

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-461/90009(DRP)

Docket No. 50-461

License No. NPF-62

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

Facility Name: Clinton Power Station

Inspection At: Clinton Site, Clinton, Illinois

Inspection Conducted: April 12-27, 1990

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5/9/90
Date

Inspection Summary

Inspection from April 12-27, 1990 (Report No. 50-461/90009(DRP))

Areas Inspected: Special safety team inspection by the resident, Region III, and NRR inspectors to review the circumstances surrounding the improper withdrawal of control rods on April 11, 1990, with main turbine bypass valves not fully closed.

Results: The safety significance of this event is derived from the lack of attention to plant indications during important evolutions by licensed personnel, not believing plant indications, not informing supervisors of unexpected plant response, and the scheduling and controlling of complex and safety significant evolutions during shift turnovers. The actual physical safety significance of this event on the reactor core was minor because all of the control rod withdrawals made during this event were in accordance with the rod pattern and were at a rate which was more conservative than the rod pattern control system limits. Two apparent violations were identified (failure to follow Technical Specifications 3.1.4.1 and 4.1.4.1 - Paragraph 8; failure to follow procedures or develop adequate procedures - Paragraph 8).

DETAILS

1. Persons Contacted

Illinois Power Company (IP)

- *J. Perry, Vice President
- *J. Cook, Manager, Clinton Power Station
- *R. Wyatt, Manager, Quality Assurance
- *J. Miller, Manager, Nuclear Station Engineering
- *F. Spangenberg, III, Manager, Licensing and Safety
- *R. Morgenstern, Manager, Scheduling and Outage Management
- *J. Palmer, Manager, Nuclear Training
- *J. Palchak, Manager, Nuclear Planning and Support
- *D. Morris, Director, Plant Operations
- *S. Rasor, Director, Plant Maintenance
- *D. Miller, Director, Plant Radiation Protection
- *J. Mansker, Director, Planning and Programming
- *R. Phares, Director, Licensing
- *S. Hall, Director, Nuclear Program Assessment
- *K. Baker, Supervisor, I&E Interface

Soyland Power

- *J. Greenwood, Manager, Power Supply

The inspector also contacted and interviewed other licensee personnel during the course of this inspection.

*Denotes those present during the exit interview on April 27, 1990.

2. Purpose (41701, 71715, & 93702)

The purpose of this special team inspection was to review the circumstances surrounding the events on April 11, 1990, when several control rods were withdrawn during a reactor startup while the main turbine bypass valves were not fully closed.

The inspectors interviewed the shift crews, training department personnel and managers involved in this event. The inspectors developed a chronology of events and analyzed this event for its safety implications. The inspectors provided augmented monitoring of control room activities during the restart of the reactor.

3. Description of the Event

The following description of the event and the chronology were developed upon review of operating logs and strip charts, and interviews conducted during the inspection. Some of the times listed are approximate and are based upon a consensus of individual memories of the event. All of the times listed are CDT.

On April 10, 1990, at approximately 11:00 p.m., the midnight shift "A" reactor operator (RO) (the RO assigned to the control room panels controlling reactor power and monitoring equipment, turbine/generator controls, feedwater controls, etc.) assumed the watch. The "A" RO had noted during the shift turnover that generator load was at 105-110 MWe, reactor power was at 18-19%, and the electrohydraulic control (EHC) system generator load set was at 300 MWe. He also reviewed the plant procedures, in place at that time, in preparation for continuing the power ascension. After completing the procedure review, the "A" RO noted that reactor power had decreased to approximately 16% due to xenon building in (increasing). He then commenced withdrawing control rods with the line assistant shift supervisor (LASS) acting as the independent verifier. During the interviews, the inspectors uniformly were told that the purpose of the independent verifier was to ensure that the correct control rod was selected from the rod withdrawal sequence and moved to the correct location.

On April 11, 1990, at approximately 1:30 a.m., the "A" RO stopped withdrawing control rods with reactor power at 23-24%. During this time period he did not make any adjustments to generator load set. At this point the low power set point (LPSP) (approximately 22%) of the rod pattern control system (RPCS) had just been reached and there were a number of surveillances that needed to be completed, before the power ascension could be continued. A repair to a feedwater pump mechanical overspeed relay also needed to be completed and tested prior to increasing power.

At approximately 6:30 a.m., the "A" RO completed testing of the feedwater pump mechanical overspeed relay. Fifteen minutes later, at 6:45 a.m., the shift supervisor (SS) instructed the LASS to recommence the power ascension with the goal of reaching 35% power, prior to the end of the shift. The LASS in turn instructed the "A" RO to commence withdrawing control rods, in order to bring the reactor up to approximately 35% power. The "A" RO complied and commenced control rod withdrawal with a day shift staff assistant shift supervisor (SASS), who had come in early, acting as the independent verifier.

At this same time, day shift operators were arriving and began the process of shift turnover (which included panel walkdowns, a shift briefing, log reviews, etc.). Due to this, the normal senior operator oversight of this evolution did not occur. In addition, there were also more people in the control room than normal. At around 7:20 a.m., the normal day shift SASS needed to get his turnover from the SASS who was acting as the independent verifier. The LASS had the day shift shift technical advisor (STA) relieve the SASS as the independent verifier. At about 7:25 a.m., the "A" RO noted that generator load was about 200 MWe. He was also cognizant that generator load set was still at 300 MWe. At this same time the LASS shift turnover had just been completed and the midnight shift LASS left. Prior to leaving, the midnight shift LASS reminded the day shift LASS about surveillances that were due at 25% power and also informed him that they had received permission to continue the power ascension to 35% power. The day shift LASS started reviewing

the power ascension procedure being used from the point where they were at to see what needed to be completed next. He did not go back and review the portion that had already been done. The LASS was engaged in making plans for the work to be accomplished on dayshift. Because of this he did not adequately monitor overall unit operation by observing plant indicators in order to detect any unusual or abnormal trends.

At approximately 7:28 a.m., the reactor reached 25% power. Since permission had already been given to continue the power ascension to 35% power, the "A" RO continued withdrawing control rods. At about 7:30 a.m., the day shift SS relieved the midnight shift SS. Eight minutes later at 7:38 a.m., generator load reached the load set and the first main turbine bypass valve began to open. This went unnoticed by anyone, including the LASS who was responsible for monitoring overall plant response to the ongoing evolution, and the "A" RO continued to withdraw control rods. At about 7:40 a.m. the STA noted that generator load had not been increasing even though control rods were being withdrawn and reactor power was increasing. He questioned the "A" RO about this and was told it was due to the computer display control system (DCS) not updating properly. Even though the STA was not satisfied with this answer, he did not pursue it any further. At 7:44 a.m., the first bypass valve reached the full open position and the second bypass valve began to open as control rods continued to be withdrawn. Three minutes later at 7:47 a.m., the last control rod withdrawal was made with reactor power reaching approximately 35%. The STA again questioned the "A" RO about the fact that generator load had not increased. The "A" RO attributed the problem to lockup of the DCS and/or xenon buildup. During control rod withdrawals earlier in the shift, the "A" RO had noted that generator load increases were not as large as expected. This fact was attributed to the fact that the control rods being withdrawn were peripheral control rods with little rod worth and due to xenon building in. During the time that the bypass valves were open a total of 14-17 single notch, gang mode, control rod withdrawals were made. With control rod withdrawals stopped, the STA left the control area. The "A" RO obtained a process computer printout (OD-3) to verify reactor power level. The OD-3 printout indicated that reactor power was approximately 34%. The "A" RO waited approximately three minutes and then obtained a second OD-3 printout. This printout indicated that reactor power was approximately 38%. The "A" RO did not check what generator load was and had not looked at that parameter since 7:25 a.m.

At 7:51 a.m., the midnight shift "A" RO commenced turnover to the day shift "A" RO. As part of the turnover, the "A" ROs walked down all the panels in the control room. This included the panels containing the indications that two bypass valves were open. They stopped at those panels and discussed items of interest but neither noted that the bypass valves were open. The "A" ROs continued the turnover process until 8:30 a.m. when the midnight shift "A" RO was officially relieved by the day shift "A" RO.

At about 8:00 a.m., the day shift LASS assigned the extra day shift RO (referred to as "B prime" RO) the task of performing the portions of the power ascension procedure necessary to lineup balance-of-plant

(BOP) equipment. The "B" and "B prime" ROs are assigned to the control room panels controlling balance-of-plant systems. Sometime between 8:00 a.m. and 8:30 a.m., the "B prime" RO did note that there were bypass valves open, but apparently did not recognize the significance of this fact. At approximately 8:33 a.m., the open bypass valves were discovered by the two "B" ROs while performing panel walkdowns as part of their shift turnover. They immediately brought it to the attention of the midnight shift "A" RO who was still in the area. The operators recognized that the generator load set was too low. After a brief discussion as to whether any control rod withdrawals had been made with the bypass valves open (the midnight shift "A" RO did not remember making any), the midnight shift "A" RO increased generator load set, in order to close the bypass valves. At 8:35 a.m., the generator load set was increased to approximately 520 MWe. By 8:36 a.m., the bypass valves were fully closed and generator load increased to approximately 300 MWe.

The SS directed that the high speed computer monitoring system GETARS be checked to determine if any control rod withdrawals had been made with the bypass valves open. By 10:00 a.m., the GETARS records had been obtained and they indicated that 14-17 control rod withdrawals had occurred with bypass valves open. The exact number of rod withdrawals could not be determined because the first bypass valve started to open sometime during a series of three rod pulls. The Operations department management made notifications of the initial facts to the NRC residents and senior plant management. Operations department conducted a critique at 4:00 p.m. that day, to review the event. Senior licensee management was informed of the initial facts of the event; however, the results of the critique and the significance of the issues involved in this event (reactivity control, performance of licensed operators, and conduct of control room evolutions) were not communicated to senior management until they were expressed by NRC Region III management at a previously scheduled meeting the next day with licensee corporate management. After reviewing this information, licensee management decided to shutdown the unit and implement the corrective actions discussed in Paragraph 6. The shutdown was commenced at 7:34 p.m. on April 13, 1990, by inserting control rods. The generator was off-line at 9:42 p.m. that day. The unit was subcritical at 6:40 a.m. on April 14 and reached cold shutdown by 5:45 a.m. on April 15, 1990.

4. Sequence of Events

The following is a brief sequence of events:

April 10, 1990

11:00 p.m. "A" reactor operator (RO) took the shift with the generator at 105-110 MWe, reactor power at 18-19% power, and load set at 300 MWe. Commenced withdrawing control rods. Line assistant shift supervisor (LASS) acting as independent verifier.

April 11, 1990

- 1:30 a.m. "A" RO stopped withdrawing control rods with reactor power at 23-24% and just above the low power set point (LPSP) (approximately 22% thermal power) to perform surveillances. Generator load was 125 MWe.
- 6:30 a.m. "A" RO completed testing of a feedwater pump mechanical overspeed relay that had been repaired.
- 6:45 a.m. Shift supervisor (SS) directed the LASS who instructed the "A" RO to commence withdrawal of control rods to increase power, with the goal of reaching 35% power prior to the end of the shift. Control room turnovers had begun for some positions. Staff assistant shift supervisor (SASS) acting as independent verifier.
- 7:20 a.m. Day shift shift technical advisor (STA) relieved SASS as the independent verifier.
- 7:25 a.m. "A" RO noted that generator load was 200 MWe. "A" RO also was cognizant that load set was at 300 MWe. Midnight LASS officially relieved.
- 7:28 a.m. Achieved 25% power. Continued withdrawing control rods to 35% power.
- 7:30 a.m. Midnight shift SS relieved by day shift SS.
- 7:38 a.m. First main turbine bypass valve began to open. This fact was not observed by the "A" RO or the STA. Control rod withdrawals continued.
- 7:40 a.m. STA questioned "A" RO about generator load not increasing. "A" RO attributed this to display control system locking up (not responding).
- 7:44 a.m. First bypass valve was fully open.
- 7:47 a.m. Power reached 35%. Control rod withdrawals ended. STA again questioned "A" RO on why generator load has not increased. "A" RO again attributed this to display control system locking up or a xenon building in. STA left the control area. "A" RO recognized generator load at 200 MWe. "A" RO obtained a computer printout of thermal power level (OD-3) which indicated it to be 34%.
- 7:50 a.m. "A" RO obtained a second OD-3 which indicated reactor power to be 38%.

7:51 a.m. "A" RO commenced turnover to day shift "A" RO, including panel walkdowns.

8:00 a.m. Extra day shift "B prime" RO assigned to perform required balance-of-plant equipment lineups by LASS.

7:51 to 8:30 a.m. Both "A" ROs stopped in front of panel with bypass valve position indication and looked at and discussed items of interest. Bypass valves were not recognized as being open.

8:00 to 8:30 a.m. "B prime" RO noted bypass valves open but did not recognize significance of this fact.

8:30 a.m. Midnight shift "A" RO relieved by day shift "A" RO.

8:33 a.m. Bypass valves are recognized as being open by "B" ROs performing panel walkdowns as part of their shift turnover.

8:35 a.m. Generator load set is raised to 520 MWe by midnight shift "A" RO.

8:36 a.m. Bypass valves all fully closed. Generator load has increased to 300 MWe. SS directed that GETARS records be checked to determine if control rods were withdrawn while the bypass valves were open.

10:00 a.m. GETARS records indicated that control rods were withdrawn with bypass valves open. Initial notification of event was made by operations department to station management and NRC.

4:00 p.m. Critique conducted on the event by operations department management.

April 12, 1990

1:00 to 4:00 p.m. Licensee station and corporate management met with NRC Region III managers for a routine meeting, at which the NRC expressed concern over the event on April 11.

April 13, 1990

7:34 p.m. Licensee management directed that the unit be taken to cold shutdown (Operational Condition 4).

9:42 p.m. Generator was taken off-line.

April 14, 1990

6:40 a.m. Reactor was taken subcritical.

April 15, 1990

5:45 a.m. Unit reached cold shutdown.

5. Evaluation and Analysis

Operations Procedure CPS No. 3004.01, "Turbine Startup and Generator Synchronization," was an integrated operating procedure which provided overall direction to take the unit from 8% power with the turbine shutdown and steam flowing through the bypass valves to 35% power with the generator synchronized and the bypass valves closed. This procedure was being utilized by the operators at the time of the event. Paragraph 6.8, Limitations, stated, "In accordance with Tech Spec 4.1.4.1, when above 20% thermal power (Low Power Setpoint of the RPCS), and when the main turbine bypass valves are not fully closed, control rod withdrawal shall be prevented. This requirement shall be verified by a second licensed operator or other technically qualified member of the unit technical staff and documented by shift supervisor log entry." Paragraph 8.2.5 dealt with Generator Synchronization. Paragraph 8.2.5.5 synchronized the generator and Paragraph 8.2.5.6 directed that generator load be increased by selecting INCREASE on the Load Selector until the bypass valves are shut and Load Selector is approximately 150 MWe above generator load. Immediately before Paragraph 8.2.5.7 was a caution which stated, "NOTE, Load Selector should be maintained approximately 200 MWe above generator load for further load increases."

The "A" RO was withdrawing control rods and failed to raise the load selector as required by Procedure 3004.01; consequently, as reactor power and reactor pressure increased, the main turbine bypass valves began to open. This fact was not noted by either the "A" RO or the STA who was performing the independent verification of control rod movements.

There were multiple indications, within easy view of the "A" RO and the STA, which indicated that the bypass valves were beginning to open. However, there were no annunciators which alarm when the bypass valves were open. With the bypass valves opening, generator load did not increase. The STA did observe that generator load was not increasing. Twice he questioned the "A" RO about this problem. The "A" RO did not believe his indications and attributed this to the possibility that the display control system (DCS) had locked up (was re-sequencing) or that because xenon was building in (increasing) the relative worth of control rods was reduced; consequently, generator load might not increase. The "A" RO continued to withdraw control rods.

Administrative Procedure CPS No. 1001.05, "Authorities and Responsibilities of Reactor Operators for Safe Operation and Shutdown," Paragraph 8.1.3.1, states "The line Assistant Shift Supervisor assigned to the Main Control Room Area shall perform the following duties: a.) Monitor overall Unit operations for adherence to CPS Technical Specifications. . . . f.) Monitor CRTs, indicators, annunciators, and recorders in order to detect unusual or abnormal trends and initiate appropriate, timely action to correct or mitigate the situation. . . ." The LASS failed to

adequately follow the oversight requirements of this procedure because he was planning the work for the dayshift. Indications of reactor power, generator load and bypass valve position were readily available to him and located only a few feet in front of his desk.

Administrative Procedure CPS No. 1401.01, "Conduct of Operations," Paragraph 8.5.4.2 stated, "Indications are provided to monitor plant parameters and shall be believed, unless verified faulty by two alternate independent means when possible, or through maintenance troubleshooting." The "A" RO failed to follow this procedure and did not believe his indications. The STA still had concerns with the fact that generator load was not going up; however, he did not raise these concerns with the LASS (control room supervisor (SRO)). Nor did the "A" RO inform the LASS of the abnormal plant response.

As a result of these actions, at approximately 7:38 a.m., bypass valves began to open. During the next 9 minutes 14-17 control rod withdrawals were performed. Several different control rods were withdrawn, in the gang mode, using single notch withdrawal. By 7:47 a.m., reactor power had reached 35% and control rod withdrawals were stopped, pending startup of balance-of-plant equipment. Bypass valves remained open for an additional 49 minutes (total of 58 minutes open).

The main turbine control valves opened in response to increased reactor pressure, as reactor power was increased; this permitted the control valves to pass more steam and increase generator load. If reactor pressure was increased and generator load was limited, then the reactor pressure controller would cause the main turbine bypass valves to open. There are six hydraulically operated bypass valves. Each has a capacity equivalent to 6% of rated steam flow. When the control rod withdrawals were stopped, reactor power was approximately 35%. Nominally, 26% of the steam flow (reactor power) was going to the main turbine; the other 9% was going through the turbine bypass valves. The reactor did not sense anything different than if all 35% of the steam flow had been going to the turbine. However, this condition was significant because the rod pattern control system (RPCS) utilized main turbine first stage impulse pressure as an input. First stage impulse pressure was utilized as a linear method of measuring equivalent reactor power. Consequently, with some of the steam flow diverted from the main turbine, the first stage impulse pressure indicated a lower than actual reactor power. The RPCS used this equivalent reactor power to limit the number of notches a control rod could be withdrawn continuously.

Technical Specification 3.1.4.1 required that control rods shall not be withdrawn in OPERATIONAL CONDITIONS 1 and 2, when the main turbine bypass valves were not fully closed and THERMAL POWER was greater than the low power setpoint of the RPCS. With any control rod withdrawal when the main turbine bypass valves were not fully closed and THERMAL POWER was greater than the low power setpoint of the RPCS, IMMEDIATELY (emphasis added) return the control rod(s) to the position prior to control rod withdrawal. Technical Specification Surveillance 4.1.4.1 required that control rod withdrawal shall be prevented when the main turbine bypass valves were not fully closed and THERMAL POWER was greater than the low

power setpoint of the RPCS, by a second licensed operator or other technically qualified member of the unit technical staff.

The basis for Technical Specifications 3.1.4.1 and 4.1.4.1 stated that the rod withdrawal limiter system input power signal originated from the main turbine first stage impulse pressure. When operated with the steam bypass valves open, this signal indicated a core power level which was less than the true core power. Consequently, near the low power setpoint and high power setpoint of the rod pattern control system, the potential existed for nonconservative control rod withdrawals. Therefore, when operating at a sufficiently high power level, there was a small probability of violating fuel Safety Limits during a licensing basis rod withdrawal error transient. To ensure that fuel Safety Limits were not violated, this specification prohibited control rod withdrawal when a biased power signal existed and core power exceeded the specified level.

The actual safety consequences to the reactor core were mitigated by the fact that all of the control rod withdrawals made by the "A" RO during this event were in the proper sequence and were single notch withdrawals; vice, the four notch withdrawal limit which the RPCS would impose from 25-35% power. Consequently, a second independent error, plus a much higher reactor power level would have been necessary to challenge the fuel safety limits.

At approximately 8:20 a.m., the midnight shift "A" RO and the day shift "A" RO began their turnover. Both ROs stated that they had stopped at the panels which contained at least six separate indications that bypass valves were open and discussed the status of the equipment contained on those panels without recognizing that the bypass valves were open. The "A" ROs completed their turnover, at 8:25 a.m., The "B" ROs were performing their turnover and at 8:35 a.m. the day shift "B" RO discovered the bypass valves open. After a brief discussion, the midnight shift "A" RO then raised the load set, which caused the generator load to increase and the bypass valves to close. At no time did the operators refer to the the Technical Specifications to verify that all required actions had been taken.

The action statement of Technical Specification 3.1.4.1 required that with any control rod withdrawal, above the applicable power levels and any bypass valves open, IMMEDIATELY (emphasis added) return the control rod(s) to their prior position. Typically, licensees may comply with a Technical Specification action statement or change plant conditions such that the Technical Specification is no longer applicable. When the ROs discovered the bypass valves open, they raised the load set rather than inserting control rods. During the interviews, the operators stated that when they discovered the bypass valves open they did not believe that control rod withdrawals had caused the bypass valves to come open, but that some unrelated problem with the bypass valves had occurred. The operators remembered the procedure requirement to keep load set 200 MWe above generator load and with no nexus to the control rod withdrawals which had happened during the event, they raised the load set. However, that is not what the Technical Specification action statement required.

During the interviews, all the control room personnel stated they were familiar with the prohibition against withdrawing control rods, with the bypass valves open; however, they were not familiar with the requirements of the immediately effective action statement to insert control rods. They did state that if they were withdrawing control rods and saw a bypass valve come open that they would immediately insert the control rods.

The inspectors discussed the intent of the action statement with the NRR staff. In this event, raising the load set (so that the RPCS would more accurately know the reactor power) was not technically incorrect or unsafe. Nevertheless, the action statement was based upon the supposition that a rod withdrawal error had occurred and that fuel safety limits had been, or would shortly be, challenged; consequently, to minimize any fuel damage the control rods should be inserted to reduce the power density and enthalpy of the fuel as soon as possible.

Procedure 1401.01, Paragraph 8.5.4.4 stated, "Other permanently installed indicators (gages, meters, recorders, etc.) that are removed from service or operating in a degraded or out of calibration status, should be identified with a yellow caution tag." There were no caution tags on the load set meter or load selector pushbuttons.

During the interviews with the control room crews and the training department, several related facts emerged. The modeling of the simulator with regard to the difference between the load set and generator load was not identical to the actual plant. As originally designed the difference between the load and load set was less than 50 MWe; however, the meters in the plant did not respond that way. Per Procedure CPS No. 1401.01, Paragraph 8.5.4.4, a caution tag was previously placed on the meters in the control room to indicate that bypass valves would open if load set was not more than 150 MWe above generator load. A modification was proposed to correct this problem; however, the modification review committee did not approve the change as being cost effective and a decision was made to change the procedure to reflect the greater difference between load and load set by incorporating a cautionary note; which then allowed the caution tag to be removed. The training department was not informed of the decision of the modification review committee and consequently did not realize that the simulator did not accurately model the plant.

Statements were made to the inspectors that some control room personnel had felt they were under pressure to get to 35% power and that they did not want to continue with the rod withdrawals during the turnover process; however, when directed to proceed they did so. The oncoming SS was concerned with the continuing rod withdrawals and discussed this concern with the LASS. Before a decision to stop the rod withdrawals was made, 35% power was reached.

A review of integrated operating procedure 3005.01, "Unit Power Changes," which was used to take the unit from 35% to 100% power, indicated that

the procedure did not contain any references to raising the load set, as reactor power was increased.

6. Licensee's Corrective Actions

In response to the event, the licensee implemented the following corrective actions:

- a. Each shift crew was briefed on the event and its causes before they came on shift.
- b. Each shift crew received retraining on reactivity management procedures, the importance of procedure compliance, and the importance of close monitoring of equipment configuration and thorough equipment status checks during shift turnovers. The crews were also required to perform exercises on the plant simulator to assure that they fully understood the proper checks and procedures to follow during reactivity changes and plant startup. Each crew was required to complete a written examination covering these topics.
- c. The Plant Manager and Vice President met personally with each shift crew to discuss the causes of the event and to reinforce the lessons presented in the training described above.
- d. The Vice President met with the Clinton Power Station (CPS) managers and directors to discuss with them the importance of prompt recognition and response to potential problems, and prompt reporting of these problems up the chain of command.
- e. An experienced senior-level individual, reporting directly to the Vice President was assigned to monitor Operations department performance to provide additional assurance that significant problems would be promptly recognized and responded to.
- f. Eight director-level individuals were assigned to monitor power ascension. These individuals monitored each shift's performance until the plant attained full power during the startup subsequent to the event.
- g. Experienced personnel, reporting directly to the Vice President, from outside Illinois Power (IP) (one from Stone and Webster and two from Toledo Edison), were retained to independently review the cause of the event and the licensee's corrective actions.
- h. The licensee changed its policy so that no significant evolutions would occur during shift turnover. If necessary, the shift turnover would be delayed to allow continuation of a critical evolution that could not be stopped at that time. The plant would be placed in a stable condition prior to turnover.

- i. The power ascension procedure 3004.01 was changed to require the operator to increase generator load set to a pre-determined level in a plateau method as reactor power is increased. The pre-determined level was specified at appropriate parts of the procedure. And it was raised to its maximum value at the end of 3004.01.
- j. A label was added by the generator load set meter on the standby information panel and by the generator load set increase and decrease push buttons to annotate that the generator load set meter read 100 MWe high.
- k. The generator load set meter in the simulator was adjusted to reflect the actual control room condition of reading 100 MWe high.
- l. The training department completed a review of disapproved modifications, to ensure that they did not result in procedure changes which would affect the simulator modeling.
- m. Integrated operating procedures were changed to prohibit the LASS or the STA from functioning as independent verifier. This allowed them to step back and view the whole plant.

7. Observation of Restart

At the direction of Region III management, inspectors were assigned to augmented coverage of prestartup, startup, and power ascension activities, to approximately 35% power. Areas that were observed were as follows:

- a. Required systems were operable,
- b. Plant operating staff was ready,
- c. Minimum number of problems/alarms in the control room,
- d. Control room procedures were current,
- e. Adequate preshift briefings occurred,
- f. Inter and intra shift communications were adequate,
- g. Operator responsiveness to alarms and control room indications were correct, and
- h. Log keeping practices were acceptable.

The inspectors observed control room activities from April 22-26, 1990. The overall perception was that all operating personnel performed in an extremely conservative and safe manner. Ongoing evolutions were stopped well before shift turnover would begin. The preshift briefings were thorough and detailed. The turnovers and walkdowns were also very thorough and detailed. During the startup some of the operators were observed to be very nervous, but they became more confident

as the startup progressed. There was no sense of urgency to accomplish too many tasks, but a recognition of the need for controlled progress. Operator performance of control rod withdrawals and monitoring of the plant's response were observed to be very good. Control of personnel and restriction of work activities during the startup were good. A sign was posted limiting control room access during the startup. Control rod movements were monitored for compliance with Technical Specifications and the planned rod pull sheets. There were no discrepancies in this area. The inspectors did note that some of the LASSs would focus too closely on the 680 (reactor control) panel activities and not step back and look at the whole plant, but this was isolated to one or two individuals and they were improving as the startup progressed.

8. Conclusions

The inspectors have identified the following root causes for this event:

- a. The "A" RO failed to follow procedure to raise load set as he was increasing power, by withdrawing control rods.
- b. The "A" RO and the STA did not monitor bypass valve position after the withdrawal of control rods.
- c. The "A" RO did not believe his indications when told twice by the STA that generator load was not increasing.
- d. The STA and the "A" RO did not identify the problem with generator load to the LASS.
- e. The STA did not pursue his concerns with the LASS after the answer he was given by the "A" RO did not seem right.
- f. The LASS failed to adequately monitor overall unit operations by observing plant indicators.

The inspectors have identified the following contributing causes for this event:

- g. A poor human factors approach in the integrated operating procedure, regarding raising the load set continuously, as directed by a note, versus discrete procedural steps and raising load set to discrete plateaus.
- h. Pressure on the midnight shift personnel to get to 35% power. Performing complex evolutions during turnover.
- i. The "A" RO had only done this portion of a startup once before; and had only done a total of three startups. This type of activity was typically not practiced on the simulator. However, this operating crew had been given practice on the simulator, within a month of

this event, on reactor startups; but due to time constraints certain portions of the startup process were skipped.

- j. No annunciator alarm for open bypass valves existed.
- k. The wording of Technical Specification 3.1.4.1 and Surveillance 4.1.4.1 was cumbersome and awkward. The wording was copied into the operating procedures.
- l. The simulator did not model plant performance on the response of load set versus generator load accurately. Training was not informed of rejection of a modification and the decision to utilize a procedure change to correct a problem. Consequently, the simulator was not updated from the original design basis.
- m. The lack of understanding by the STA and the "A" RO that a xenon transient would not have a significant affect on reactor power over a 10 minute period.

The actual physical safety significance of this event on the reactor core was minor because all of the control rod withdrawals made during this event were in accordance with the rod pattern and were at a rate (single notch withdrawal vs. four notch continuous withdrawal) which was more conservative than the rod pattern control system limits.

The safety significance of this event is derived from the lack of attention to plant indications during important evolutions by licensed personnel, not believing plant indications, not informing supervisors of unexpected plant response, and the scheduling and controlling of complex and safety significant evolutions during shift turnovers.

This event and two other recent events involving operations department personnel (the cracking of condenser water boxes and the de-energization of the Division II NSPS bus) taken together were not indicative of adequate performance. All three of these events had common factors involving: adherence to procedures, communication between operating crew members, turnover of information between operating crews, and management oversight and direction of operating crews.

Technical Specification 3.1.4.1 required that control rods shall not be withdrawn in OPERATIONAL CONDITIONS 1 and 2, when the main turbine bypass valves are not fully closed and THERMAL POWER is greater than the low power setpoint of the rod pattern control system (RPCS). The action statement required that with any control rod withdrawal when the main turbine bypass valves are not fully closed and THERMAL POWER is greater than the low power setpoint of the RPCS, immediately return the control rod(s) to the position prior to control rod withdrawal.

Technical Specification Surveillance 4.1.4.1 required that control rod withdrawal shall be prevented when the main turbine bypass valves are not fully closed and THERMAL POWER is greater than the low power setpoint of

the RPCS, by a second licensed operator or other technically qualified member of the unit technical staff.

With the reactor in OPERATIONAL CONDITION 1 at a thermal power above the low power setpoint of the RPCS, 14-17 control rod withdrawals were performed by a reactor operator, with main turbine bypass valves not fully closed. Upon discovery of the open main turbine bypass valves, the load selector was raised to close the main turbine bypass valves; vice, inserting control rods. The withdrawal of control rods with the bypass valves open is an example of an apparent violation of Technical Specification 3.1.4.1 (461/90009-01a(DRP)). The failure of a second technically qualified member of the unit technical staff to prevent control rod withdrawals, with main turbine bypass valves not fully closed, is an example of an apparent violation of Technical Specification 4.1.4.1 (461/90009-01b(DRP)).

10 CFR Part 50, Appendix B, Criterion V, required that activities affecting quality shall be prescribed by documented instructions or procedures, of a type appropriate to the circumstances and shall be accomplished in accordance with those instructions.

Clinton Power Station Operations Procedure CPS No. 3004.01, "Turbine Startup and Generator Synchronization," Revision 11, Paragraph 6.8, "Limitations," stated, "In accordance with Tech Spec 4.1.4.1, when above 20% thermal power (Low Power Setpoint of the RPCS), and when the main turbine bypass valves are not fully closed, control rod withdrawal shall be prevented. This requirement shall be verified by a second licensed operator or other technically qualified member of the unit technical staff and documented by shift supervisor log entry." Paragraph 8.2.5.6 contained a note which stated, "NOTE, Load Selector should be maintained approximately 200 MWe above generator load for further load increases."

Clinton Power Station Administrative Procedure CPS No. 1401.01, "Conduct of Operations," Revision 2, Paragraph 8.5.4.2 stated, "Indications are provided to monitor plant parameters and shall be believed, unless verified faulty by two alternate independent means when possible, or through maintenance trouble shooting." Paragraph 8.5.4.4 stated, "Other permanently installed indicators (gages, meters, recorders, etc.) that are removed from service or operating in a degraded or out of calibration status, should be identified with a yellow caution tag."

Clinton Power Station Operations Procedure CPS No. 3005.01, "Unit Power Changes," Revision 12, provided detailed instructions for performing the operations required to effect unit power changes between 35% and 100% power.

Clinton Power Station Administrative Procedure CPS No. 1001.05, "Authorities and Responsibilities of Reactor Operators for Safe Operation and Shutdown," Revision 6, Paragraph 8.1.3.1, states "The line Assistant Shift Supervisor assigned to the Main Control Room Area shall perform the following duties: a) Monitor overall Unit operations for adherence to CPS Technical Specifications. . . . f) Monitor CRT's, indicators,

annunciators, and recorders, in order to detect unusual or abnormal trends, and initiate appropriate, timely action to correct or mitigate the situation."

The following are all examples of an apparent violation of 10 CFR Part 50, Appendix B, Criterion V:

- a. The "A" RO failed to raise the load set while increasing reactor power to keep the load set 200 MWe above generator load, as required by Procedure 3004.01 (461/90009-02a(DRP)).
- b. The "A" RO did not prevent the withdrawal of control rods with the main turbine bypass valves not fully closed and reactor power above the LPSP as required by Procedure 3004.01 (461/90009-02b(DRP)).
- c. The STA did not verify that control rod withdrawals were not permitted with the main turbine bypass valves not fully closed and reactor power above the LPSP, as required by Procedure 3004.01 (461/90009-02c(DRP)).
- d. The "A" RO did not believe his indications when he was informed that generator load (MWe) was not increasing. He did not verify through other available indications that generator load was responding correctly, as required by Procedure 1401.01 (461/90009-02d(DRP)).
- e. No caution tag was placed on the generator load set meter, located on the standby information panel, to indicate that it was in a degraded condition, as required by Procedure 1401.01 (461/90009-02e(DRP)).
- f. Procedure 3005.01 did not contain any instructions for raising the load selector, even though this action was required to raise unit power from 35% to 100% (461/90009-02f(DRP)).
- g. The LASS failed to adequately monitor overall unit operation by not observing plant indicators and therefore did not detect that control rods were being withdrawn with the bypass valves open, that generator load set was not being increased, and that reactor power was increasing without a corresponding increase in generator load.

Two apparent violations were identified.

9. Recommendations

The inspectors have made the following recommendations for the licensee's and the NRC management's review:

- a. The licensee should evaluate the installation of an annunciator for open bypass valves when reactor power is above the RPLS low power setpoint.

- b. NRR and the licensee or the BWR-6 owners group should review the wording of Technical Specifications 3.1.4.1 and 4.1.4.1 and determine if more easily understood wording is possible. If this is possible the inspectors recommend that the Technical Specifications for all BWR-6 reactors be amended,
- c. Licensee management needs to continue reinforcing its philosophy of operation and the need for communication and procedural compliance.

10. Exit Interview (30703)

The inspectors met with the licensee representatives denoted in Paragraph 1 at the conclusion of the inspection on April 27, 1990. The inspectors summarized the purpose and scope of the inspection and the findings. The inspectors also discussed the likely informational content of the inspection report, with regard to documents or processes reviewed by the inspectors during the inspection. The licensee did not identify any such documents or processes as proprietary.