U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No:	50-456
License No:	NPF-72
Report No:	50-456/98018(DRS)
Licensee:	Commonwealth Edison Company
Facility:	Braidwood Nuclear Plant, Unit 1
Location:	RR #1, Box 84 Braceville, IL 60407
Dates:	October 15-23, 1998; November 9-10, 1998
Inspector:	D. Muller, Reactor Engineer, Region III
Approved by:	Melvyn Leach, Chief, Operator Licensing Branch Division of Reactor Safety

EXECUTIVE SUMMARY

Braidwood Nuclear Plant, Unit 1
NRC Inspection Report 50-456/98018

This inspection included a review of the following four areas associated with the licensee's steam generator replacement project: simulator modifications, plant procedure changes, operator knowledge and performance, and operator training.

Simulator Modifications

- Modifications to the simulator appeared to have been properly implemented. Simulator hardware and software changes appeared to accurately reflect the effects of the steam generator replacement project (SGRP) for Unit 1. The process for modifying the simulator also appeared to be sound. Changes to the simulator were properly identified and tracked, and the simulator appeared to be adequately tested following the completion of the modifications. (Section O2.2)

Procedure Changes

- Procedure changes associated with the SGRP appeared to have been properly identified and implemented. The new proposed procedures appeared to accurately reflect the effects of the SGRP for Unit 1. The process for conducting the procedure changes also appeared to be sound. Changes to plant procedures were properly identified, tracked, and completed in a timely fashion. (Section O3.1)

Operator Knowledge and Performance

- Operator performance and level of knowledge observed during this inspection were generally good, with one exception in the area of communications. During the simulator exercises most of the crew members occasionally did not refer to plant equipment by the appropriate unit designator. (Section O4.1)

Operator Training

- Overall, the training associated with the SGRP was good. The overall content of the SGRP training program appeared appropriate. The instructors did a good job in presenting the training material, and the operating crew members actively participated in the training. However, two weaknesses with the training were observed. The first weakness was the use of all encompassing vice definitive learning objectives. The second weakness was the lack of a well-defined plan for evaluating student mastery of SGRP training material prior to the restart of Unit 1 with the new steam generators. The licensee, however, planned to administer a 15 question written exam, covering SGRP training material, to all licensed operators. This exam was scheduled to be administered prior to the restart of Unit 1. (Section O5.1)

Report Details

Summary of Plant Status

Unit 1 was shutdown for refueling and steam generator replacement during the entire inspection period.

I. Operations

O2 Operational Status of Facilities and Equipment

O2.1 Overview of the Impacts of Steam Generator Replacement

Braidwood Station's Unit 1 steam generator replacement project (SGRP) outage began September 5, 1998. The outage was expected to be completed in mid to late November 1998. Major changes associated with the SGRP are summarized as follows:

- Unit 1 feedwater system changes. These changes included: removal of feedwater isolation valve bypass piping and bypass valves, removal of the water hammer prevention system and associated feedwater valve interlocks, and the removal of steam generator (SG) tempering flow lines. SG tempering flow is now directed through the main feed lines.

- Revised Unit 1 SG program levels and SG high/low level alarms and actuation set points.

- Changes associated with a two-degree lower Unit 1 100% power average reactor coolant system temperature (RCS Tave). These effects included set point or programmed set point changes associated with reference temperature, steam dump actuation, over-temperature and over-pressure delta temperature protection, high/low RCS Tave alarms, and changes in steam pressure.

- Changes associated with the thermal-hydraulic characteristics of Unit 1's new SGs. These effects included: improved heat transfer, an increase in RCS volume (more SG tubes), and a decrease in SG secondary (steam) side volume.

- The addition of a wet layup system. This is a multipurpose system designed to drain, add chemicals, and provide recirculation for Unit 1's SGs.

In addition, as a part of the SGRP, licensee personnel have taken actions to modify main control room panels (and control room simulator panels), make revisions to 452 procedures, and conduct additional training for plant operators.

O2.2 Simulator Modifications Associated with the SGRP

a. Inspection Scope (50001)

The inspector observed simulator performance during crew training exercises, which included low power feedwater manipulations, steam breaks, SG tube ruptures, and loss of coolant accidents. Additionally, walk downs of the Unit 1 panels in the station's main control room and in the simulator were conducted to compare panel configurations. Finally, the inspector discussed simulator changes with licensee instructors, operating crew members, and the simulator supervisor.

b. Observations and Findings

Hardware Changes

Control room panel changes associated with the SGRP primarily occurred at the feedwater control station. These changes consisted primarily of:

- Removal of control switches and indicators associated with the removed feedwater isolation bypass valves.

- Deletion of flow alarms associated with the removed feedwater isolation bypass piping.

- Deletion of tempering line and water hammer prevention system alarms. The tempering line and water hammer prevention system had both been removed.

Based on panel walk downs conducted at the simulator and at the station's main control room, no discrepancies with the simulator were noted. The simulator panels did correctly represent the SGRP control room panel configuration of Unit 1.

Software Changes

Numerous simulator software changes were made primarily to account for numerous set point changes and changes associated with the thermal-hydraulic characteristics of the new SGs. During panel walk downs and some of the observed simulator exercises, the inspector monitored a sample of the new set points. No discrepancies with the revised set points were observed. In addition, based on the observations during the simulator exercises and on discussions with licensee instructors and operating crew members, the inspector noted the following differences in transient plant behavior:

(1) Secondary side SG shrink and swell effects appeared to be more pronounced.

(2) The RCS appeared to depressurize at a faster rate during steam break accidents.

(3) The SG secondary side appeared to fill up quicker, and the associated SG power operated relief valve appeared to lift earlier during an SG tube rupture.

These above three observations appeared to be consistent with the increased heat transfer and smaller secondary side volume associated with the new SGs.

Process Used for SGRP Simulator Changes

Based on an interview conducted with the licensee's simulator supervisor, the inspector determined the overall process in which the simulator was modified during the SGRP. The process consisted of the following major steps:

(1) The simulator supervisor received copies of station work packages and set point changes from the station's configuration control group.

(2) The simulator supervisor reviewed these work packages and set point changes, and developed simulator work requests to describe the necessary simulator changes. In addition, the simulator supervisor also used information from Byron Station personnel to develop simulator work requests. Byron Station performed almost an identical SGRP in 1997.

(3) The simulator work requests were then entered into a computer database for tracking purposes and distributed to simulator technicians to perform the work.

(4) Upon completion of all the modifications, the simulator was tested using approximately 320 different plant evolutions, including various malfunctions. In addition an initial license training class and their instructors were utilized to obtain further feedback on simulator performance.

(5) The licensee planned to continue monitoring performance of the simulator, especially after more information about plant behavior becomes available during and after the restart of Unit 1.

c. Conclusions

Modifications to the simulator appeared to have been properly implemented. Simulator hardware and software changes appeared to accurately reflect the effects of the SGRP for Unit 1. The process for modifying the simulator also appeared to be sound. Changes to the simulator were properly identified and tracked, and the simulator appeared to be adequately tested following the completion of the modifications.

O3 Operations Procedures and Documentation

O3.1 Procedure Changes Associated with the SGRP

a. Inspection Scope (50001)

The inspector reviewed a sampling of the station's current procedures (plant startup, plant shutdown, annunciator response, normal operating, off normal, and emergency), to assess the impact of the SGRP on plant procedures. The inspector additionally reviewed the licensee's proposed procedure changes associated with the SGRP, and

observed some of the new procedures in use during simulator training exercises. Finally, the inspector conducted interviews with licensee procedure group personnel who were involved with the SGRP procedure changes.

b. Observations and Findings

Impact of the SGRP on Plant Procedures

The inspector determined that the SGRP had the following major impacts on plant procedures:

- Deletion of annunciator response procedures associated with the removed feedwater isolation bypass piping, and the removed tempering line and water hammer prevention system alarms.

- Changes to feedwater procedures and plant startup and shutdown procedures. The major changes were associated with low power feedwater system operations.

- A "global" effect on a large number of procedures, due to the changes in SG level set points, and the numerous set point changes associated with the two-degree lower Unit 1 100% power RCS Tave. This required an update to the set point values used in these procedures.

Based on reviews of a sample of existing and proposed new Unit 1 procedures, and the observed simulator training exercises, the inspector determined that the licensee appeared to have properly identified and implemented procedure changes associated with the SGRP.

Process Used for SGRP Procedure Changes

As part of the SGRP, the licensee reviewed 9,040 procedures and identified that 452 procedures required revision. The inspector determined that the following process was utilized to identify and implement procedure changes associated with the SGRP:

(1) Cognizant engineers reviewed the design change packages associated with the SGRP. Based on this review plus information from Byron Station personnel (who performed almost an identical SGRP in 1997), procedure changes were identified.

(2) The identified procedure changes were then entered onto a computerized spreadsheet for tracking purposes. All procedure changes were identified approximately six months prior to the start of the SGRP outage.

(3) The identified procedure changes were then forwarded to the procedure owners/reviewers to markup the actual changes to the procedures.

(4) The marked up actual procedure changes were then forwarded to clerical personnel for typing of the new draft procedures. This step occurred approximately four months prior to the start of the SGRP outage.

(5) The new draft procedures were reviewed by the procedure owners/reviewers.

(6) A second technical/onsite review was then conducted. Following this review, the new procedures were placed in a hold status, until the SGRP outage was completed. All revised procedures were on hold awaiting the completion of the SGRP approximately one month prior to the start of the SGRP outage.

(7) Feedback on the new procedures has been gathered from licensed operators and instructors during simulator training exercises.

c. Conclusions

Procedure changes associated with the SGRP appeared to have been properly identified and implemented. The new proposed procedures appeared to accurately reflect the effects of the SGRP for Unit 1. The process for conducting the procedure changes also appeared to be sound. Changes to plant procedures were properly identified, tracked, and completed in a timely fashion.

O4 Operator Knowledge and Performance

O4.1 Operator Knowledge and Performance Associated with the SGRP

a. Inspection Scope (50001)

The inspector observed the performance of four operating crews during the conduct of SGRP simulator training exercises. These exercises included low power feedwater manipulations, steam breaks, SG tube ruptures, and loss of coolant accidents. In addition, the inspector interviewed two licensed operators to assess their level of knowledge on a variety of SGRP topics.

b. Observations and Findings

Operator Performance

Each operating crew consisted of the following five personnel: a Shift Manager, a Shift Technical Advisor, a Unit Supervisor, and two Nuclear Station Operators. The performance of each crew was observed during the conduct of SGRP simulator training, which consisted of the following four exercises per crew: (1) feedwater system operation at low power, (2) a steam line break, (3) an SG tube rupture, and (4) a small break loss of coolant accident. Based on the observed exercises, the inspector noted no major deficiencies in crew performance. In general, the observed crews demonstrated proper annunciator and alarm response, adequate diagnosis of off normal conditions, adequate plant and system knowledge, correct procedural use, accurate and timely control manipulations, and a questioning attitude toward new procedure steps and

control board changes. However, one weakness was observed in the area of communications. The inspector observed that most of the observed crew members occasionally did not refer to plant equipment by the appropriate unit designator. For example, following a reactor scram on Unit 1, one Nuclear Station Operator directed a local operator to check on the diesel generators vice directing a check on the *Unit 1* diesel generators.

Operator Knowledge

The inspector interviewed two licensed operators, who had already completed the SGRP training associated with the current training cycle. One operator interviewed was a licensed reactor operator, who typically performed control room duties. The other operator interviewed was a licensed senior reactor operator, who typically performed duties related to drafting out of services. During the course of each interview, the inspector asked each operator the following six questions:

(1) Describe the piping and valve changes to the Unit 1 feedwater system associated with the SGRP.

(2) Describe control board changes associated with the SGRP.

(3) Describe the thermal-hydraulic changes associated with the new SGs.

(4) How are transients affected by the new SGs? (steam break, shrink/swell, tube rupture)

(5) Describe the changes to plant heatup and startup as a result of the SGRP.

(6) What is the major effect of the new SGs on the emergency operating procedures?

Both operators interviewed provided satisfactory responses to all six of the above questions. The inspector noted no deficiencies.

c. Conclusions

Operator performance observed during the SGRP simulator training exercises was generally good. In general, the observed crews demonstrated proper annunciator and alarm response, adequate diagnosis of off normal conditions, adequate plant and system knowledge, correct procedural use, accurate and timely control manipulations, and a questioning attitude toward new procedure steps and control board changes. In addition, operator level knowledge concerning the impacts of the SGRP was also good. However, during the simulator exercises one weakness in operator performance was observed in the area of communications. The inspector observed that occasionally crew members did not refer to plant equipment by the appropriate unit designator.

O5 Operator Training and Qualification

O5.1 Operator Training Associated with the SGRP

a. Inspection Scope (50001)

The inspector interviewed licensee training staff personnel and reviewed licensee provided training cycle plans and lesson plans, to determine the content, development, implementation, and quality of training associated with the SGRP. The inspector also interviewed licensed operators, who were the recipients of the SGRP training, to gain additional insights on the content and quality of the training. Finally, the inspector observed licensee training staff personnel and licensed operators during a portion of the cycle 6 SGRP simulator training exercises and classroom instruction.

b. Observations and Findings

Content of SGRP Training

Training for licensed operators concerning the SGRP was distributed over four training cycles: cycle 6 of 1997, and cycles 3, 4, and 6 of 1998. Cycle 6 of 1998 was the first cycle which utilized the control room simulator configured with the SGRP simulator modifications.

During cycle 6 of 1997 (October-November 1997), SGRP training consisted of the presentation of an approximately one hour videotape which documented the major steps involved in replacing SGs. This video was an overview of the SG replacement process and did not focus on the specific plant changes that would occur.

In cycle 3 of 1998 (April-May 1998) an approximately 1.5 hour classroom presentation was conducted concerning SG replacement unit differences. This presentation focused on changes associated with the Unit1 SGRP in the following areas: (1) SG configuration (number of SG tubes, feedwater entry point, etc.); (2) feedwater system configuration and operation; (3) SG water level span; (4) addition of the wet layup system; and (5) control panel configuration. The associated lesson plan, "SG Replacement Outage Unit Differences," was well written and contained an appropriate level of detail. However, one weakness observed with this lesson plan was the fact that it contained only one all encompassing learning objective - "Review SG Replacement Outage Unit Differences." Such an all encompassing learning objective did not aid in focusing student attention and it made it difficult to determine the appropriateness and effectiveness of the training.

In cycle 4 of 1998 (June-July 1998) an approximately two-hour classroom presentation was conducted concerning the SGRP procedure changes. This presentation consisted of the following SGRP-related subjects: (1) a review of some of the subject matter presented in cycle 3 of 1998; (2) a list and discussion of new set points; (3) a discussion of the changes to normal operating (plant startup, plant heatup, power ascension, plant shutdown, and feedwater system) procedures; and (4) a discussion of the changes to emergency operating procedures (EOPs). The associated lesson plan, "SGRP

Procedure Changes," was well written and contained an appropriate level of detail. However, similar to the previously discussed lesson plan, this lesson plan also contained the same weakness of utilizing only one all encompassing learning objective. For this lesson plan, its sole learning objective was to "discuss the changes to procedures affected by the SGRP." Such an all encompassing learning objective did not aid in focusing student attention and it made it difficult to determine the appropriateness and effectiveness of the training.

In cycle 6 of 1998 (October-November 1998) both classroom instruction and simulator exercises were utilized for training on the new SGs. Classroom instruction consisted of two separate lessons. The first lesson was an approximately two-hour presentation on the special testing that would be conducted following the SG replacement outage. The second lesson was an approximately 2.5 hour presentation on changes to EOPs. This second lesson was somewhat different from the cycle 4 presentation on EOPs, in that during this lesson the new EOPs were reviewed, and all new changes were discussed, including those not associated with the SGRP. One cycle 6 EOP classroom session was observed by the inspector. No major deficiencies with the presentation were identified. The instructor presented the material in a clear and logical manner, and the operating crew members asked many questions and actively participated in the presentation. The supporting lesson plans for both presentations were well written and appeared to contain an appropriate amount of detail. However, similar to the previous finding, one weakness of the lesson plans was observed, in that they only contained all encompassing learning objectives. More definitive learning objectives would assist in focusing student attention and in determining the appropriateness and effectiveness of the training.

SGRP simulator training for cycle 6 was divided into basically five different exercises: (1) an introduction and walkthrough of the control panel changes, (2) low power feedwater system operations, (3) a steam line break, (4) an SG tube rupture, and (5) a small break loss of coolant accident. During the observed simulator exercises no deficiencies with the training were identified. The instructors presented the material in a clear and logical manner, and the operating crew members asked many questions and actively participated in the exercises. Post exercise critiques of operator performance were also effective. Charts and diagrams used to accompany the simulator training were clear and easy to read. Learning objectives for the simulator exercises appeared to be properly developed.

Process Used for Developing and Implementing SGRP Training

Based on interviews with members of the licensee's training staff, the inspector identified that the following steps were utilized to develop and implement SGRP training:

(1) Training needs were identified by the training staff, utilizing inputs from the licensee's procedure, operations, and engineering groups. In addition, training needs were also identified using information from Byron Station personnel (who performed almost an identical SGRP in 1997).

(2) Based on the identified training needs, training request forms were initiated and tracked via a computerized database.

(3) Based on input from the licensee's operations staff, the SGRP training content was broken down into smaller parts (description of overall changes, procedure changes, set point changes, etc.) with some repetition between parts.

(4) Lesson plans, simulator exercise guides, and learning objectives were then developed. Additionally, an implementation schedule was determined.

(5) SGRP training was then conducted, primarily in cycles 3, 4 and 6 of 1998.

Two weaknesses in the above training process were identified by the inspector. The first weakness, which was previously discussed, was the use of all encompassing learning objectives, such as "describe SG differences" or "describe procedure changes associated with the SGRP." The second weakness was that the licensee's training staff did not initially have a plan in place to evaluate student mastery of the SGRP training material, prior to the operation of Unit 1 with the new SGs. Throughout the above mentioned training cycles, no written exam questions or evaluated simulator exercises were used to evaluate the knowledge and ability of licensed plant operators concerning the subject matter of SGRP training. The licensee initially planned to conduct evaluations, which would have included some SGRP training material, beginning in 1999. It appeared to the inspector that since the SGRP was a highly significant and complex modification, that some form of student evaluation should be conducted prior to the restart of Unit 1. The licensee planned to administer a 15 question written exam, covering SGRP training material, to all licensed operators. This exam was scheduled to be administered prior to the restart of Unit 1.

c. Conclusions

Overall, the training associated with the SGRP was good. The overall content of the SGRP training program appeared appropriate. The instructors did a good job in presenting the training material, and the operating crew members actively participated in the training. Post exercise critiques of operator performance in the simulator were also effective. The conclusion that the training was good was further supported by the good operator knowledge and performance concerning SGRP topics discussed in section O4.1. However, two weaknesses with the training were observed. The first weakness was the use of all encompassing vice definitive learning objectives. The second weakness was the lack of a well-defined plan for evaluating student mastery of SGRP training material prior to the restart of Unit 1 with the new SGs.

V. Management Meetings

X1 Exit Meeting Summary

The inspector presented the inspection results to members of licensee management at the conclusion of the inspection on November 10, 1998. The licensee acknowledged the findings presented. The inspector asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

T. Tulon, Site Vice President
K. Schwartz, Station Manager
R. Wegner, Operations Manager
T. Simpkin, Regulatory Assurance Supervisor
J. Walker, Training Manager
F. Cerovac, Operations Training Superintendent
M. Cassidy, Regulatory Assurance - NRC Coordinator

NRC

M. Jordan, Chief, Reactor Projects Branch 3
M. Leach, Chief, Operations Branch Region III
C. Phillips, Senior Resident Inspector
D. Pelton, Resident Inspector

INSPECTION PROCEDURES USED

IP 50001:	Steam Generator Replacement Inspection
IP 41500:	Training and Qualification Effectiveness
IP 71001:	Licensed Operator Requalification Program Evaluation

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

NONE

Closed

NONE

Discussed

NONE

LIST OF ACRONYMS USED

EOP	Emergency Operating Procedure
RCS	Reactor Coolant System
RCS Tave	Average Reactor Coolant System Temperature
SG	Steam Generator
SGRP	Steam Generator Replacement Project