FSAR.

As we discussed, our inspection efforts in the above areas are considered to supplement rather than replace those requested in your memorandum.

Original signed
H. R. Denton

H. R. Denton, Chief
Technical Support Branch
Division of Compliance

Enclosure:
List

cc: M. L. Ernst
J. P. O'Reilly
CO Senior Reactor Inspectors
V. Thomas

OFFICE ▶	CO:TSB	CO:TSB				
SURNAME ▶	V.D.T. VThomas:gk	HRDenton				
DATE ▶	12/10/69	12/10/69				

CONSOLIDATED EDISON COMPANY
INDIAN POINT 2

REACTOR PROTECTION AND ENGINEERED SAFETY FEATURE INSTALLATION CRITERIA
SECTION #7 - GENERAL DESIGN BASES

7.2-4

1. All reactor trip protection channels are supplied with sufficient redundancy to provide the capability for channel calibration and test at power.

Removal of one trip circuit is accomplished by placing that circuit in a half-tripped mode; i.e., a two-out-of-three circuit becomes a one-out-of-two circuit. Testing does not trip the system unless a trip condition exists in a concurrent channel.

7.2-5

2. Channel independence is carried throughout the system extending from the sensor to the relay actuating the protective function. The protective and control functions when combined are combined only at the sensor. Both of these functions are fully isolated in the remaining part of the channel, control being derived from the primary protection signal path through an isolation amplifier. As such, a failure in the control circuitry does not affect the protection channel. This-approach is used for pressurizer pressure and water level channels, steam generator weater level, T_{avg} and ΔT channels, steam flow-feedwater flow and nuclear source, power range channels.

7.2-6

3. The engineered safety features equipment is actuated by one or the other of the engineered safety features actuation channels. Each coincidence network actuates an engineered safety actuation device that operates the associated engineered safety features equipment, motor starters and valve operators. As an example, the control circuit of a safety injection pump is typical of the control circuit for a large pump operated from switchgear. The actuation relay, energized by the Engineered Safety Features Instrumentation System has normally open contacts. These contacts energize the circuit breaker closing coil to start the pump when the control relay is energized.

7.2-7

4. The components of the protection system are designed and laid out so that the mechanical and thermal environment accompanying any emergency situation in which the components are required to function does not interfere with that function.

Separation of redundant analog protection channels originates at the process sensors and continues back through the field wiring and containment penetrations to the analog protection racks. Physical separation is used to the maximum practical extent to achieve separation of redundant transmitters. Separation of field wiring is achieved using separate wireways, cable trays, conduit runs and containment penetrations for each redundant channel. Redundant analog equipment is separated by locating redundant components in different protection racks. Each channel is energized from a separate a-c instrument bus.

7.2-7

5. The signal conditioning equipment of each protection channel in service at power is capable of being tested and tripped independently by simulated analog input signals to verify its operation. This includes checking through to the trip breakers which necessarily involves the trip logic. Thus, the operability of each trip channel can be determined conveniently and without ambiguity.

7.2-8

6. The engineered safety features actuation circuits are designed on the same "de-energize to operate" principle as the reactor trip circuits with the exception of the containment spray actuation circuit which is energized to operate in order to avoid spray operation on inadvertent power failure.

7.2-8

7. Testing of the diesel-generator starting scheme may be performed from the main Unit No. 2 control board. The generator breaker is not closed automatically after starting during this testing. The generator may be manually sychronized to the 480 volt bus for loading. Complete testing of the starting of diesel generators can be accomplished by tripping the associated 480 volt bus supply breaker and providing a coincident simulated safeguards signal. Blocking the closing of the generator breaker causes the bus tie breaker to close after a time delay sufficient for normal diesel-generator starting. The ability of the units to start within the prescribed time and to carry load can be periodically checked.

Automatic starting of either emergency diesel-generator is initiated by redundant undervoltage relays on the 480 volt bus to which the diesel-generator is connected, or by the safety injection signal. Engine cranking is accomplished by a stored energy system supplied solely for the associated diesel-generator. The under-voltage relay scheme is designed so that loss of 480 volt power does not prevent the relay scheme from functioning properly.

7.2-11

8. Information Readout and Indication of By-Pass

The protective systems are designed to provide the operator with accurate, complete, and timely information pertinent to their own status and to plant safety.

Indication is provided in the control room if some part of the system has been administratively bypassed or taken out of service.

Trips are indicated and identified down to the channel level.

7.2-12

9. The protective systems are so designed that, once initiated, a protective action goes to completion. Return to normal operation requires administrative action by the operator.

7.2-13

10. Interlocking functions of the Reactor Protective System inhibit control rod withdrawal on the occurrence of a specified parameter reaching a value lower than the value at which reactor trip is initiated.

7.2-14

11. Indication

All transmitted signals (flow, pressure, temperature, etc.) which can cause a reactor trip are either indicated or recorded for every channel.

7.2-15

12. Separation of Redundant Protection Channels

Separation of redundant analog channels originates at the process sensors and continues through the field wiring and containment penetrations to the analog protection racks. Physical separation is used to the maximum practical extent to achieve separation of redundant transmitters. Separation of field wiring is achieved using separate wireways, cable trays, conduit runs and containment penetrations for each redundant channel. Analog equipment is separated by locating redundant components in different protection racks. Each channel is energized from a separate a-c power feed.

Overall, the Protection System is comprised of identifiable channels which are physically, electricall and functionally separated and isolated from one another.

7.2-16

13. Loss of Power

A loss of power in the Reactor Protective System causes the affected channel to trip. All bistables operate in a normally energized state and go to a de-energized state to initiate action. Loss of power thus automatically forces the bistables into the tripped state.

Availability of power to the engineered safety features instrumentation is continuously indicated. The loss of instrument power to the sensors, instruments, logic or actuating devices in the engineered safety features instrumentation, starts the engineered safety features equipment associated with the affected channels, except for containment spray which requires instrument power for actuation.

7.2-18

14. Each protection rack will include a test panel containing those switches, test jacks and related equipment needed to test the channels contained in the rack. A hinged cover encloses the test panel. Opening the cover or placing the test-operate switch in the "TEST" position will initiate an alarm. These alarms are arranged on a rack basis to preclude entry to more than one redundant protection rack (or channel) at any time. The test panel cover is designed such that it cannot be closed (and the alarm cleared) unless the test signal plugs (described below) are removed. Closing the test panel cover will mechanically return the test switches to the "OPERATE" position.

7.2-20

15. <u>Logic Channel Testing</u>

The following procedure illustrates the method used for testing Trip Breaker No. 1 and its associated logic network.

a. With the by-pass breaker (AB-1) racked-out, manually set and trip AB-1 to verify operation.

b. Rack-in and set AB-1. Trip TB-1.

c. Sequentially de-energize the trip relays (A1, A2, A3) for each logic combination (1-2, 1-3, 2-3). Verify that the logic network de-energizes the UV coil on TB-1 for each logic combination. Since the event recorder monitors the signal applied to the UV coil, operation of the UV coil can be determined from the event recorder.

d. Repeat "C" for every logic combination in each matrix.

e. Close Reset TB-1.

f. Trip TB-1 to validate prior test results as evidenced by the event recorder.

g. Close Reset TB-1. Trip and rack-out AB-1.

7.2-22

16. Manual Trip

The manual actuating devices are independent of the automatic trip circuitry, and are not subject to failures which make the automatic circuitry inoperable. Either of two manual trip devices located in the control room will initiate a reactor trip.

7.2-41

17. Feedwater Flow

A spurious high signal from the feedwater flow channel being used for control would cause a reduction in feedwater flow and prevent that channel from tripping. A reactor trip on low-low water level, independent of indicated feedwater flow, will ensure a reactor trip if needed.

In addition, the three-element feedwater controller incorporates reset on level, such that with expected gains, a rapid increase in the flow signal would cause only a 12 inch decrease in level before the controller re-opened the feedwater valve. A slow increase in the feedwater signal would have no effect at all.

Steam Flow

A spurious low steam flow signal would have the same effect as a high feedwater signal, discussed above.

7.3-11

18. Trip Breaker Arrangement

The trip breakers are arranged in the reactor trip switchgear in individual metal enclosed compartments. The 1000 ampere bus work, making up the connections between scram breakers will be separated by metal barriers to prevent the possibility that any conducting object could short circuit, or bypass, scram breaker contacts.

7.3-16

19. Control Rod Drive

a. The need for an outside power source has been eliminated by incorporating build-in holding sources as part of the rod control system and by providing two M-G sets.

b. The equipment is contained within enclosed steel cabinets precluding the possibility of an accidental connection of either AC or DC power in the cabinets.

c. AC power distribution is accomplished using steel enclosed bus duct. The high capacity (400 KVA) AC power source is unique and not readily available. Multiple connections are required.

d. DC power is distributed to the individual mechanisms through insulated cables and enclosed electrical connections precluding the accidental connection of an outside DC source external to the cabinets. The high capacity DC source required to hold rods is not readily available in the rod control system, would require multiple connections, and would require deliberate positioning of switches within the enclosed cabinets.

e. Provisions are made in the system to permit detection of an external DC source which could preclude a rod release.

The total capacity of the system including the overload capability of each motor generator set is such that a single set out of service does not cause limitations in rod motion during normal plant operation. In order to minimize reactor trip as a result of a unit malfunction, the power system is normally operated with both units in service.

7.4-4

20. Power Range Channels

The electronic equipment for each power range channel is contained in a draw-out panel mounted adjacent to the main control board.

Multiple power supplies furnish necessary positive and negative voltages for the individual channels and detector power.

Mounted on the front panel of each power range channel drawer are the ion chamber current meters, shunt selector switches with appropriate positions and the nuclear power indicator (0 to 120 per cent full power).

7.4-7

21. Intermediate Range Channels

Low voltage power supplies contained in each drawer furnish the necessary positive and negative voltages for the channel electronic equipment. Two medium voltage power supplies, one in each channel, furnish compensating voltage to the two compensated ion chambers. The high voltage for the compensated ion chambers is supplied by separate power supplies also located in the intermediate range drawers.

On the front panel of the intermediate range channel cabinet and on the control board are mounted a neutron (log N) flux level indicator calibrated in terms of ion chamber current (10^{-11} to 10^{-3} amp).

7.4-9

22. Source Range Channels

Amplifiers and discriminators are located in the control room. Tri-axial cable is used for all interconnections from the detector assemblies to the instrumentation in the control room. The pre-amplifiers are located outside the reactor containment.

7.5-2

23. Containment Pressure

The containment pressure is transmitted to the main control board for post accident monitoring. Six transmitters are installed outside the containment to prevent potential missile damage. The pressure is indicated (all six channels) on the main control board.

24. Refueling Water Storage Tank Level

Two redundant channels indicate that safety injection and containment spray systems have removed water from the storage tank. One is located at the tank and the other is transmitted from the tank to a control board indicator.

25. Safety Injection Pumps Discharge Pressure

These channels show that the safety injection pumps are operating. The transmitters are outside the containment.

7.5-3

26. Valve Position

All engineered safety features valves have position indication on the control board. Air-operated and solenoid-operated valves are selected so as to move in a preferred direction on the loss of air or power. Motor-operated valves remain in the position at time of loss of power to the motor. Spray flow is also indicated on the control board.

7.5-3

27. Alarms

Visual and audible alarms are provided to call attention to abnormal conditions. The alarms are of the individual acknowledgement type; that is, the operator must recognize and silence the audible alarm for each alarm point. For most control systems, the sensing device and circuits for the alarms are independent, or isolated from, the control devices.

7.5-4

28. System Evaluation

Redundant instrumentation has been provided for all inputs to the protective systems and vital control circuits.

Where wide process variable ranges and precise control are required, both wide range and narrow range instrumentation is provided.

All electrical and electronic instrumentation required for safe and reliable operation is supplied from four redundant instrumentation busses.

7.7-3

29. The control room ceiling covering is fire retardant egg crate diffusers. Door frames and doors are metallic. Wood trim is not used.

The control room is equipped with portable fire extinguishers sized and located in accordance with National Fire Code and National Fire Protection Association specifications. Extinguishers carry the Underwriter's Laboratory label of approval and are electrical shock resistant.

The cable spreading room has a fire and smoke detection system and flame sensing devices which can actuate alarms.

The control room ventilation consists of a system having a large percentage of recirculated air. The fresh air intake can be closed to control the intake of airborne activity if monitors indicate that such action is appropriate.

All control and indication is transmitted into the control room assuring that no combustible process fluids are carried into the room.

Cables that penetrate the control room floor pass through sealing devices to minimize fume and flame transmission from possible fire sources external to the control room.

All internal wiring in switchboards and instrument racks is type SIS cross linked polyethylene.

7.7-4

30. Plant operators can shutdown and maintain the plant in a safe condition by means of controls located outside the control room.

Local controls are located so that the stations to be manned and the times when attention is needed are within the capability of the plant operating staff. The plant intercom system will provide communication among the personnel so that the operation can be coordinated.

7.7-5

31. Control Room Evacuation

Following evacuation of the control room the following systems and equipment are provided to maintain the plant in a safe shutdown condition from outside the control room:

(a) Residual heat removal

(b) Reactivity control. i.e., boron injection to compensate for fission product dacay

(c) Pressurizer pressure and level control

(d) Electrical system as required to supply the above systems

(e) Other equipment, as described

7.7-8

32. Indication and Controls Provided Outside the Control Room

The specific indication and controls provided outside the control room for the above capability are summarized as follows:

Indication

Level Indication For the Individual Steam Generators.
One set visable from the auxiliary feed pumps
One set visable from the main feed control valves

Pressure Indication For the Individual Steam Generators.
Visable from the auxiliary feed pumps.

Pressurizer Level and Pressure Indicators.
One set visable from the auxiliary feed pumps
One set visable from the charging pump local control point
All instruments at the auxiliary feed pumps are grouped on a local gauge board.

Controls

Local stop/start push button motor controls with a selector swich are provided at each of the following motors. The selector switch will transfer control of the switch gear from the control room to local at the motor. Placing the local selector switch in the local operating position will give an annunciator alarm in the control room and will turn out the motor control position lights on the control room panel.

Auxiliary Motor Driven Feedwater Pumps.
Charging Pumps.
Boric Acid Transfer Pumps.

Remote stop/start push button motor controls with a selector switch are provided for each of the following motors. These controls are grouped at one point in the switch gear room convenient for operation. The selector switch will transfer control of the switch gear from the control room to the remote point. Placing the selector switch to local operation will give an annunciator alarm in the control room and will turn out the motor control position lights on the control room panel.

Service Water Pumps.
Containment Air Recirculation Fans.
Control Room Air Handling Unit Including Control for the Air Inlet Dampers.

Speed Control

Speed control is provided locally for:

The Auxiliary Turbine Driven Feed Pump
The Charging Pump

Valve Control

Local Valve Control is Provided At The:

Main Feed Regulators.

Auxiliary Feed Control Valves. (These valves are located local to the auxiliary feed pumps.)

Atmospheric Dump. (Auto control normally at hot shutdown.)

All other valves requiring operation during hot standby can be locally operated at the valve.

Letdown orifices isolation valves locally to the charging pumps. Local stop and start buttons with selector switch and position lamp.

Lighting

Emergency lighting is provided in all operating areas as defined by the foregoing.

Communications

The communication network provides communications between the area of the auxiliary feed pumps and the charging pumps, boric acid transfer pumps, diesel generators, and the outside exchange without requiring the control room.

7.8-1

33. Maximum Safety System and Minimum Conditions for Operating

Maximum permissible settings for safe operation. See Section 15.

9.9

34. Surveillance Testing Schedule

Look for the test frequency, procedures, and data sheets that are being provided.