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PSB Section A

FROM: S. Rhow, Plant Systems Branch, Division of Operating Reactors

SUBJECT: COMMENTS PREPARED BY S. RHOW, PLANT SYSTEMS BRANCH, DOR

New York's power black-out in July, 1977 gave the good opportunity to evaluate system arrang-ments especially in switchyards to a system engineer. The overall system analysis is beyond my position and capability.

On July 13, 1977, the first lightning hit the overhead shield-wire of 345 kv transmission lines between the Millwood West station and the south bus of Buchanan station, and the direct stroke current through the steel tower impedance to the ground caused a tremendous voltage rise on these towers above the Basic Impulse Insulation Level (BIL about 1550 kv for 345 kv system), and created the flash@over and the short circuit between the phase conductor and ground of both 345 kv circuits.

These transmission lines are equipped with transfer tripping relaying protections through carrier signal. The impedance type distance relay $(Z=\frac{v}{i})$ was abl- to detect the fault (single line to ground) and tripped the breakers at Buchanan South bus and sent the signal to the remote side of the fault line to trip the breaker as the transfer tripping scheme.

This distance relay operated the lock-out relays and tripped the breakers 3, 5, 1, and 6 in Figure 1 to isolate the fault on the lines.

As shown in Figure 1, the Indáan Point Nuclear Unit 3 is completely isolated so that there are no transmission lines available to carry the generating power from the Indian Point Unit 3.

Therefore, this lightning forced this nuclear plant to shut down, and the shutdown increased the generation deficiency. The automatic load shedding program should respond to the critical situation through the under-frequency relays to keep the system stable, if available.

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8110310713 780408 ADDCK 05000003 Consequently, generating power should be brought to load center to meet load demand via the long transmission lines. These transmission lines carried the load beyond the load-carrying capabilities (long and shorttime emergency rating) by I²Rt heating of cable.

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As the result of overload to the lines, main transmission lines were tripped out by the overcurrent relaying.

Based on fact, I woold like to comment on the system improvement as follows:

- (1) Bus arrangement: A-Breaker-And-A-Half Bus Arrangement;
- (2) Automatic Load Shedding Program by the application of Underfrequency Relays;
- (3) Reduce the transmission line steel tower ground resistance (counterpoise and/or ground rod), or increase the BIL by the number of insulators on transmission lines;
- (4) Increase the generation capacity near the load center; and
- (5) Install \$ransmission lines and acquire additional ties to the PJM system.

I believe that modification of present Ring Bus to the A-Breaker-And-A-Half (a half-breaker) arrangement is more practical and economical to be improved as far as the Indian Point Units 2 and 3 and associated systems are concerned. My suggestion could be more understandable by comparing the a-half-breaker bus to the ring bus as follows:

(1) When two line circuits are at fault as occurred in the NEW Yorkbblackfout, the "a-half-breaker" bus arrangement is able to keep the Indian Point Unit 3 operable and send the generation through the transmission line between the Buchanan South and Ladentown.

But on the ring bus, Unit 3 was isolated completely and shut down.

(2) When any breaker of a T/Lccircuit fails to trip on the a-half breaker bus, a tie breaker failure relaying scheme trips two T/L circuits. The side breaker failure scheme manges to trip enly faulted T/L circuits.

On ring bus of Buchanan North, any breaker failure scheme shutd down the Indian Point Unit 2.

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(3) When any breaker of a T/L circuit fails to trip on the a-halfbreaker bus, a tie breaker failure relaying scheme trips two T/L circuits. The side breakers failure scheme manages to trip only faulted T/L circuits. The tie breaker failure on the bay of the Indian Point Unit 3 shuts down the generating station.

On the ring bus of the Buchanan South, any breaker failure trips out two T/L circuits. Specifically, the breaker failure of two adjacent to the Indian Point Unit 3 shuts down this generating station.

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