8.0 ELECTRICAL SYSTEM

8.1 DESIGN BASIS

The main generator (described in Chapter 10) will feed electrical power at 22 KV through isolated phase bus to two half-sized main power transformers.

The auxiliary power distribution system for Indian Point Unit No. 3 is essentially the same as that used in present day conventional plants. Two large auxiliary transformers supply power at 6.9 KV. One transformer, designated designated the unit auxiliary, is fed directly from the generator output. The other transformer, designated the station auxiliary, is supplied from the 138 KV Buchanan Substation.

8.2 NETWORK INTERCONNECTIONS

Electrical energy generated at 22 KV will be stepped up to 345 KV by the main generator transformers and delivered to Buchanan 345 KV switching station through one 345 KV, 25,000 MVA, 2000 amp circuit breaker.

Indian Point #2 Unit and a 345 KV tie to Pennsylvania-Jersey-Maryland (P.J.M) system will also be connected to Buchanan 345 KV switching station. A one line diagram of the proposed system interconnections is shown on Figure 3-1.

The new Buchanan 345 KV switching station will be connected by two 345 KV overhead lines, subsequently three, 345 KV overhead lines, to Millwood 345 KV switching station. Millwood and Buchanan bus and circuit breakers will all be rated 345 KV, 25,000 MVA, 2000 amp.

Millwood switching station is connected to the north to the Pleasant Valley substation (which is the interconnection point between Con Edison and the Niagara Mohawk and Connecticut Light and Power systems) and south to Sprain Brook substation (which has connections to New York City and the 1000 MW unit at Ravenswood).

A 345/138 KV autotransformer will also connect the 345 KV bus to the 138 KV bus and transmission system at Millwood East.

The Indian Point Unit No. 3 138/6.9 KV station startup transformer will be supplied from the 138 KV bus at Buchanan substation. Buchanan has connections to Indian Point No. 1 generator, the Lovett station of the Orange and Rockland system and the Consolidated Edison 138 KV transmission system via two overhead lines to Millwood East.

8.3 STATION DISTRIBUTION

The function of the Auxiliary Electrical System is to provide reliable power to those plant auxiliaries required during any normal or emergency mode of plant operation.

The design of the system is such that sufficient independence or isolation between the various sources of electrical power is provided to guard against concurrent loss of all auxiliary power.

Independence or isolation of supply to the various duplicate auxiliaries provided as engineered safeguards is maintained so a single fault will not result in the total loss of the plant's engineered safeguards systems.

The Auxiliary Electrical System is designed to provide a simple arrangement of buses requiring the minimum of switching to restore power to a bus in the event that the normal supply is lost.

The basic components of the station electrical system are shown on the Main Electrical One Line Diagram, Figure 8-2.

8.3.1 6.9 KV SYSTEM

During startup, shutdown and hot standby, auxiliary power is supplied from the Station Auxiliary Transformer. When the generator is synchronized to the 345 KV system, auxiliary power is supplied primarily by the Unit Auxiliary Transformer. A small portion of the auxiliary load consisting of two circulating water pumps and two 6900/480 auxiliary transformers, remain on the Station Auxiliary Transformer at all times. The Station Auxiliary Transformer supplies two 6.9 KV bus sections (Nos. 5 and 6) through 2000 ampere, 500 MVA air circuit breakers. The Unit Auxiliary Transformer supplies 6.9 KV bus sections Nos. 1, 2, 3 and 4 through 1200 ampere, 500 MVA air circuit breakers.

The 6.9 KV bus section No. 1 and 2 can be connected to 6.9 KV bus section No. 5, by a 1200 ampere, 500 MVA air circuit breaker. In a similar manner, 6.9 KV bus section No. 3 and 4 can be connected to 6.9 KV bus section No. 6.

All major auxiliaries above approximately 300 HP are supplied from the 6.9 KV switchgear by 1200 ampere, 500 MVA air circuit breakers.

Each of 6.9 KV bus sections 1 through 4 supplies one reactor coolant pump and other auxiliaries as shown on the main one line diagram, Figure 8-2. The auxiliaries are divided between the four 6.9 KV buses to provide a high degree of diversity to minimize the possibility of plant trip due to loss of one 6.9 KV bus. After a reactor or turbine generator trip, the necessary auxiliaries on 6.9 KV bus sections 1, 2, 3 and 4 are transferred automatically to 6.9 KV bus sections 5 and 6 by high speed open transition transfer. This transfer time is on the order of twenty cycles so that the transfer will be completed before the reactor coolant pumps have begun to slow down.

8.3.2 480 VOLT SYSTEM

Motors between 100 and 300 HP are supplied by 480 volt switchgear. This 480 volt system consists of four bus sections designated as Nos. 2A, 3A, 5A and 6A. Each section is normally supplied by a 2000/2666 KVA ventilated, dry type 6900/480 volt transformer. The transformers are numbered to correspond with the bus section they supply.

Two of these transformers (Nos. 5 and 6) are normally supplied by the 138/6.9 KV Station Auxiliary Transformer. These bus sections normally supply some of the engineered safeguards equipment and are left on the outside source of power to avoid subjecting them to a transfer at the time when the equipment supplied by them may be called upon to operate. Complete duality of supply of engineered safeguards equipment is maintained. Additional safeguards equipment which may be used is supplied from 480 volt bus sections Nos. 2A and 3A which can be connected to bus sections Nos. 5A and 6A if required.

The 6900/480 volt transformers Nos. 2 and 3 are fed from bus sections Nos. 2 and 3 of the 6900 volt system, and normally supply 480 volt bus sections Nos. 2A and 3A. The 480 volt buses can be interconnected by electrically operated tie breakers in case one of the normal 6900/480 KV transformers is out of service.

Each of the four of the 480 volt bus sections can also be supplied by an automatic starting diesel generator which will act as a back up to the normal source of supply to the bus section. If the normal supply to all 480 volt bus sections is lost, the diesels will automatically start.

For loss of all normal AC power to the 480 volt bus sections, the tie breakers between the sections allow any of the four to be supplied by diesel generators. The diesels will be sized so that any two of the three diesels will have sufficient capacity to supply the engineered safeguards load required for an acceptable post-blowdown containment pressure transient.

8.3.3 DC SYSTEM

The dc system consists of station batteries, static rectifier type battery chargers and panels to distribute the required dc power to equipment. The battery chargers will be of sufficient size to carry normal continuous dc load.

8.3.4 INSTRUMENT SUPPLY SYSTEM

The 115 volt ac supply system for the Reactor-Turbine Control and Instrumentation Systems will consist of four distribution panels, two having static inverter system sources and two having 480V system sources. An alternate source will be provided to each panel from the lighting system.

Vital instrument loads that make up two out of three or two out of four logic matrices for reactor trip circuits are supplied from separate buses so that failure of one bus will not result in a reactor trip. Instrument channel isolation is maintained by the use of the four separate panels. Three of the panels provide the sources for the two out of three logic devices. The fourth panel supplies the devices that make up the two out of four logic as well as other nuclear plant instruments that require a regulated source.

8.4 EMERGENCY POWER SOURCES

The 480 volt bus sections which supply power to the engineered safeguards equipment have the following alternate sources of power, to provide assurance of operation under all conditions.

1. All four buses can be supplied from the 138 KV Buchanan Substation.
2. All buses can be supplied directly by automatically starting diesel generators.
3. All buses can be interconnected by tie breakers.
4. Automatic transfer is provided to an active bus if a diesel should fail to start.

There will be three (3) 50% capacity emergency generators installed for Indian Point Station, Unit #3. Any two units, as a back-up to the normal standby AC power supply (Consolidated Edison 138 KV system) will be capable of sequentially starting and supplying the power requirements of one complete set of safeguards equipment. Figure 8-3, as attached, is a one-line diagram of the 480 volt bus arrangement of the emergency diesel-generator units and the engineered safeguards equipment. The equipment automatically started during the injection phase is:

One residual heat removal pump
Two safety injection pumps
Two service water pumps
One containment spray pump
Three of five containment ventilation fans
One auxiliary steam generator feed pump

The loads will be changed manually from the above during the recirculation phase to provide cooling to the containment and core by either the fan coolers or the recirculation of coolant from the containment sump.

The diesel units will be started on loss of voltage on the 480 volt buses. The loss of voltage signal coincident with a safeguards signal, will also trip all motor feeder, main supply, and tie breakers on the 480 volt buses. After each unit comes up to speed and voltage, requirement for a safeguard system operation will initiate the closure of the emergency generator supply breakers to their respective 480 buses.

Upon energization of the 480 volt buses, the following two sequences will be started simultaneously:

Sequence 1 (Equipment Connected to Bus 5A and 2A)

Start safety injection pump (#1) and energize motor control center (Bus 5) to supply power to valves. If safety injection pump #1 did not start, start safety injection pump No. 2.

Start first containment ventilation fan.

Start second containment ventilation fan.

Containment spray pump (No. 1) can now be started by a high containment pressure signal. If containment spray pump No. 1 did not start, start containment spray pump No. 2.

Sequence 2 (Equipment Connected to Bus 6A and 3A)

Start residual heat removal pump (No. 2) and energize motor control center to supply power to valves. If residual heat removal pump No. 2 did not start, start residual heat removal pump No. 1. Start service water pump No. 4. If service water pump No. 4 did not start, start service water pump No. 5.

Start fourth containment ventilation fan.

If one of the containment ventilation fans in either sequence 1 or sequence 2 did not start, then the third containment ventilation fan in sequence 1 and/or the second containment fan in sequence 2 will be started.

In the event an emergency diesel-generator unit did not start, appropriate tie breakers will be closed in order to energize the four 480 volt buses depending on which unit did not start; the buses will be energized as follows:

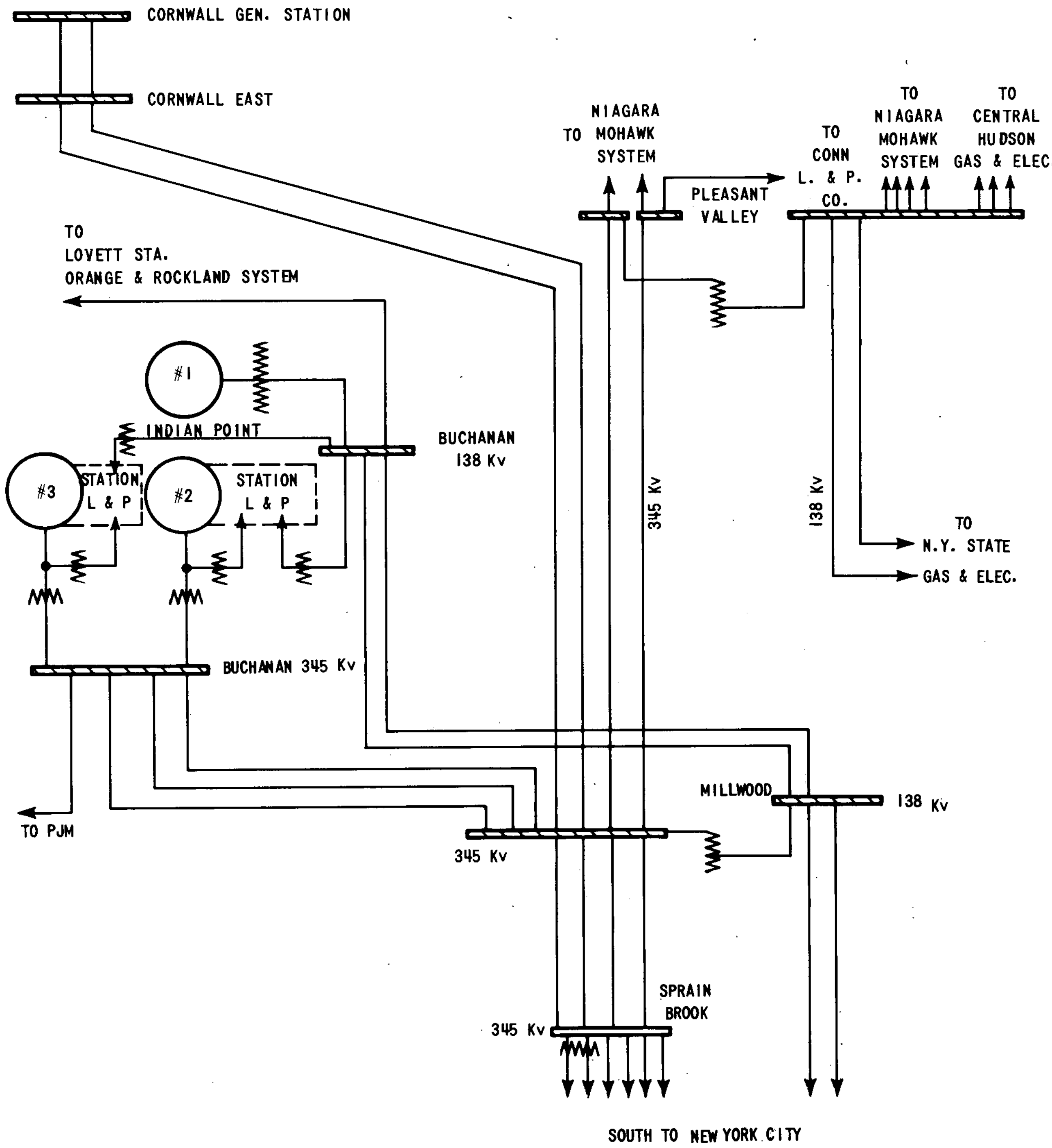
1. Diesel-generator 1 did not start - diesel-generator 2 supplies Bus 5A and Bus 2A, diesel-generator 3 supplies Bus 3A and Bus 6A.
2. Diesel-generator 2 did not start - diesel-generator 1 supplies Bus 5A and Bus 2A, diesel-generator 3 supplies Bus 3A and Bus 6A.
3. Diesel-generator 3 did not start - diesel-generator 1 supplies Bus 5A and Bus 2A, diesel-generator 2 supplies Bus 3A and Bus 6A.

The sequence of starting the motors will be the same as previously listed and will not be affected by the buses being supplied either by two or three diesel generators.

Two 60 cell, lead acid, station type batteries are provided for power supply for control, emergency lighting and the inverters for critical 60 cycle instrument power.

8.5 TESTS AND INSPECTION

Periodic tests and inspections will be made on all breakers. Also, periodic start tests and routine maintenance procedures will be performed on the diesel-generator sets. The frequency and nature of these tests will be established during the system design when the components are selected.



SIMPLIFIED ONE-LINE DIAGRAM PROPOSED SYSTEM INTERCONNECTIONS

FIG. 8-1

MAIN ELECTRICAL ONE-LINE DIAGRAM
FIG. 8-2

SECTION 9

PSAR Section	Page	Remarks
9.1.1	9-1	Table 9-1 has been superseded by Table 1 of Item 11 of Supplement 1.
9.1.2	9-2	A description of the method of calculation of the reactor coolant fission product activities and activity in the volume control tank is given in Item 16 (E - 4.2) of Supplement 1.
9.1.3.9	9-7	Preliminary design parameters of the charging pumps are given in Item 2 (1 - 18) of Supplement 1.
9.5	9-35	A modified flow diagram of the service water system is presented in Item 1 of Supplement 5.
Figure 9-4		A modified flow diagram of the auxiliary coolant system is presented in Item 1 of Supplement 5.