U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-461/96004(DRP)

FACILITY
Clinton Power Station

License No. NPF-62

Licensee
Illinois Power Company
500 South 27th Street
Decatur, IL 62525

DATES
April 9 - 26, 1996

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2 May 1996
Date

AREAS INSPECTED

Special safety inspection of the circumstances involved in the partial loss of offsite power and subsequent reactor scram event on April 9, 1996.

Results: The failure to understand the breaker relay scheme for GCB4522 and poor pre-planning of risk significant online maintenance contributed to the event on April 9, 1996. Initial operator actions following the event were well executed. However, problems were encountered during several recovery actions which delayed restoration of the condenser and placed the operators in a difficult operating condition. One violation with two examples, and one inspection follow-up item were identified.

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Executive Summary

- Due to a lack of design understanding and poor procedural guidance, the electrical differences between GCB4522 and the remaining switchyard breakers were not identified prior to beginning work on April 9, 1996. This resulted in inadequate procedure for performing maintenance on GCB4522, a violation of NRC requirements.

- The licensee failed to identify the consequences of performing the preventive maintenance work even though the scenario which occurred on April 9, 1996, was discussed in the Updated Safety Analysis Report.

- Initial operator actions during the event were focused and well coordinated. Procedures were fully utilized and control room briefings were timely.

- Operators responded appropriately to the loss of the core map display during the event.

- A technical inaccuracy within an emergency operating support procedure was identified which resulted in injecting suppression pool water into the vessel. The licensee's review of other support procedures identified additional problems in this area. This was a violation of NRC requirements.

- Recovery of the main condenser was delayed because of the following:

    - The procedures for recovering the condenser were inadequate resulting in delays in plant recovery.
    - Poor turnover and weak panel walkdowns failed to address a high hotwell level.
    - Circulating water pump "B" failed to start due to a previously identified material condition problem.

- Maintaining the reactor in hot shutdown challenged the operators with a constantly changing reactor bottom head heatup/cooldown rate and resulted in exceeding the heatup rate limit.

DETAILS

1.0 BACKGROUND

1.1 Overview of the Event

On April 9, 1996, the reactor scrammed from 100% power as the result of maintenance activities in the switchyard. Electrical maintenance personnel, performing preventive maintenance (PM) on a switchyard breaker, inadvertently caused the breakers protective relay logic to actuate resulting in the de-energization of the reserve auxiliary transformer (RAT). This resulted in the temporary loss of off-site power which caused a high turbine building temperature closure of the main steam isolation valves (MSIV). The MSIV closure caused a reactor trip followed by a turbine trip. As the turbine generator slowed, the unit auxiliary transformer (UAT) was unable to transfer to the de-energized RAT and all non-vital systems lost power. This resulted in the draining of several important water systems including: service water, condensate water, and circulating water. Restoration of the condenser, as a heat sink, was delayed while these system were refilled. During the event, decay heat was rejected to the suppression pool for 30 hours using reactor core isolation cooling (RCIC) and safety relief valves (SRV).

1.2 Failure to Recognize Design Differences in Breaker (GCB4522) Relay Protective Scheme Lead to Reactor Trip

Although the licensee had accomplished maintenance on other switchyard breakers without incident, the failure to recognize unique design features of breaker GCB4522 lead to an inadvertent trip of the unit on April 9, 1996. Although the licensee had recognized that each pole for the three phases of breaker GCB4522 could move independently and had a vendor present because of this design feature, the licensee failed to identify uniqueness in the breaker's protective relay scheme. Because the breaker's design was not completely understood, appropriate precautions were not taken prior to commencing maintenance activities.

Because the breaker poles could move independently, the breaker's protective logic specifically monitored the alignment of the three poles as one logic condition. The other logic conditions were low insulating gas pressure or low hydraulic pressure. As part of the breaker PM, both of these systems were depressurized. As Electrical Maintenance personnel moved the phase "C" pole, per the vendors guidance, a pole disagreement condition as generated and a pole disagreement contact closed in the breaker's protective relay logic. With the low insulating gas pressure and low hydraulic pressure relay contacts already made up, the pole disagreement caused the GCB4522's local breaker failure relay to energize. This actuation sent a trip and lock out signal to the adjoining breakers of GCB4522 (see attached sketch). GCB4502 and GCB4518 tripped and locked open. Since GCB4522 was already open, the RAT was de-energized.

Additionally, the licensee assumed that electrical current was required for the local breaker failure relay to actuate. Although true for all other switchyard breakers, GCB4522 did not require current to be available in order to actuate the local breaker failure relays.

1.3 Sequence of Events

~8:00

Electrical maintenance (EM) began physical work on switchyard (SY) breaker GCB4522. The control room was notified. Initial work consisted of draining the sulfur-hexaflouride (SF_6) insulating gas, depressurizing the breaker hydraulic system, and removing inspection covers. The work was performed under PM task PEMSYM004. The control power, which allowed actuation of the local breaker failure relay, to the breaker was intentionally left energized to allow electrical cycling of the breaker during the course of the PM task.

13:31:38.6 (hour:minutes:seconds)

EM manually stroked the linkage for phase "C" of the breaker as part of the PM. This action generated a pole disagreement condition with phases "A" and "B." Since the breaker's hydraulic system was already depressurized and the SF_6 gas drained, the breaker's protective logic was met. The logic activated the local breaker failure relay for breaker GCB4522 and caused breakers GCB4502 and GCB4518 to trip and lock open. With breaker GCB4522 open for maintenance, the opening of GCB4502 de-energized the RAT causing an immediate undervoltage condition on the safety-related (SR) busses. (See attached sketch of switchyard)

BACKGROUND: The RAT is the normal, offsite, source of power for the three 4.16 kV SR busses 1A1, 1B1, and 1C1 and is the shutdown source of power for other non-safety-related (NSR) 6.9 kV busses. During normal operation, the 6.9 kV NSR busses are powered by the unit auxiliary transformer (UAT) off of the main generator.

13:31:39.4

During the 2.5 second loss of power to the Division I and II busses, the respective Riley temperature detectors de-energized and failed to the conservative tripped condition. With 2 out of the 4 detectors in the tripped condition, the logic coincidence for MSIV closure was met and the MSIV closed as designed.

BACKGROUND: Part of the main steamline leakage detection system consists of 4 high temperature detectors located in the heater bay. This is for protection from steam line breaks downstream of the outboard MSIVs. The Riley temperature detectors are powered from separate Divisions. Divisions I and II delay transfer for approximately 2.5 seconds to provide time for the RAT undervoltage condition to clear before transferring to the ERAT. Division III power rapidly transfers to the ERAT upon sensing undervoltage on the RAT. The Division IV Riley is powered from an uninterruptible nuclear system protection system (NSPS) power supply.

Following the respective time delays, the Division I, II, and III busses successfully transferred to the ERAT.

13:31:39.5

When the MSIVs reached less than 90% open, the reactor scrammed and the turbine tripped as designed.

Both reactor recirculation pumps downshifted to slow speed.

Reactor pressure rose above the high pressure reactor trip setpoint and continued until two SRVs opened.

13:31:55

In the control room, the full core display provided conflicting information concerning control rod position following the scram. The reactor operator initiated a manual scram and alternate rod insertion (ARI) in accordance with procedures. While the operator continued to monitor the full core display, it dimmed and then lost power.

Prior to a reverse current trip, the operators manually tripped the main generator, which opened switchyard breakers GCB4506 and GCB4510. As the generator rotation slowed, input voltage to the UAT and NSR busses decreased. Since the RAT was already de-energized, the UAT could not transfer loads to the RAT as designed and power was lost to many NSR loads including: both reactor recirculation pumps, instrument air, service water, condenser circulating water, and the condensate system.

1337

Reactor core isolation cooling (RCIC) was started.

1340

Notice of Unusual Event (NOUE) declared due to the failure of all rods to immediately insert following the reactor scram.

Note: The Unusual Event was terminated at 2005 when the licensee determined that all control rods had fully inserted within three seconds of the reactor scram. The rod control and information system (RCIS) a had become inoperable during the scram, providing conflicting rod position indication.

1343

RCIC was shutdown.

1344

Condenser vacuum was lost.

1346

RCIC was started.

1350

Licensee attempted to close switchyard breaker GCB4502 but was unsuccessful since the GCB4522 local breaker failure relay logic was still satisfied.

1354

RCIC was shutdown.

1438

Second attempt to close GCB4502 was unsuccessful since the GCB4522 local breaker failure relay logic was still satisfied.

1453

The tripped local breaker failure relay for breaker GCB4522 was recognized and reset. Breaker GCB4502 was closed energizing the north bus and the RAT.

1506

All transformers and associated busses were re-energized from the RAT. Operations started filling and venting water system and restoring them to service.

2.0 RESPONSE TO EVENT

2.1 Initial Operator Response Considered Good

Although the inspectors considered initial operator response to the event to was thorough and timely, recovery actions were hampered due to a number of procedural and equipment problems. Immediately following the scram, the full core display provided information which indicated that many of the control rods were both in the full in position and the full out position (the reason for this is explained in Section 3.4). The operator initiated a manual scram and ARI as directed by procedure when he was unable to verify that all rods had inserted into the core. When the operator was still unable to verify that all of the control rods were in the full in position, the shift supervisor informed the control room that the criteria for a NOUE was met and the respective EOP was entered. The inspectors considered the shift supervisor's decision to declare the NOUE to be appropriate considering the information available at the time.

Following the declaration of the NOUE, operators were able to verify that all rods fully inserted into the core by observing that the "all rods in" indication was lit on one division of RC&IS. Later, the licensee reviewed GETARS traces and verified that all rods inserted into the core as designed in response to the initial automatic scram signal.

In addition to the normal control room shift compliment, additional operators from both the training crew and the relief crew were available to aid in responding to the event. By having additional personnel available, operations was able to locally verify equipment configuration (this needed to be done due to several equipment problems discussed in Section 4.1) and begin restoring balance of plant systems once power was restored.

Command and control during the event was good. The line assistant shift supervisor (LASS) and the other senior reactor operators on shift monitored the activities of the operators and documented their progress through the EOPs. Timely briefs were held within the control room to apprise the entire crew of current plant conditions, on-going activities, and recovery actions that were being planned. The coordination between the operator operating RCIC and the SRVs and the operator monitoring the reactor control panels was also well controlled.

Although senior licensee management personnel was present in the control room, at no time did they divert the attention of operations personnel from responding to the event. On one occasion, the plant manager noted an excessive number of people in the control room and asked that personnel not already assigned to perform a specific task wait in the technical support center for further instructions. This reduced the number of people in the area as well as the ambient noise level and distractions the operating crew faced.

2.2 Maintenance and Engineering Response Aided in Troubleshooting Efforts

The EM workers' initial response to the event was good. Upon noticing that breaker GCB4502 had tripped the electricians stopped work on breaker GCB4522 and proceeded to the relay house. Senior maintenance management, plant engineers, and equipment operators all responded to the switchyard to provide additional troubleshooting assistance. The electrical maintenance group leader immediately contacted the load dispatcher to determine the cause of the switchyard disturbance. Initial indications showed that the sequence in which breakers GCB4502, GCB4518, GCB4506, and GCB4510 opened was indicative of a breaker failure in breaker GCB4522. Later, it was verified by maintenance and operations via a panel walkdown, and by engineering via the electrical prints, that GCB4522's failure relay logic had been satisfied due to the work performed as part of the planned PM task. Once offsite power was restored to the plant (in 1.5 hours), GCB4522 was placed in a safe condition and all PM work on the breaker was suspended.

3.0 RECOVERY ACTIONS

3.1 Reactor Pressure Control Using SRVs

Management directed the plant be maintained in hot shutdown based on the expectation that the condenser would be recovered shortly. A pressure band of 500 to 700 psig was established with a corresponding temperature of greater than 460°F. The licensee indicated that by maintaining the plant hot, a thermal cycle would be avoided. By avoiding a thermal cycle, heatup activities were expedited and control rod drive venting was minimized. In addition, an inboard MSIV drain line valve which had substantial leakage when opened, would not have to be cycled if the plant remained hot.

By maintaining the reactor hot and using SRVs for pressure control, operators were challenged by constantly changing conditions. For example, when operators opened an SRV, relatively hotter water moved from the core region through the downcomer annulus region and down to the reactor vessel bottom head causing swings in bottom head temperature. Operators countered by cycling the CRD pump and reactor water cleanup system (RT) in an attempt to control the heatup rate of the reactor vessel bottom head. At approximately 8.5 hours into the event, the TS heatup rate of 100°F/hour for the vessel bottom head was exceeded. As the bottom head drain temperature approached the limit, operators stopped RT flow. By securing this flow, the temperature indication no longer tracked the actual heatup rate which was continuing to rise based on bottom head metal temperature. The indicated heatup rate, based on the compromised bottom head drain temperature, peaked at 130°F/hour before turning. The operators were able to restore the rate within the limiting condition of operation period of 30 minutes.

The cycling of CRD flow also stopped flow to the reactor recirculation (RR) pump seals. Although the RR seals functioned normally after the event, this activity caused unnecessary thermal and mechanical cycling of those seals.

3.2 Entry Restrictions for Containment Cause Technical Specification to be Missed

Off normal procedures addressed evacuating containment prior to lifting SRVs. However, the procedure did not address long term access restrictions on containment. As the event progressed, radiation protection asked operations several times for permission to enter the containment to assess radiological conditions but operations denied access. Containment access was required every 24 hours to verify appropriate upper pool level and temperature. Due to the restricted access, surveillance requirements for TS 3.6.2.4.1 and 3.6.2.4.2, could not be met within 24 hours nor was it met using Surveillance Requirement 3.0.2 which allows a 25% interval extension. The licensee was able to meet the limiting condition for operation for the missed surveillance. Following the event, the licensee was reviewing access to the containment for such scenarios.

3.3 Delayed Recovery of the Condenser for Decay Heat Removal

3.3.1 Delays Due to Required Priority

Following the loss of all NSR power, recovery of the condenser was substantially delayed due to required restoration of several plant systems. Many systems drained during the loss of power which required additional time to fill and vent prior to restarting. Essentially, operators were faced with starting the balance of plant (BOP) equipment from an outage condition. Operators followed procedures and restored the priority systems appropriately.

Procedure CPS 4200.01, "Loss of AC Power," provided guidance in establishing priority for restoring non-safety bus loads. The priority order included: plant service water, component cooling water, service and instrument air, turbine building closed cooling water, control rod drive hydraulics, makeup and cycled condensate, condensate and feedwater, turbine and generator auxiliaries, and heating ventilation and air condition systems. While the reactor trip occurred at 1:31 p.m. recovery efforts for higher priority systems delayed the filling and venting of the condensate system until 7:40 p.m.

3.3.2 Delays Due to Lack of Procedural Guidance

Additional delays were encountered due to lack of guidance in restoring the condensate system. During plant recovery the steam jet air ejectors (SJAE) were not isolated which directly delayed filling the condensate system. With the unisolated SJAE, valve CD039 opened to provide a minimum flow path. This path short cycled the filling of the condensate system by creating a drain path to the condenser. Although the condenser hotwell level was already elevated due to the expected drainage from the condensate system, this additional water raised hotwell level offscale high. Procedural guidance was lacking concerning this condition as the "Loss of AC Power" procedure CPS 4200.01, "Automatic Isolation" procedure CPS 4001.02, and "Condensate/Condensate Booster," procedure CPS 3104.01 did not address this condition.

At 7:40 p.m. the operators started filling the condensate system using cycled condensate (CY) water. Shortly before midnight the CY tank reached a low level and operators concluded the system was not filling as expected. The operators identified the open CD039 valve as the problem by referring to a note on an operational schematic (OS-1005).

Precautions in the "Condensate/Condensate Booster" procedure, CPS 3104.01, states that when the plant is shutdown, condensate level should not exceed 60 inches, and shall not exceed 75 inches. This prevents condensate from contacting condenser tubes to assure that no path exists for leakage of radioactivity outside the condenser. Due to the lack of procedural guidance the precaution was not met.

Following the initial attempt to fill the condensate system, additional time was required to refill the CY tank from the makeup condensate tank.

Once a condensate pump was started and a condensate polisher was placed in service, the pumpdown of the condenser hotwell water began. This process took additional time due to the extra water added during the first attempt to fill the condensate system.

3.3.3 Delays Due to Weak Turnovers and Panel Walkdowns

Weakness in a turnover and a panel walkdown delayed filling of the circulating water system (CW). Following the initial event, operators recognized that condenser level was high and would require draining prior to starting CW. Following the addition of CY water during swing shift, the level indication pegged high. Between swing shift and the midnight shift the high level condition was not turned over nor was it identified during the operators' panel walk down. At 2:15 a.m. (April 10) the operators identified the high condenser hotwell level was pegged high and directed closing of the CW discharge valve. Although the CW fill had been progressing for several hours, this action negated the fill. The CW fill resumed at 11:06 a.m.

The operator turnover and panel walk down that failed to identify the condenser high hotwell level was considered a weakness. A contributing factor to the walk down problem was the fact that the video and analog displays for hotwell level were in disagreement by 5 to 6 inches and had been caution tagged since November 1995. Some operators indicated that they no longer considered the video indication accurate and therefore ignored it.

3.3.4 Delays Due to Equipment Problems

Due to the failure of CW pump "B" to start, another delay was encountered. CW pump "A" was out of service for maintenance due to an oil cooler leak. The breaker for CW pump "C" did not show a trip indication following the scram and required troubleshooting. CW pump "B" was different from the other two pumps (as described in Section 4.2) and had a history of tripping the first time a start was attempted after the pump had been off for a period of time. At 3:17 p.m. operators attempted to start CW pump "B" which tripped. The water fill for CW was lost. Following evaluation of the first trip, refilling of the CW system, and briefing the oncoming shift, CW pump "B" was started at 6:46 p.m.

The failure of the CW "B" to start the first time was a long standing problem know by the licensee; however, this problem was not in the operator work around list. This workaround delayed the recovery of the condenser by 3.5 hours and further complicated recovery efforts by the operators.

3.3.5 Final Restoration of the Condenser

At 8:20 p.m. (April 10) operators began equalizing steam pressure around the MSIVs to establish a path to remove decay heat via the condenser. By this time the main steam line drains would have been sufficient to remove decay heat. However the inboard MSIV drain line valve had a known substantial steam leak (when open). The valve was used only long enough to equalize steam and open the inboard MSIVs. The drain line valve was repaired prior to restart.

Overall recovery of the condenser was significantly delayed due to several avoidable items listed above. The improper first attempt to fill the condenser resulted in approximately a 4-hour delay. The failure to identify the high level condition in the condenser hotwell resulted in approximately a 9-hour delay in resuming the CW fill. The CW "B" pump failure to start delayed the recovery by another 3.5 hours. While these delays may not be completely additive, they were a significant contributor to the approximately 30 hours the reactor remained on pressure control using safety relief valves and decay heat continued to be rejected to the suppression pool.

4.0 EQUIPMENT AND PROCEDURE PROBLEMS

4.1 Dual Indication Problems with Several Pieces of Equipment

During the event, it was noted that the equipment listed below displayed dual indications on the control room panels.

- 1C1 reserve feed breaker
- "C" CW pump breaker
- RR discharge isolation valves (67 A&B)
- RT valve 1G33F100
- Shutdown service water valves (14 A&B)

In most cases operators verified from the field that the equipment operated as designed. Only the discharge isolation valves for both reactor recirculation loops could not be verified during the event due to their location in the drywell. The need to verify equipment operation in the field did not adversely impact the licensee's response to the event due to the large number of operators available following the scram. The breaker indication problems were corrected prior to reactor startup on April 12, 1996.

The five valves in question were stroke tested or monitored with VOTES equipment to ensure that the switch settings were appropriately set. The inspectors questioned the torque switch settings for the 14 A & B shutdown service water valves. Prior to the event, these valves were placed in test to perform a daily flushing of piping to prevent microbiologically induced corrosion. It appears that these valves may have torqued-out during the event prior to reaching their fully shut position. This is considered an inspector follow-up item (50-461/96004-02(DRP)).

4.2 Failure of Equipment to Start

In addition to the indication issues, additional problems were encountered with two pieces of equipment. Although the compressor for the Division 1 H_2O_2 monitor failed to start, this did not impact the operators monitoring of the event since the Division 2 monitor was available for use. The licensee also found that circulating water (CW) pump "B" was difficult to start once power was restored to the balance of plant equipment.

The failure of the compressor to start for the H_2O_2 monitor was due to a faulty lamp socket which blew a fuse.

Failure of the "B" CW pump to start on the first attempt had occurred several times in the past. According to plant engineers, this pump (which is different than "A" and "C") may have failed to maintain an oil wedge between the bottom of the thrust bearing and the surface it rides on which dramatically increased the static friction between these two points. The pump rotated on receiving a start signal but the pump tripped prior to attaining running speed because of the increased friction. The initial rotation was enough to allow an oil wedge to form which reduced the amount of friction and allowed the pump to start on the second attempt. The licensee was evaluating the installation of a lift oil system in an attempt to mitigate this problem in the future.

4.3 Off-Normal Procedural Problems Identified

A procedural deficiency was identified by the operators while responding to the event. As a result of operating SRVs to control reactor pressure, suppression pool level increased. Prior to reaching a high level in the suppression pool (which automatically transfers the RCIC suction from the RCIC storage tank to the suppression pool), operators attempted to defeat the RCIC suppression pool level suction transfer using procedure CPS No. 4410.00C002 "Defeating High Suppression Pool Water Level RCIC Suction Transfer," due to water quality concerns. However, the attempt failed due to a technical inadequacy in the procedure which directed the operators to turn an automatic trip module (ATM) in the wrong direction (clockwise).

The inability to defeat the RCIC suction transfer logic resulted in injecting suppression pool water into the vessel for approximately one hour. Under direction from the LASS, and with print verification, the operator turned the ATM counter-clockwise and successfully defeated the suction transfer. A subsequent chemistry sample of the reactor coolant system identified increased conductivity. The chemistry department suspected that the high conductivity was due to elevated nitrate levels within the water stored in the RCIC storage tank. Through discussions with licensee personnel, the inspectors determined that elevated nitrate levels within the RCIC tank were identified a number of years ago. However, the licensee had not yet determined the source of the nitrates.

A condition report was written to document the procedural problem described above. As part of the licensee's corrective actions, CPS No. 4410.00C002 was revised to include the correct information. In addition, a review of the other four EOP support procedures which adjust ATMs was initiated in an attempt to identify similar problems. As a result, the licensee identified additional deficiencies in each of the four support procedures.

Technical Specification (TS) 5.4.1 states that written procedures shall be established, implemented, and maintained covering the activities recommended in Regulatory Guide (RG) 1.33, Revision 2, Appendix A, February 1978. RG 1.33, Appendix A, Section 4, states that "Instructions for energizing, filling, venting, draining, startup, shutdown, and changing modes of operations should be prepared, as appropriate for the Reactor Core Isolation Cooling System. The failure to have an adequate procedure for changing modes of operation of the RCIC system is a violation of TS 5.4.1 (50-461/96004-01a(DRP)).

4.4 Loss of Power to and Conflicting Information on the Core Display

The loss of the core map display was due to a loss of electrical power. The display was powered from non-safety related power which was being supplied from the UAT. Once the generator was tripped (approximately 46 seconds into the event), NSR loads automatically transferred to the RAT. In this case, the RAT was already de-energized and the transfer resulted in a loss of power to those busses. As the voltage rapidly decayed on the NSR 6.9 kV bus, the 120 volt ac power for the core display also decreased. The core display power supplies drew excessive current in response to the dropping voltage until the display breaker tripped on instantaneous over-current.

Just before the core map display went dark, the operators noted that, for a number of control rods, both the green (fully inserted) light and the red (fully out) light were lit. In addition, the position indication system provided meaningless information for some rod positions. These conflicting indications led the operators to question initial rod position following the scram.

Following initial actions taken by the operator, all rods were verified fully inserted on Division I of the rod action control system (RAC) on a back panel. In accordance with procedures, only one Division was required for verification. The indication was a single light that energized after all control rod position indications were queried and all responses indicated that each rod was fully inserted.

Division II panel of RAC was receiving an intermittent signal from one rod position indication reed switch which resulted in a data fault. The system continued to scan the rod positions and each time the fault cleared the indication for all rods in would light. The intermittent fault continued for approximately 30 minutes and then cleared. A work request was written to troubleshoot the problem. Since Division I and II use independent rod position indication probes, Division I was not effected.

Plant engineers, in consultation with the vendor, were unable to determine the cause of dual information. Several transients occurred during the short time between the start of the event and loss of the core display. The digital system has several subsystems which are powered from several different power sources. The power transfer of Division I & II from the RAT to the ERAT caused a transient on portions of the system. A fault detected on one transponder card, prevented HCU information from being transmitted to the core display; however, rod position information continued to be sent. In addition, there was the intermittent fault for a single rod position indication associated with Division II.

Communication between all the subsystems was by asynchronous digital communication. As a result of the transients to the system, it appears that the system was unable to re-establish proper communication with the core display before the core display lost power. Once all power was returned and the portion of the system associated with HCU information reset, the system functioned normally. Although no problem could be found with the transponder card, it was replaced.

4.5 Leaking Safety Relief Valves Identified Following Plant Recovery

Before the event three SRVs were identified leakers, based on tail pipe temperature. For 30 hours following the event, 85 SRV lifts were used to control reactor pressure. As a result, four additional SRVs are leaking based on increased tail pipe temperature following plant recovery.

5.0 ROOT CAUSE AND CORRECTIVE ACTIONS

5.1 Overview

The inspectors reviewed the licensee's post trip report and the results of several critiques and fact findings held following the event. The licensee determined that the lack of an appropriate review of the work to be performed as part of the PM was one apparent cause of the event. Specifically, the review failed to assess the potential impact of the PM work on the remainder of the switchyard. At the conclusion of the inspection the licensee was in the process of performing a formal human performance evaluation system (HPES) review to determine other possible root causes. The inspectors determined that three factors contributed to the event. First, the licensee's current procedures do not contain adequate guidance on how to assess and mitigate the impact of work performed in the switchyard on the remainder of the switchyard and plant. In addition, licensee personnel were unaware that the relay scheme for breaker GCB4522 differed from the other four breakers within the switchyard. Lastly, personnel did not fully understand the consequences of isolating the power feed to the RAT as discussed in Section 6.1.

5.2 Lack of Guidance to Properly Plan Preventive Maintenance Work

While the licensee's current procedures provide guidance to assess the impact of taking individual pieces of equipment out of service, they were deficient with respect to providing guidance to fully assess the impact that the maintenance work had on the remaining switchyard and plant components. In addition, portions of the information contained within the licensee's documented expectations were not fully understood. For example, Plant Manager's Standing Order (PMSO) 072, "Control of Work in the 345kV Switchyard," states that an impact assessment shall be prepared as part of the planning process for work covered by the PMSO. However, a formal impact assessment was not completed since many personnel were unaware of the existence of the PMSO. Although the inspectors could not determine if the completion of the impact assessment would have identified the switchyard vulnerability, the failure to perform the assessment removed a barrier intended to preclude such events, as discussed in this report, from occurring.

Sensitivity to first time evolutions was also not apparent. Although, licensee personnel were aware of the physical differences between GCB4522 and the remaining four switchyard breakers, it was assumed that the relay scheme for all the breakers was the same (See Section 1.2 for additional details). In addition, successful completion of PMs on other switchyard breakers added to the decreased awareness of possible electrical differences.

TS 5.4.1 states that written procedures shall be established, implemented, and maintained covering the activities recommended in Regulatory Guide (RG) 1.33, Revision 2, Appendix A, February 1978. RG 1.33, Appendix A, Section 9, states that "maintenance that can affect the performance of safety-related equipment should be properly pre-planned and performed in accordance with written procedures, documented instructions, or drawings appropriate to the circumstances. The failure to have procedures appropriate for properly pre-planning preventive maintenance on GCB4522 is a violation of TS 5.4.1 (50-461/96004-01b(DRP)).

5.3 Corrective Actions

The actions needed to place breaker GCB4522 in a safe condition were completed prior to commencing reactor startup on April 13, 1996. The licensee's review of the event was still in progress at the conclusion of the inspection. The inspectors will evaluate the effectiveness of the final corrective actions as part of the violation and licensee event report follow-up.

6.0 SAFETY ASSESSMENT/QUALITY VERIFICATION (RISK CONSIDERATIONS)

6.1 Poor Review of Risk Considerations for On Line Maintenance

The licensee did not recognize the significance of losing the RAT. Previously, several online breaker maintenance activities were performed in the switchyard which held the potential for de-energizing the RAT. The Updated Safety Analysis Report (USAR), Section 15.2.6.2.2.1, indicates "the reactor is subject to a complex sequence of events when the plant experiences a loss of all auxiliary power...At t=0, an MSIV closure is initiated due to a momentary power loss to the leak detection system which causes an isolation signal." It appears the licensee did not consider the scenario when planning the maintenance.

Although GCB4522 was different than all the other breakers in the yard, no additional review for potential problems was considered. The reviews were limited to how lifting the power connections to the breaker would effect the respective breaker. The focus appeared to be on how to make the system work without the component, not what other systems might be effected when the component is taken out of service.

6.2 Consequences of Maintaining Hot Shutdown Using SRVs

Management's direction to maintain the plant in hot shutdown without the main condenser as a heatsink resulted in difficulties meeting TS requirements. The licensee consensus was that the condenser would be restored soon. However, several avoidable items contributed to the 30-hour delay in restoring the condenser.

Operators were placed in a difficult situation trying to maintain the plant in hot shutdown. As they opened SRVs to control pressure, heatup rate at the bottom vessel head changed dramatically. Attempts were made to compensate by cycling the CRD pumps but eventually the heatup rate limit was exceeded. The numerous lifts of SRVs increased the risk of an SRV sticking open and the cycling of the CRD pump challenged the RR pump seals.

Access to the containment was restricted during the 30 hours which prevented the completion of TS required surveillance and other activities in the containment.

7.0 REVIEW OF UFSAR COMMITMENTS

A recent discovery of a licensee operating their facility in a manner contrary to the Updated Final Safety Analysis Report (UFSAR) description highlighted the need for a special focused review that compares plant practices, procedures and/or parameters to the UFSAR description. While performing the inspections discussed in this report, the inspectors reviewed the applicable portions of the UFSAR that related to the areas inspected. The following inconsistencies were noted between the wording of the UFSAR and the plant practices, procedures and/or parameters observed by the inspectors.

i) References to the Steam Condensing Mode of the Residual Heat Removal (RHR) System:

Two UFSAR Chapters discuss the use of this subsystem of RHR to remove residual heat from the reactor when a loss of the Main Condenser occurs (references are found in Chapters 5 and 15). The UFSAR portrays this mode of RHR as the one to be used prior to utilizing the Safety Relief Valves (SRV) with the Suppression Pool becoming the heat sink.

It is evident that Clinton Power Station management never intended this system to be used. Start-up testing on this mode of RHR was not completed and operating procedures for this mode do not exist. Design Change documentation also exists which depicts this management decision (Modification Number RH-031 from 1987, Temporary Modification Number 90-04 from 1990, and Modification RG-033 from September, 1993). While some sections of the UFSAR have been updated, others have not. The licensee was re-evaluating their position on updating the UFSAR at the conclusion of the inspection.

2) Inappropriate Reference to the use of the Motor Driven Reactor Feed Pump (MDRFP)

UFSAR Section 15.2.6 deals with Loss of AC Power events. Subsection 15.2.6.2.1.3 directs the operators to maintain reactor water level in these events by using the Reactor Core Isolation Cooling (RCIC) System or the High Pressure Core Spray (HPCS) System or by utilizing the MDRFP. This statement is in error (pertaining to using the MDRFP) in that this pump will be without a source of power in the event of a loss of AC Power. This licensee planned to correct this error.

8.0 MANAGEMENT MEETINGS (40500)

7.1 Preliminary Inspection Findings (Exit)

The inspectors contacted various licensee operations, maintenance, engineering, and plant support personnel throughout the inspection period.

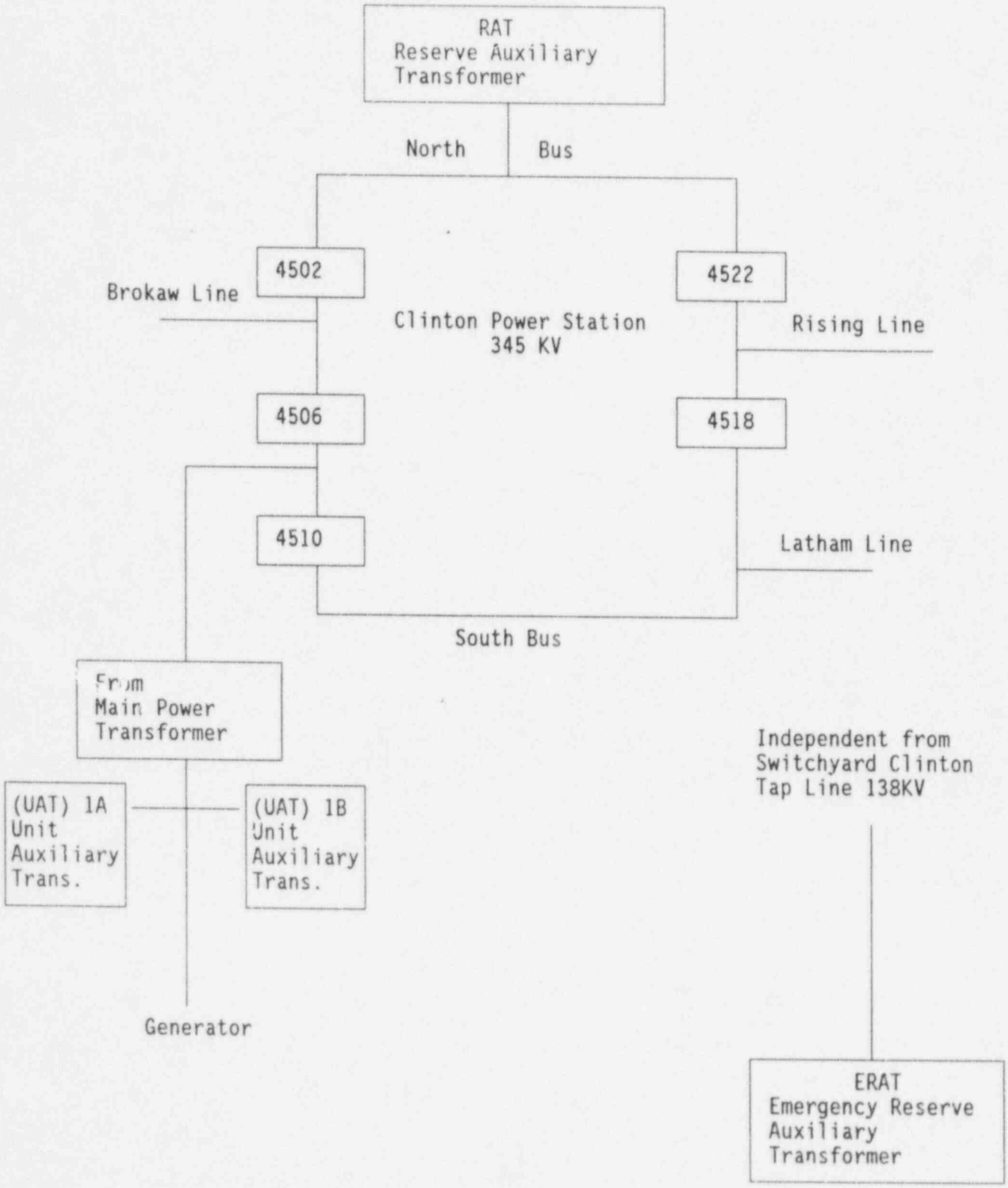
At the conclusion of the inspection on April 26, 1996, the inspectors met with licensee representatives (denoted below) and summarized the scope and findings of the inspection activities. The licensee acknowledged the inspector's comments. The inspectors also discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspectors. The licensee did not identify any such documents or processes as proprietary.

J. Cook, Senior Vice President - Energy Supply
R. Morgenstern, Manager - Clinton Power Station
D. Thompson, Manager - Nuclear Station Engineering Department
R. Phares, Manager - Nuclear Assessment
M. Lyon, Director - Licensing
D. Morris, Director - Radiation Protection
A. Mueller, Director - Plant Maintenance
K. Moore, Director - Plant Operations
D. Antonelli, Acting Director - Plant Support Services
C. Elsasser, Director - Planning & Scheduling
M. Stickney, Supervisor - Regulatory Interface

9.0 DEFINITIONS

9.1 Inspection Follow-up Item

Inspection follow-up items are matters which have been discussed with the licensee, which will be reviewed further by the inspector, and which involve some action of the part of the NRC, or the licensee, or both. An inspection follow-up item disclosed during this inspection is discussed in Section 4.1.


RAT
Reserve Auxiliary
Transformer
North Bus
4502
Brokaw Line
4522
Clinton Power Station
345 KV
Rising Line
4506
4518
4510
Latham Line
South Bus
From
Main Power
Transformer
Independent from
Switchyard Clinton
Tap Line 138KV
(UAT) 1A
Unit
Auxiliary
Trans.
(UAT) 1B
Unit
Auxiliary
Trans.
Generator
ERAT
Emergency Reserve
Auxiliary
Transformer

LIST OF ACRONYMS

ARI	Alternate Rod Insertion
ATM	Automatic Trip Module
ATWS	Anticipated Transient Without Scram
BOP	Balance of Plant
CRD	Control Rod Drive
CW	Circulating Water
CY	Cycled Condensate Water
DRP	Division of Reactor Projects
EM	Electrical Maintenance
EOP	Emergency Operating Procedure
ERAT	Emergency reserve Auxiliary Transformer
HCU	Hydraulic Control Units
HPES	Human Performance Evaluation System
LASS	Line Assistant Shift Supervisor
MC	Make-up Condensate
MSIV	Main Steam Isolation Valve
NOUE	Notice of Unusual Event
NSPS	Nuclear System Protection System
NSR	Non-Safety-Related
PDR	Public Document Room
PM	Preventative Maintenance
PMSO	Plant Manager's Standing Order
RAT	Reserve Auxiliary Transformer
RCIC	Reactor Core Isolation Cooling
RC&IS	Rod Control and Information System
RCS	Reactor Coolant System
RG	Regulatory Guide
RR	Reactor Recirculation
RT	Reactor Water Cleanup System
SJAE	Steam Jet Air Ejectors
SR	Safety Related
SRV	Safety Relief Valve
SY	Switchyard
TS	Technical Specification
UAT	Unit Auxiliary Transformer
USAR	Updated Safety Analysis Report
WS	Service Water