TENNESSEE VALLEY AUTHORITY

NUCLEAR POWER

OPERATIONAL READINESS REVIEW INTERIM REPORT BROWNS FERRY UNIT TWO

OPERATIONAL READINESS REVIEW TEAM

JUNE 9, 1989

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REPORT OF

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ERRATA

1) Page 25 (IV.D.2.c.) Should read "Other examples are discussed in subsection A. above."

2) Page 27 (Last sentence in V.A.2.a.(4).) Should read "He was not aware that out-or-tolerance conditions could be accepted based on engineering justification."

3) Page 49 (VII.A.2.h.(1).) Should read ". . . Rosemount transmitters."

OPERATIONAL READINESS REVIEW REPORT

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SUMMARY

Synopsis:

The Operational Readiness Review (ORR) Team was formed by the Senior Vice President, Nuclear Power, to assess, prior to restart, the qualification and motivation of personnel at BFN and the availability of necessary supporting resources for the safe and reliable testing, operation, and maintenance of unit 2. The review was to be performed in two phases; the first, a bounding review and the second, to make a final assessment of readiness.

The ORR Team interim findings are presented in this report and reflect the first phase review of the plant activity areas listed in the table of contents.

The ORR Team observed both positive areas of performance and areas of concern. The concerns and recommendations are detailed in the report under related topic headings. A summary of positive observations and areas of concern are listed below.

Positive Observations

- The standards of performance expected by the senior site and plant managers are visible and are beginning to penetrate to the working level.
- Personnel generally demonstrated a good attitude toward their responsibilities.
- A good understanding of the importance of compliance with procedures was evident.
- Watch station turnover in the control room was performed thoroughly.
- Positive results have been achieved from senior plant management efforts to train managers and supervisors in properly walking down their spaces.
- Operations has produced a good video tape on "Communications."
- Radiological Controls progress towards readiness for restart is good with appropriate plans in place. Coverage of maintenance and modification work was thorough.
- Chemistry programs are in place to improve performance. Procedures ensure that routine chemistry samples are taken.

Significant Concerns:

- Conduct of operations, including simulator training, was not uniformly at the desired high standards of performance.

- The division of responsibilities between the unit operators in the control room was not well defined or practiced and may impact performance.

- Less than desired sensitivity to important reactor safety factors existed among some personnel. Opportunities to enhance reactivity management and control rod drive system performance had not been taken.

- Actions to improve Assistant Unit Operator performance had not effectively addressed their supervision.

- The Training organization was not taking a proactive approach to meeting the needs of the Operations Department.

- Deficiencies were noted in Operations administrative instructions and in the use of operator aids.

- Operating and work procedures were often deficient. The number of deficiencies in procedures indicated the need to identify and correct the fundamental causes for errors.

- Work packages need to be improved to ensure adequate work instructions are provided to Maintenance personnel. Requirements for substituting parts need to be better defined.

- Post maintenance testing did not consistently verify that maintenance was performed correctly.

- Management involvement had not been sufficient to correct a large backlog of preventive maintenance. The amount of outstanding work has the potential to affect plant reliability.

- Timely implementation of technical recommendations from vendors was lacking.

- Testing and training had not been adequate to ensure proper operation of the reactor vessel water level system.

- Nuclear experience reviews and other aspects of lessons learned information have not received sufficient attention as part of preparations for restart.

- The procedures and training to support proper post accident sampling performance were not adequate.

Significant Concerns: (continued)

- Some chemists' sampling and laboratory techniques need to be improved.

- An emergency preparedness exercise did not demonstrate sufficiently high standards of performance.

- Many commitments, other than those related directly to physical work in the plant, were slipping. These commitments were associated with being ready for restart and could impact restart if allowed to accumulate.

ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
AOI	Abnormal Operating Instruction
ASOS	Assistant Shift Operating Supervisor
AUO	Assistant Unit Operator
BFN	Browns Ferry Nuclear Plant
BWR	Boiling Water Reactor
CRD	Control Rod Drive
CSSC	Critical Systems, Structures, and Components
ECP	Estimated Critical Position
EMI	Electrical Maintenance Instruction
EOI	Emergency Operating Instruction
ESF	Engineered Safety Feature
GE	General Electric
GOI	General Operating Instruction
gpm	gallons per minute
HCU	Hydraulic Control Unit
IGSCC	Inter Granular Stress Corrosion Cracking
INPO	Institute of Nuclear Power Operations
LI	Level Indicator
LIS	Level Indicating Switch
M&PS	Material & Procurement Services
MI	Maintenance Instruction
MOV	Motor Operated Valve
MOVAT	Motor Operated Valve Actuator Testing
MR	Maintenance Request
NER	Nuclear Experience Review
NM	Nuclear Maintenance
NMRG	Nuclear Manager's Review Group
NRC	Nuclear Regulatory Commission
OI	Operating Instruction
ORP	Operational Readiness Program
ORR	Operational Readiness Review
OSIL	Operations Section Instruction Letter
PASS	Post Accident Sample System
PM	Preventive Maintenance
PMI	Plant Manager's Instruction
PMP	Program Manual Procedure
PMT	Post Modification Testing
POTC	Power Operations Training Center
PRO	Pressure Restricting Orifices
PWR	Pressurized Water Reactor
RHR	Residual Heat Removal
RIMS	Records Information Management System
RO	Reactor Operator
RVWL	Reactor Vessel Water Level

ACRONYMS AND ABBREVIATIONS (continued)

SER	Significant Event Report
SI	Surveillance Instruction
SIL	Service Information Letter
SMART	Senior Management Assessment of Readiness Team
SOS	Shift Operating Supervisor
SPDS	Safety Parameter Display System
SQN	Sequoyah Nuclear Plant
SRO	Senior Reactor Operator
STA	Shift Technical Advisor
TI	Test Instruction
TMI	Three Mile Island
TSC	Technical Support Center
UO	Unit Operator

I. CONDUCT OF OPERATIONS

A firm basis of solid performance is evident in some areas encompassed in the conduct of operations. However, additional effort is required to achieve a uniform standard of excellence.

A. Communications

1. Concern

Communications were not uniformly consistent with the Browns Ferry Nuclear Plant (BFN) required standard.

2. Basis

a. In observations of four training exercises at the simulator, some individuals did not consistently repeat back orders.

b. Some orders were not technically specific; e.g., "bring level up a little."

c. Acknowledgment of significant information during simulator exercises was lacking or limited to a nod of the head in several instances.

d. In one simulator exercise, the instructor noted that the Shift Operations Supervisor (SOS) was cognizant of a pertinent parameter from a redundant recorder while the operator was searching for the information but had not communicated that he was having a problem.

e. Some information exchange was done in a very low voice, barely above a whisper.

f. During an emergency preparedness drill one Emergency Response Team leader mistakenly thought there was a real medical emergency after a phone call. This was not noted at the critique.

g. Two Operations shift crews, conducting a simulator exercise immediately after having seen the BFN communications training film, performed to a higher standard than crews that had not been refreshed with the film.

3. Recommendations

Upgrade the operational communications by:

a. Frequent use of the BFN training film with the Operations Superintendent lead-in as the standard of communications to be consistently demonstrated.

3. Recommendations (continued)

   b. Uniformly enforce and encourage the standard be maintained both in the simulator and in the plant. See section II A.

   c. Consider the use of commercially available communications training modules, e.g., Westinghouse films using non-nuclear examples, to encourage broad acceptance of the necessity for high standards of communications. Plant personnel, in addition to operators, might benefit from some training in communications.

B. Control Room Delineation of Responsibility

1. Concern

The current division of responsibilities between Unit Operators (UOs) in the control room may contribute to degraded performance during off-normal or emergency conditions.

2. Basis

   a. INPO Guideline for Teamwork and Diagnostic Skill Development, INPO 88-003, lists obstacles which could disrupt operations including "Desired actions are not conducted due to coordination problems" and "Actions are not verified due to misunderstandings of roles and responsibilities".

   b. Governing instructions for UO duties were provided in Plant Managers Instruction, PMI 12.12, Conduct of Operations, and included the requirement that "The Lead Operator is responsible for the coordination of all Unit Operators assigned to that shift and for informing the Assistant Shift Operations Supervisor (ASOS) of any changes in plant status. All operations performed on shift will be done with the cognizance of the Lead Unit Operator." Additional requirements were that a licensed Reactor Operator or Senior Reactor Operator "shall be present at the controls" of each fueled unit. The following observations raised the question of the sufficiency of these instructions:

      (1) Lack of coordination between UOs was noted in every ORR Team observation of simulator training.

      (2) In one simulator exercise, one UO went to the back of the panel, the second UO was searching a shelf for a procedure, and the ASOS had his back to the 9-5 (Reactor Control) panel addressing the Shift Operations Supervisor (SOS).

2. Basis (continued)

(3) Two instances were noted where both UOs responded to the same alarm and left the panel 9-5 area untended. In one case the alarm was on panel 9-8 (Electrical Control) and the other on panel 9-20 (Condenser Circulating Water Pump Control).

(4) Other cases were noted where both UOs and the ASOS gave their full attention to an alarm condition at a side panel.

(5) In several simulator exercises, reactor water level control deteriorated partially because of diversion of operator attention to other functions by both operators.

(6) In one simulator exercise, the UO asked the assigned Lead UO about the division of panel responsibility. The response was indefinite and they agreed to see how the scenario proceeded.

3. Recommendation

Provide a more specific delineation of the responsibilities of the control room lead UO and other control room UOs. Conduct simulator exercises and control room operations carefully following the intended delineation of responsibilities.

C. Formal Conduct of Operations

1. Concern

Conduct of operations was observed not be be uniformly at the desired high standard of performance.

2. Basis

Uniformly high standards are a key to reliable, safe operation. Several items were observed in the unit 2 control room and in the plant which tended to detract from a formal businesslike atmosphere.

a. During a back shift, the daily newscast on "TVA TODAY" was broadcast into the control room by someone calling a number where the news can be obtained from a recording, and then putting it on a speaker phone.

b. Instances were noted when proper alarm response was not made, e.g., alarms not announced.

2. Basis (continued)

c. The plant announcing system was noted broadcasting in the control room and distracting the operators.

d. Operations personnel were noted wearing their dosimetry hanging from belt loops, i.e., below the waist.

e. Response to alarms on the Channel C, Source Range Monitor, were noted in the control room. Although in these instances, initial alarm response followed the correct procedure, this condition has existed for several months. The ORR Team considers this may be a case of "accepting the unacceptable."

f. An Assistant Unit Operator (AUO) log book contained two partial copies of an operating instruction. Each was several pages long and covered procedures used by the AUO on the control rod drive system. One was apparently an informal copy, the other appeared to be the original pages from a formal controlled copy. While the current revision, both copies had obviously been in use for some time. One referred to a figure for operating limits. The figure was not included, but limits had been written in. The other referred to precautions, but the precaution section was not included. A UO said this was an acceptable practice as long as the AUO checked that the revision was proper.

g. Two AUOs were observed conducting an operation requiring manipulation of instrument panel valves. The AUOs had to go behind the panel and trace pipe runs because the valves were not labeled. Many other instrument panel valves are not labeled, causing difficulties for the watch standers.

3. Recommendation

a. Continue the efforts of all levels of supervision and management to be consistent in requiring a high standard in the conduct of operations.

b. Consider providing valve numbers and labels for all plant valves.

D. Sensitivity to Areas Critical to Reactor Safety

1. Concern

Interviews and discussions with plant personnel indicated a less than desired sensitivity to some of the factors important to reactor safety.

2. <u>Basis</u>

a. In discussions of reactivity, most plant personnel, including both operators and shift technical advisors, indicated this area was the responsibility of the Reactor Engineering group.

b. Some operations personnel demonstrated only a limited understanding of the factors which would influence a calculation of an estimated critical rod position.

c. One operator did not know magnitude of the excess reactivity needed for a theoretical prompt criticality and could not relate the value to control rod worth.

d. There did not appear to be a requirement for a formal independent verification of the rod pull sequence for each startup.

e. Some operators were unaware of the reactivity addition problems at other utilities' Boiling Water Reactors (BWRs) as delineated in INPO 87-015, Material For A Case Study on Control Rod Mispositioning and Reactivity Events.

f. There was confusion as to the most probable causes of the unit 3 reactor water level problems which occurred before shut down in 1985.

g. Some operators were not clear on the modifications to the reactor water level systems.

h. During simulator training there appeared to be an over reliance on reaction to reactor water level alarms to prompt operator response.

i. During interviews with operators, several did not always identify core monitoring in the reactor vessel or spent fuel pit as an important watchstanding concern.

j. The term "critical safety functions" was not used in operator training and is therefore unfamiliar to the operators. The generic definition is available in INPO 88-003, Guideline for Teamwork and Diagnostic Skill Development. Supplement 1 to the Post Three Mile Island Accident Action Plan, NUREG-0737, provides the BWR safety functions as used in safety parameter display systems. The concept of critical safety functions was employed in the structuring of the BFN Emergency Operating Instructions. There was difficulty on the part of some operators with articulating recognition of the concept.

3. <u>Recommendations</u>

a. Develop enhanced sensitivity to reactor safety concerns as the startup effort continues. This includes awareness of reactivity concerns; e.g. shutdown margin.

b. Incorporate into the startup training program an increased appreciation for those plant areas important to reactor safety. This should emphasize those features such as rod control and reactor water level where there is a direct and continuing operator interface.

c. Encourage the development of a questioning attitude so that every interface with reactor safety gets the most careful scrutiny including challenges by those who inherit responsibility (Operations) but are not initially responsible (Reactor Engineering).

E. Correction of Assistant Unit Operators (AUO) Performance Problems

1. <u>Concern</u>

While the need to improve the performance of AUOs has been recognized for some time, the corrective actions have not yet effectively addressed supervision of AUOs.

2. <u>Basis</u>

a. A Nuclear Managers Review Group (NMRG) report dated March 1988, an INPO evaluation concern of April 1988, a BFN Operations Department self-assessment in August 1988 and tours with AUOs by a 'corporate' representative earlier in 1989 all noted the need to improve AUO performance. ORR Team observations confirmed this need.

b. Corrective actions taken to date have centered on additional evaluation and training, e.g., the AUO proficiency checks. Planned actions include having a more senior AUO assigned to each crew as a training AUO. While these actions may be helpful, they have not corrected the problem.

c. The ORR Team noted a lack of on-shift supervisory attention to AUOs. In one instance in which the team observed an opportunity for supervisory coaching, it did not occur. When a question arose as to the correct means of verifying a tagout removal, an ASOS, who raised the question, left it to the AUO to decide. The ASOS did not check to see how it was done. During interviews, ASOSs acknowledged that supervising AUOs was part of their responsibilities.

2. Basis (continued)

d. In discussing the lack of SOS/ASOS attention to AUO performance with Operations management, the ORR Team was informed that the pace of activities under the existing plant conditions limits such involvement. However, the team's observations of control room activities found some periods of lessened activity during back-shift hours when ASOSs could have (but did not) supervise or coach AUOs.

4. Recommendations

a. Reinforce direct supervisory responsibility and accountability for AUO performance with the SOS and through the ASOS. The ASOS should spend time coaching the AUOs.

b. Individual performance should be monitored by the SOS/ASOS and action taken as necessary to bring performance to the standards required by PMI 12.12, Conduct of Operations.

II. OPERATOR TRAINING

Continuing excellence in training is essential to maintaining the ability of operations personnel to handle their responsibilities. This section discusses concerns about the conduct of simulator training, the Operations/Training interface, and the instruction governing operator training.

A. Simulator Training

1. Concern

Simulator training did not always enforce high standards for the conduct of plant operations.

2. Basis

a. During observations of simulator training the ORR Team noted several instances where improper practices were either not critiqued by the instructor or ineffectively critiqued. For example:

(1) Procedures not always followed, e.g., in one scenario the reactor was not scrammed as required by Abnormal Operating Instruction, AOI-64, Drywell Pressure High and/or Temperature High or Excessive Leakage Into Drywell, at 160°F drywell temperature

(2) Weak supervisory control; sometimes neither the Shift Operations Supervisor (SOS) or the Assistant Shift Operations Supervisor (ASOS) provided direction when it was needed.

(3) Teamwork lacking or disorganized, e.g. operators simultaneously tried to answer an alarm on one panel while ignoring another.

(4) Inattention to reactor instrumentation during simulated critical operations.

(5) Occasional failures to use procedures.

(6) Many shortcomings in communications, e.g. lack of acknowledgments and imprecise orders.

(7) Control Room logs not always maintained as required.

(8) Instances of informality, e.g. pounding on the rod position digital indicators.

b. There were shortcomings observed in instructional technique which contributed to the deficiencies discussed earlier.

2. Basis (continued)

(1) There were two instructors assigned. Both instructors often sat at the instructor's console and did not observe at the panels or perform on-the-spot corrections.

(2) Failure to require and provide time for a thorough self-critique by the students prior to the instructor's critique.

(3) During instructor critiques there was insufficient emphasis on problems and the reasons for proper actions. In some cases there was insufficient time allowed to conduct a proper critique.

c. During observations, the ORR Team noted several labels and operator aids differing on the simulator from the Control Room. The specific problems noted were reported to the instructor.

3. Recommendations

The enforcement of proper standards for the conduct of operations during simulator training should be shared by Operations and Training as discussed below:

a. Have the SOS become more involved. Make the proper conduct of operations part of his responsibility just as it is in the control room. He should be doing more on-the-spot corrections.

b. Increase the Operations management attention to simulator training, focusing evaluation of the conduct of operations against high standards. Operations management should provide feedback to Training management on instructor performance.

c. Training management should monitor the simulator (along with Operations management) and ensure that the instructors take a more active role in enforcing the proper standards and that they utilize proper instructional techniques. Technique improvements should include:

(1) Having the students perform a thorough self-critique first; followed by a comprehensive critique from the instructor. Include a discussion of why the students may have missed any items that the instructor alone identifies. Consideration should be given to use of the closed circuit television recording in such circumstances.

3. Recommendations (continued)

(2) Having one of the instructors move about the simulator control room. During nonevaluation exercises he should perform on-the-spot corrections for lapses in proper practices.

(3) Maintaining the simulator current with the unit 2 control room.

B. Operations and Training Interface

1. Concern

The Training organization was not taking a proactive approach to meeting the needs of the Operations organization.

2. Basis

a. While Operations is providing their needs to Training; both organizations need to be proactive in dealing with training situations and the operations/training interface.

b. Training management was concerned about the potential for a high failure rate on the forthcoming NRC examination of licensed operators. Despite that concern, Training had not developed a plan of action or possible alternatives to deal with the potential problem. A proactive approach would have been to develop possible alternative solutions and present a recommended course of action to the Operations Superintendent for his agreement. (This situation was subsequently resolved by the Operations Superintendent.) See subsection C for a related procedural concern.

c. The Training organization had not developed any specific planning for conducting special restart training. Considering the fall 1989 restart target, a proactive organization should have had planning for restart training well underway. Since similar training was developed for the restart of Sequoyah Nuclear Plant (SQN), the ORR Team considered that a draft curriculum and some lesson plans already should have been prepared. See Section VII A for additional discussion related to restart training.

d. In discussing the results of the April 1989 INPO evaluation with an instructor responsible for training Assistant Unit Operators (AUOs), the ORR Team learned that the instructor was unaware that INPO found problems in AUO knowledge and attention to detail. The ORR Team also learned that the information about the INPO findings was already available

2. Basis (continued)

in the Training organization. A proactive approach would have been to quickly communicate the INPO information when it became available.

e. The training which was conducted to cover a modification, ECN P7131, Reroute of Unit 2 Reactor Vessel Reference Legs, was incomplete. Performance curves which show the calibration of actual versus indicated level (for various operational pressures) were not included in the lesson because they were not yet available. The simulator was used to demonstrate water level instrumentation response without reprogramming for the modification. No plan was established to further discuss water level indication response after the new performance curves became available and the simulator response was reprogrammed. Considering the importance of those performance curves in understanding the response of the reactor water level instrumentation, a proactive approach would have established a formal plan.

f. Further evaluation by the ORR Team disclosed that the same level of detail was provided to operators as to plant management (except the operators did not receive the simulator portion). The ORR Team also noted some weaknesses in operator knowledge of the water level modification (see Section I.D and VI.D). When this situation was brought to the attention of plant management by the team, prompt action was taken to ensure that additional training would be provided to operators prior to restart.

3. Recommendation

Training management should exert leadership to instill a proactive approach throughout the Training organization.

C. TVA Nuclear Program Manual, Nuclear Plant Operator Training Program

1. Concern

Program Manual Procedure, PMP 0202.05, Nuclear Plant Operator Training Program, was weak on some training matters.

2. Basis

(1) PMP 0202.05 did not require frequent meetings between the Operations Superintendent and the Manager, Operator Training to discuss student progress and agree upon actions to resolve problems. (The existing practice was adequate in that such meetings are usually held weekly.)

2. <u>Basis</u> (continued)

(2) PMP 0202.05 did not provide sufficient guidance relative to handling requalification training problems regarding academic standards, e.g., there was no limitation on the number of retake examinations allowed subsequent to examination failures and remedial training. (Section 6.5.6.4 of 0202.05 contains criteria for removal of students from initial license training. There was no corresponding criteria for requalification training.)

(3) PMP 0202.05 did not include a formal process for the identification of special training needs and the development of appropriate training.

3. <u>Recommendation</u>

PMP 0202.05 should be revised to include Operations/Training periodic review meetings, academic standards for the requalification program and a formal process for identification/development of special training.

III. OPERATIONS ADMINISTRATION

Some Operations administrative instructions had shortcomings and in one instance implementation of an instruction was deficient.

A. Administrative Instructions

1. Concern

   Some administrative instructions appeared to grant latitude in areas that could lead to avoidable problems. Other documentation difficulties hindered proper operation.

2. Basis

   Examples of administrative procedures or other documents that appeared to have the potential for allowing problems or hindering operations follow:

   a. Site Directors Standard Practice, SDSP-14.9, Equipment Clearance Procedure:

      (1) Special requirements (e.g., double valve isolation where possible) for clearances on high energy systems are not included.

      (2) Paragraph 6.1 authorized performance of work not under the controls of the clearance procedure including "work of a limited scope where full control can be provided and maintained in the immediate proximity to the involved equipment." This work was authorized at the same management level as all other work. Even considering the requirements on the use of this exclusion; i.e., "thoroughly researched and preplanned" work, higher management involvement is warranted.

      (3) The procedure allowed issuing a clearance with voice contact when the person issuing the clearance can recognize the voice of the person to whom it is issued. INPO Significant Event Report 88-017, Electrocutions and Injuries Incurred While Working Near Energized Electrical Equipment, emphasizes face-to-face communication, including joint review of controlled drawings and diagrams, to reduce misunderstandings about clearances.

   b. SDSP-3.15, Independent Verification recommended but did not require physical separation of the independent verifier from the person performing the first check. This would apply to system lineups. The ORR Team observations of independent verification performance in the plant noted it

2. Basis (continued)

was being done with correct physical separation. The requirements of Section 6.3 of SDSP 14.9, "Equipment Clearance Procedure," concerning independent verification were considered appropriate for system lineups.

c. Plant Managers Instruction, PMI 12.12, Conduct of Operations:

(1) Paragraph 4.5.3 stated ". . . operation or manipulation (clearances, etc.) of other plant equipment not affecting reactivity . . . may be performed by trainees under the direction of a licensed SRO or RO but the licensed individual does not have to be present. The licensed individual will use his judgment in monitoring the particular situation." The use of unqualified personnel to perform clearances did not provide full assurance of personnel/equipment safety. Additionally, the degree of supervision by a licensed person who is not present at the scene may not be sufficient to avoid operational problems.

(2) The subject of appropriate controls or limitations on trainees for AUO positions was not addressed nor was it planned for the next revision.

(3) Paragraph 4.6.3 stated that the communication requirements are intended for use during normal operation of the plant and that in an abnormal or emergency condition, communication will be done in a manner that does not interfere with proper and timely mitigation of the event in progress. This precaution implied a lower standard of communications would be acceptable in an emergency. The ORR Team considers this an improper precaution. Specifically, the careful use of proper oral communications in normal situations is precisely so that it will become routine and normal in emergency situations. Plant safety will be enhanced, not threatened, by rigor in communications during emergencies.

(4) Paragraph 4.10.8.1 stated operators are to believe their instruments unless it is verified by other means (i.e., another indicator or direct observation) to be false. The ORR Team considers a more conservative qualifier would lower the potential for error; e.g., unless verified by all other available indicators, direct observation, or confirmation by checks or tests that the indication is false.

2. Basis (continued)

(5) Paragraph 5.6.1 assigned the Assistant Shift Operations Supervisor (ASOS) responsibility for the safe and efficient operation of the plant. Paragraph 5.6.3 authorized the position of non-licensed ASOSs with the limitation that they could not operate controls that directly affect reactivity or power level or direct the activities of licensed operators at the controls. The use of non-licensed ASOSs appears to have the potential for confusion in line responsibility and authority.

(6) Paragraph 5.7 addressed the Unit Operators. See Section I.B of this report which discusses unit operator coordination.

d. The tour and turnover checklists of Operations Section Instruction Letter, OSIL-66, checklists, logs, inspections, and routine sheets, for the AUOs did not include all the rooms or equipments for which the AUOs have responsibility.

e. The information in OSIL-63, Electric Circuit Breaker - Rack-in/Rack-out, would be more appropriately placed in a higher tier document.

f. The control room drawing, flow diagram condensate storage and supply system, 67 MI-47E818-1, was not usable for a normally trained operator. One area of the top sheet had match lines, to allow going to the following sheets, but those are confusing to use. This system has interconnections to safety significant systems and must be capable of realignment on short notice.

3. Recommendations

a. The responsibilities section, 5.0, of PMI 12.12 should be reviewed with an intent to clarify any ambiguities and aid coordination of the Control Room team.

b. The necessity for judgment in operations is recognized by the ORR Team. As a general policy, it is recommended that instructions hold to a conservative standard of operations and allow deviations when required. That is, do not allow undue latitude in operations while only recommending a preferred, more rigorous, option.

c. Provide a "user friendly" drawing for the condensate storage and supply system and address the other specific deficiencies noted above.

The team understands that action has been initiated on some of the items noted above.

B. Operator Aids

1. Concern

The operator aids procedure had shortcomings and detailed implementation of the procedure was deficient.

2. Basis

a. Section 4.15 of PMI 12.12 Rev. 5, discussed operator aids. Subsection 4.15.2 discussed the Operator Aid Book and the Operator Aid Index. Subsection 4.15.3 referred to a Control Room Information Book and to a Technical Review Form and a Screening Review (also a form). No reference was made to form numbers. These forms are used to document safety reviews for operator aids included in the information book. No such review was required for posted operator aids. The distinction between the two books was not stated.

b. An Operations Department manager explained to a team member that the Operator Aid Book is to log and contain copies of posted aids while the Control Room Information Book is to log and contain operator aids that are for reference but are not posted. This manager agreed both types of operator aid should require use of the Technical Review and Screening Review forms to ensure aid accuracy when they contain safety related information.

c. Operators in the Unit 2 Control Room generally did not understand the distinction between the Operator Aid Book and the Control Room Information Book. Separate books were not used; however, the Unit 2 Operator Aid Book did include a divider page tabbed as Control Room Information Book with nothing entered thereafter.

d. The Operator Aid Book contained a number of administrative errors including an aid listed in the index for which no copy was in the Book, aids listed as removed in the index but with copies still in the Book, one aid copy out of sequence by 3 numbers, and one copy of an aid that did not reflect the posted diagram. (These errors were subsequently corrected).

e. Improper or unauthorized aids were noted in the Unit 2 Control Room.

(1) Numerous colored stickers (dots) are used on Control Room panels to indicate nominal system alignment. The colors of the dots are the same as the desired indicator lamp color.

2. Basis (continued)

(2) A diagram showing power supplies for the Residual Heat Removal Service Water pumps was under the glasstop on the Assistant Shift Operations Supervisors desk.

(3) Operator Aid 2-89-54, warning against operating a defective recorder, was used in lieu of a caution tag.

f. Nearly half of the operator aids were for posting of electrical panel labels or for warning labels which were clearly intended to be permanent. Many of the labels had been posted as aids since at least February 1989 and some much longer. An Operations Department manger informed the team that design change requests had not been processed for many of these operator aids.

g. One aid, a diagram of the reactor vessel level indicating system, did not reflect modifications completed during the current outage. (This was subsequently corrected).

3. Recommendations:

a. Section 4.15 of PMI 12.12 should be revised to make clear the distinction between the Operator Aid Book for posted aids and the Control Room Information Book for non-posted operator reference materials as defined in INPO Good Practice, OP-207, INPO 84-005 Rev. 01, February 1987. An Operations Department manager stated this would be done in Revision 6 to PMI 12.12 now in preparation.

b. Issue design changes needed to install permanent equipment and warning labels where needed and delete the operator aids for this purpose. Revise Section 4.15 of PMI 12.12 to require prompt issue of a request for a design change as part of the process for issuing any further aids that post equipment labels intended to be permanent.

c. When revision 6 to PMI 12.12 is issued, provide training to all operators on the use of Section 4.15 including the prohibition on the use of unauthorized aids and aids used in lieu of caution tags.

IV. PROCEDURES

Generally, an understanding of the need for strict procedure compliance was observed. However, deficiencies in procedures discussed below make procedures compliance difficult.

A. Procedure Quality

1. Concern

The number of deficiencies in procedures indicates that the fundamental causes have not been identified and corrected.

2. Basis

Other sections in this report discuss procedure deficiencies in the context of specific concerns. Additional procedure deficiencies noted are listed here.

a. Surveillance Instruction, 2-SI-4.9.A.2.a-1, Weekly Check for 250 Volt Main Bank Number 2, required redundant recording of readings. One set of readings is confirmed four times. Step 7.2.5 stated that, if the pilot cell voltage is low, perform applicable portions of another SI but did not delineate those portions and stated to notify appropriate personnel but did not delineate which personnel (or positions).

b. 0-SI-4.2.B, RHR Service Water Initiation Logic, contained testing steps for a pump. Step 7.23.6 referred to an incorrect paragraph elsewhere in the SI and required a double verification. This SI had been in use and the double verifications have been made several times. However, the reference error was not corrected until an ORR Team member noted the error.

c. Specific comments on Plant Managers Instruction, PMI 12.12, Conduct of Operations:

(1) At least five incorrect references were made to the reference list, Section 2.

(2) Some inconsistent use of references existed. A few references were not contained in the reference list but were listed at the point in PMI 12.12 where mentioned.

(3) A number of references in Section 2 contained only the document number; no title or subject was given. This made them more difficult to use.

2. Basis (continued)

(4) Section 4.17, Defeating/Bypassing Interlocks, contained instructions on completing procedure steps in sequence unless specifically stated otherwise or authorized by the Shift Operations Supervisor. These instructions should be contained in Section 4.12, Procedure Compliance, so that they apply generally and not just to defeating or bypassing interlocks.

d. PMI 17.1, Conduct of Testing contained a large number of handwritten non-intent changes that affected the readability of the instruction. Also, some of these changes appeared to be of an intent nature, e.g., change in scope.

e. Operating Instruction, OI-35A, Stator Cooling Water Operating Instructions, contained the Assistant Unit Operator (AUO) round sheet on operation of the stator cooling water system. This OI used different terms than the label plates on the stator cooling water control panel. An AUO noted the differences pointed out by a team member.

f. Maintenance Instruction, MIC-0-085-VLV002, Maintenance Instruction for Scram Inlet Valves was reviewed following the procedure revision issued as a result of the work which caused damage to scram inlet valve 50-23 from over pressure. The following deficiencies were noted:

(1) The pressure source requirements were inconsistent. The procedure was originally written to address the use of a 70-75 psig air source for pressurization, rather than high pressure bottled nitrogen through a regulator. (A prudent approach which minimizes the chance of valve damage.) Specifically, Section 5.2, "Special Tools" listed a "source of filtered air" and Section 7.3, "Packing Replacement" required the use of a 70-75 psig source of filtered air. Section 7.3 implied the control air system was the desired source. Section 7.6, the activity which resulted in valve damage, did not indicate the pressure source requirements of 7.3. It did, however, discuss attachment and removal of an "air" line.

(2) Paragraph 7.6.1 stated "Contact Maintenance Foreman to establish conditions for performing valve spring adjustment." No "conditions" were specified. This step required a signoff. It is not clear whether this verified that the foreman was contacted or that the conditions had been established.

2. Basis (continued)

(3) Paragraph 7.6.2 required the foreman to "verify test equipment is properly installed." While requiring that test gauge calibration data be recorded, no requirements for the test equipment were specified other than the use of a "test gauge" (apparently a pressure gauge of unspecified range). There was no signoff required to "verify" proper installation.

(4) The changes to section 7.6, following the incident, were also deficient. Specifically:

° Rather than requiring use of the 70-75 psig air source, the revised procedure permitted use of high pressure nitrogen provided a specified test rig is used.

° The test rig specification was inadequate. Two regulators of unspecified range were required. Three gauges were required, inlet and outlet pressure gauges on one regulator (range not specified) and a "CSSC gauge" (presumably another pressure gauge). A relief valve with a 100 psig setpoint, but no specified capacity, was required.

° The critique corrective action stated that "prior use testing requirements" would be specified for the testing equipment. Paragraph 7.6.2 was revised to require a sign off to check that the relief valve has been calibrated. No test equipment requirements have been added if air is used. No requirements existed to check the calibration or proper operation of the regulators or the "non-CSSC" gauges.

g. The prerequisite section of Electrical Maintenance Instruction, EMI-106, Wirelift and Troubleshooting, contained a caution against the use of glow sticks in certain operations. The precaution was not a prerequisite and should be in the precautions section or in an appropriate place in the body of the instruction.

h. Precaution 3.1.7 of EMI-106 required the craftsman to determine whether a jumper could cause an Engineered Safety Function actuation and, if so, to notify the Shift Operations Supervisor. However, the body of the EMI required only that the craftsman sign that he understood the prerequisites not the precautions.

2. Basis (continued)

   i. EMI-106 required that the removal of a temporary alteration (e.g., a jumper) be second person verified but there was no requirement to log the installation of a temporary alteration. Thus, the existence of a jumper could be overlooked.

   j. Draft Test Instruction, TI-131, Feedwater Control System, included a general precaution, 4.2, which specified that when inputing transients the operator is to start with small inputs and slow input rates to monitor system performance prior to inserting the larger steps. In the body of the report the test director was given the latitude of making the determination as to whether it is necessary to start out with small inputs and slow input rates which, in effect, negated the precaution.

   k. Draft TI-131 stated in a number of places that the reactor vessel water level was to be verified at "approximately 33 $\pm$ 1 inches". The range, 32 to 34 inches is not an approximation. If this was the range required, then the word "approximately" should not have been included.

   l. Section VI.D. of this report discusses deficiencies in TI-149, Reactor Water Level Measurement.

   m. Subsection B. that follows refers to numerous deficiencies in General Operating Instruction, 2-GOI-100-1A, Unit Startup from Cold Shutdown to Power Operation.

3. Recommendations

   a. Conduct a root cause analysis of the procedure deficiencies identified in this report and in other recent documents available to BFN. Implement corrective actions.

   b. The Team notes that BFN intends to have a "Joint Test Group" review and approve test procedures for the restart and power ascension program prior to use. Some similar multidiscipline group (or groups) for various types of procedures and instructions may be needed on a more permanent basis.

   c. Review of non-intent changes should be conducted and review results fed back to personnel, especially if non-intent changes are being abused.

B. Verification and Validation of Operating Procedures

1. Concern

The processes for ensuring operating procedures had been revised but a number of essential and routinely used procedures were not to be revalidated using the revised processes.

2. Basis

a. General Operating Procedure, 2-GOI-100-1A, Unit Startup from Cold Shutdown to Power Operation, was checked out on the BFN simulator by the ORR Team with the cooperation and assistance of BFN personnel including three licensed operators. A memorandum to the Site Director dated May 25, 1989 (A02 890524 011) contained an extensive list of the ORR Team comments from this checkout.

b. Because of the number of comments on 2-GOI-100-1A, the ORR Team was concerned for the procedure verification and validation process. The following were determined:

(1) BFN had recently revised Site Directors Standard Practice, SDSP-7.4, to improve the procedure verification and validation process (for procedures other than EOIs) but an Operations Department manager stated that only a small number of GOIs, OIs, and Abnormal Operating Instructions (AOIs) would be revalidated to the new SDSP-7.4 revision (Rev. 5). The ORR Team received a list of those procedures to be revalidated and noted GOI-100-1A was included but others, such as OI-1, "Main Steam," OI-2, "Condensate," and OI-3, "Reactor Feedwater" were not. The checkout of GOI-100-1A (item a. above) indicates such OIs should be revalidated.

(2) An NRC inspection of SI's in February 1989 indicated deficiencies that should have been identified with a satisfactory verification and validation system. The team was informed that approximately 600 SIs were to be revalidated to the new SDSP-7.4.

(3) An NRC inspection of Emergency Operating Instructions (EOIs) in August 1988 found numerous concerns. The team was informed that revisions of the instructions for verification and validation of EOIs had just been issued and all EOIs would be revalidated.

c. The number of procedure deficiencies identified in subsection A indicates that a number of the types of man-machine interface procedures at BFN should be revalidated.

3. Recommendations

a. Prior to restart, validate all essential and routinely used operating instructions, such as those OIs identified in 2.b above.

b. Sufficient resources and attention should be placed on the implementation of the verification and validation process to increase substantially the assurance that procedure errors will be minimal.

C. Use of 'Not Applicable' (N/A) In Procedure Steps

1. Concern

Guidance on use of the 'not applicable' (N/A) notation in procedure steps was not provided for the general use of operating and maintenance personnel.

2. Basis

a. Some extensive procedures, such as 2-GOI-100-1A, Unit Startup from Cold Shutdown to Power Operations, allowed the Shift Operations Supervisor (SOS) great latitude in determining whether a specific prerequisite or operations step was to be performed. After a long shutdown (such as the current one) few steps in GOI-100-1A would be expected to be marked 'N/A' but after shorter shutdowns of a few days or weeks, many questions could arise as to whether a number of steps may be N/A'd since the specific work that has been done may substantially effect those steps. GOI-100-1A, as an example, did not provide any prerequisite step that might require management or supervisory review to specify additional steps that would require the 'R' (required performance) designation for a specific startup.

b. A review of eight completed maintenance work packages indicated some misunderstanding of the use of 'N/As'. In one package, the cognizant reviewer lined through and marked as 'N/A' two signatures that verified connector resistance was within specified limits. In another package, a valve operability check in Mechanical Maintenance Instruction, MMI-51, Maintenance of CSSC and non-CSSC Valves and Flanges, was marked N/A but the procedure specifically prohibits marking this step 'N/A'. In several Maintenance Requests, the failure code was not designated, but not marked as 'N/A' as required by SDSP-7.6, Maintenance Request and Tracking.

2. Basis (continued)

c. A completed performance copy of 0-SI-4.2.B-67, RHR Service Water Initiation Logic, showed many N/As marked on procedure steps. In three cases the N/As had been changed to show subsequent accomplishment of the steps. A Senior Reactor Operator (SRO) stated that this was a common problem in that a work package will call for the post maintenance test to be ". . . applicable steps of SI. . .". Operations then had to decide what is applicable and during subsequent performance some decisions on steps would be revised.

d. With a few exceptions, when N/As are used in operating and maintenance procedures, no explanation was given as to the reason for the use of an "N/A."

e. Section V.A. identifies other errors in use of N/As.

f. No formal guidance on use of 'N/As' was apparent from review of SDSP and PMI indices. SDSPs and PMIs reviewed did not contain such guidance with the exception of one, PMI 17.1, Conduct of Testing. This PMI 17.1 guidance could form the basis for a more generally applicable PMI or SDSP on this subject.

3. Recommendations

a. Promulgate an SDSP or PMI with guidance on use of 'N/As'. Such a document should consider requirements similar to those in PMI 17.1, Conduct of Testing.

b. In complex, safety-related procedures, such as GOIs, a prerequisite step should require prior review of non-"R" steps before procedure initiation to determine which should be required for that particular startup. This would increase the management involvement in the decisions to N/A steps in important procedures.

c. Consider requiring the Maintenance Engineer, Planner, or Foreman to mark up Maintenance work packages with N/A'd steps (where feasible to decide in advance) before issue of the work package to the Maintenance mechanics. At least one other utility does this.

D. Meaning of Signature Steps

1. Concern

Some signature steps in procedures were not clear as to what was meant by the signature or what had to be accomplished to sign the step.

2. Basis

a. Section 4.3.7 of PMI 12.12, Conduct of Operations, stated that a signature (or initials) when used in a procedure signifies the individual has performed the action or verified the action, but the following steps in 2-GOI-100-1A, Unit Startup from Cold Shutdown to Power Operation, did not appear to fit either of these categories:

(1) Steps 5.91 and 5.95 concerned "ensuring" certain containment actions were completed within 24 hours of achieving operating temperature and pressure, but at the point in the startup sequence where these steps were included, 24 hours would not have elapsed. In fact, operating temperature and pressure are just being obtained at these steps. Operators questioned either stated what was to be signed for was not clear or stated they would sign only after the conditions in the drywell and torus had been achieved, which would create a sequence problem in the procedure. Note that Step 5.118 required verification that drywell/torus conditions were met within 24 hours.

(2) Step 5.117 stated to contact the Shift Technical Advisor (STA) if heat balance indicated a thermal power greater than 3293 MW. It was not clear whether the signature meant the STA was contacted and the procedure could continue after the STA was notified or that the operation must not proceed until some action was forthcoming from the STA.

b. A Maintenance Instruction, MMI-6, on diesel generators specified in paragraph 9.2.6 to inspect and change the air start air compressor intake filters if dirty, yet the signature step (Step 9.26) stated only that the filters have been inspected. Thus the signature may or may not have meant the filters were replaced.

c. Another examples are discussed in subsection A. above.

3. Recommendation

As part of the verification process for procedures, review specifically the meaning of signature steps to assure they are clear and not ambiguous.

V. MAINTENANCE

The ORR Team noted many actions were under way to improve plant maintenance. The team observed maintenance activities, reviewed some process procedures relative to maintenance and numerous maintenance request work packages, and interviewed a number of personnel. A few concerns that need further attention were noted.

A. Post Maintenance Testing

1. Concern

   Post Maintenance Testing (PMT) does not consistently verify that maintenance is performed correctly and that equipment performs its intended function.

2. Basis

   a. Although a detailed procedure SDSP-6.7, Post Maintenance Test Program, existed which describes the PMT process, it was apparent that plant personnel were unclear about the preparation, performance, and review of a PMT appropriate to the maintenance activity performed. This was confirmed by the team during interviews, and documentation reviews. For example:

      (1) PMTs were specified by planners, and signed for as completed by foremen, when none were actually required or possible to perform; e.g., completion of a data sheet was specified as the PMT for painting anchor bolts; completion of a data sheet was also specified as the test for installation of hanger U-bolts per Mechanical Maintenance Instruction, MMI-164, Temporary Removal and Reinstallation of Pipe Supports. This MMI specifically stated that no testing was required.

      (2) A Maintenance Request (MR) for diesel generator work incorrectly specified a Surveillance Instruction (SI) for fast start testing of the diesel as the PMT. The SI was not performed after work completion, but a foreman and an Operations supervisor signed the MR indicating proper completion of the specified PMT.

      (3) An MR for a diesel generator fuel oil transfer pump coupling specified a PMT which required running the pump. The MR was signed by a foreman and Operations supervisor indicating proper completion of PMT. In fact, a work log entry stated that the PMT had not been performed.

2. Basis (continued)

(4) One System Engineer stated that there is a reluctance to place acceptance criteria in PMTs since failure to meet the acceptance criteria would mean that the component was inoperable. He also stated that out-of-tolerance conditions could be accepted based on engineering justification.

(5) MMI-51, Maintenance of CSSC and non-CSSC Valves and Flanges, section 10.6, was frequently specified as the PMT, if a leak check is required after valve pressure boundary maintenance. However, procedural steps of MMI-51 permitted this step to be marked "N/A" if plant conditions did not support test performance. This could allow MR closure without the specified PMT being performed.

b. Although specified as part of the work package, PMT requirements were often vague allowing for interpretation by the personnel performing the work.

(1) The PMT for one MR written to correct a problem with an annunciator for the 1D diesel generator, specified the performance of procedure PMI 12.12, "Conduct of Operation" which is a larger administrative procedure describing operator responsibilities. The appropriate PMT should have been a wire check, visual inspection and a functional check, as required by SDSP 6.7, Attachment A, page 4.

(2) The PMT for another MR for valve maintenance required performance of the "appropriate data sheet" of procedure MMI-51. A review of the completed work package by the team revealed that the step for valve operability (Step 10.1) was marked N/A. Valve operability was one of the retests stated in SDSP 6.7, Attachment A, page 86.

c. Over half of the work packages reviewed by the team had PMT guidance which did not provide verification of the activity performed.

(1) In an MR to troubleshoot the failure of an air compressor to start, the PMT section was marked "N/A." The work section of the procedure required breaker testing per Electrical Maintenance Instruction, EMI 7.6, Temporary Removal for Initial Installation and Trouble Shooting of Power Circuit Breakers (480VAC and 250 VDC). There was no requirement to start the compressor.

2. Basis (continued)

(2) The PMT for an MR requiring the adjustment of a valve packing gland did not require a valve stroke to check operability.

(3) The PMT for an MR requiring the adjustment of the flange bolts on a two-bolt flange did not require a leak check.

(4) The PMT for an MR on a CSSC cooling fan did not require verification of air flow.

(5) The PMT for an MR which performed extensive work on a diesel generator air start system did not require verification of moisture removal from the system or a functional test of the air start system (start the diesel, monitor the pressure, etc.).

d. Planning personnel stated that they were more likely to specify PMT requirements for Critical Systems, Structures, and Components (CSSC) than non-CSSC. This differentiation was made arbitrarily on a CSSC versus non-CSSC basis instead of a technical basis. For example, CSSC motor-operated valves (MOVs) receive "MOVATS" testing after maintenance; non-CSSC tests for MOVs are limited to visual inspection of limit switch and torque switch actuation. The MOVATS test is a much more accurate test and provides base line data on the condition of the valve. SDSP 6.7, Attachment A, page 88, properly made no differentiation between testing of CSSC or non-CSSC limit switches on MOVs.

e. The team observed a tendency to use SIs or sections of existing procedures for PMT requirements without a technical evaluation to ensure that the referenced procedure constituted an adequate retest. For example, the PMT for the 1/D diesel generator, where an alignment of the motor to generator was performed, specified SI-4.9.A.1.a, "Diesel Generator D Monthly Operability Test." However, there was no requirement for vibration analysis as part of the PMT. The MR had been initiated to address a vibration concern. Although an independent vibration test was performed it was not part of the PMT since the engineer did not specify any acceptance criteria, for the reasons outlined in paragraph a.(4) above.

f. SDSP-6.7 provided for developing a specific PMT utilizing the SDSP Form 292, included as part of SDSP-6.7. This form requires the planner to specify initial conditions, step-by-step instructions, including reference to specific procedural steps (SIs or other existing procedures), acceptance criteria, etc. This form, however, is seldom used.

2. Basis (continued)

g. When an SDSP 292 form was not used, there was no formal review by another technical group within maintenance of the testing requirement established by the planner. Furthermore, there was no post test review by the planner who originally established the requirements or criteria. Therefore, cradle to grave continuity of work scope review is not provided to ensure that the PMT actually accomplished was appropriate to the scope of work performed.

h. Qualitative instead of quantitative acceptance criteria were often used in PMT requirements. Examples of qualitative acceptance criteria were: ensure equipment performs "adequately"; verify that component functions "properly"; assure vibration levels are "acceptable".

3. Recommendations

a. Provide training to all personnel involved in the development, review, and performance of PMTs. Unlike the current training program, this training should not be limited to the procedural requirements of SDSP-6.7 but instead should include practical examples of maintenance activities and the PMT that would verify the adequacy of that activity. This course should be taught by someone who understands the concept of an appropriate PMT (refer to INPO Good Practice MA-305, Post Maintenance Testing).

b. Revise procedure SDSP-7.6, "Maintenance Request and Tracking", and SDSP-6.7, "Post Maintenance Testing," to require a form 292 for every maintenance activity requiring a PMT. The form should delineate the PMT step by step referencing an SI, or section thereof, or procedural step as necessary. As part of the revision of SDSP-7.6, the section on return to service should be strengthened to ensure that all required testing, including operability requirements, are identified as part of PMT activities.

c. Require peer or technical review of PMT's to provide additional assurance that both maintenance and Technical Specification requirements are met. Post work review should also be performed by the cognizant planner.

B. Preventive Maintenance

1. Concern

The large number of outstanding Preventive Maintenance (PM) activities has the potential to compromise plant reliability. Management involvement has not been sufficient.

2. Basis

a. The current number of outstanding restart related PM activities for Unit 2 (as of April 30) were approximately 2700, of which approximately 900 were safety-related. This did not include deferred activities. Based on the current work off rate these 2700 items represent approximately a 10-1/2 man-year effort.

b. Numerous Maintenance personnel expressed concern over this backlog and indicated that the PM program was not receiving the attention needed to correct the situation.

c. A new PM manager has been onboard less than two months.

d. Interviews with PM program personnel revealed that there is an attempt underway to identify the causes of the outstanding backlog. Scheduling difficulties appeared to be a major reason for PM activities dropped off the schedule for outage work given a higher priority, equipment not available when scheduled, or manpower limitations.

3. Recommendations

Commit to aggressively address the PM backlog and clearly communicate this commitment to all personnel. Monitor and provide immediate corrective action when PM performance slacks.

C. Work Packages

1. Concern

The quality and detail of work package preparation have resulted, at times, in inadequate work instructions being provided to Maintenance personnel.

2. Basis

a. Work Package Performance

(1) Work activity instructions did not, in all cases, provide clear delineation of the scope of work required. Interpretation of these instructions was left to the worker in the field. For example, work instructions for a diesel generator alignment, specified Maintenance Instruction, MCI-0-082-ENG014, "Standby Diesel Engine Generator Removal and Reinstallation." In performing the activity, the craftsman had to determine which steps of the instruction were applicable since none were specified.

2. Basis (continued)

(2) A review of in-process and completed MRs showed that many changes were made to work packages. There were no explanations for the changes, and the initials were difficult to decipher. The results were work packages that had changed significantly from the original. It was unclear as to who made the changes, why, and with what authorization.

(3) It was difficult to determine, in some work packages, if a change of work scope received the appropriate level of review. While changes to safety-related MRs required Quality Assurance organization (QA) review, this could not be verified to have always been performed. When reviewing a completed work package, the sequence of events, or reviews and approvals could not be easily determined.

b. Planning Performance

(1) Planning supervisors (lead planners) were not performing periodic reviews to evaluate the quality and consistency of the work packages sent to Work Control.

(2) Interviews with Planning personnel indicated a lack of thorough understanding of the planning process. There was a reluctance to specify exact work sequences since they felt the craft were knowledgeable. They preferred to keep instructions as vague as possible or to refer to a specific procedure instead of providing detailed work instructions. While training had been provided to all planning personnel, planners stated that the training focused on administrative controls and the use of procedures. There was no emphasis on the practical aspects of planning a work activity. A review of the training material by team members confirmed this.

(3) Once the work package left the planner there was no further involvement on his part unless there was a significant problem with the package. Planners stated that feedback sheets have been provided with each package issued but the sheets have been returned sporadically and inconsistently.

(4) The planners did not review completed work packages.

2. Basis (continued)

c. Procedural Deficiencies

(1) There was no guidance provided on the use of N/As other than SDSP 7.6, "Maintenance Request Tracking," Section 6.4.5, Note 1 which specifies that N/As be initialed and dated. No justification for the N/A is required. See also Section IV.C.

(2) Section 6.1.8 of SDSP 7.6 requires that all changes to MRs be made by lining through the item, writing in the change, initialing, and dating it. No reason for the change has to be provided.

(3) Procedure SDSP 7.6 did not provide sufficient administrative guidance for the maintenance planner to perform his task. Guidance for review and documentation of revisions to the work package was not specified.

3. Recommendations

a. Planning supervision should become more actively involved in the planning process by providing more effective supervisory review and oversite of planning activities.

b. The ORR Team understands that Maintenance personnel are currently revising SDSP 7.6 to provide specific guidance on the preparation and control of maintenance work packages. A possible alternative would be to create a stand alone procedure for the planning process which would supplement SDSP 7.6. Such a procedure should consider the following as a minimum:

(1) Specific job walkdown (scope) requirements including a stated reason if the job is not sighted.

(2) Instructions for the assembly and content of work packages.

(3) Guidance for the preparation review and approval of specific work instructions.

(4) Requirements for the preparation and review of changes to work instructions.

(5) Guidance for obtaining required parts and materials, and for contingency materials.

3. Recommendations (continued)

c. A sense of ownership, on the part of the planner, should be established. A change in maintenance policy, which formally involves the planner with the entire work process, should be made. The cognizant planner should be involved with the closeout review of the work package to ensure that all required activities were performed, the PMT was adequate, the scope of work did not change without appropriate review, and that all documentation is complete.

d. Review the qualification and training of personnel involved in maintenance planning. Consideration should be given to increased engineering involvement in the planning process. Enhanced training which emphasizes the technical aspects of maintenance planning, including PMT, should be provided.

D. Configuration Control

1. Concern

Some maintenance personnel were not aware of the requirements for approval of use of substitute parts when an identical part is not available.

2. Basis

a. During interviews, some craftsmen stated that they could substitute a part (e.g., a sealed for a shielded bearing), if in their judgment it was suitable for its intended service. They did not know how an approved substitution should be documented in a work package.

b. Inconsistent answers to questions regarding parts substitution were obtained from planning personnel. One stated substitution of parts in non-CSSC equipment was permitted by planners, others stated that engineering approval was needed for substitutions for both CSSC and non-CSSC equipment. None of the planners interviewed could identify any plant instructions providing the requirements for approval of parts substitution.

c. No single site instruction provides the requirements for approval of use of equal or better substitute parts.

3. Recommendations

a. Provide clear requirements for approval of substitute parts.

b. Train maintenance personnel, both planners and craftsmen, on these requirements.

E. Valve Lubrication

1. Concern

The lack of a program to ensure proper lubrication of valves could result in valve damage or failure to operate.

2. Basis

a. Numerous valves were observed without stem lubrication. Valve damage (e.g., bent hand wheels) indicate that excessive force has been applied to operate some valves.

b. Nuclear Maintenance (NM) personnel stated that neither BFN nor TVA 'corporate' documents provide requirements for lubrication of valve stems. The need for, and type of, lubrication is dependent on valve design and function. NM is currently working on a lubrication program and a standard valve manual for all sites which could address this subject.

3. Recommendation

Ensure that the NM developed lubrication program and/or the standard valve manual addresses valve stem lubrication requirements.

VI. TECHNICAL MANAGEMENT

Concerning Subsections A. and B. below, important technical information and direction to inform personnel or implement work, inspections and operations comes from many sources both internally and externally. There are processes in place to route, review, and feedback information important to the plant. There is evidence that there are inadequacies in implementing needed actions.

A. Timely Implementation of Technical Recommendations by Vendors, and Other Sources

1. Concern

Recommendations of some General Electric (GE) Service Information Letters (SILs) are not being implemented in a timely manner. Review of BFN implementation of GE SILs provided examples of important SIL recommendations not being implemented in a timely manner.

2. Basis

a. Hydraulic Control Unit Hancock Isolation Valves

(1) BFN Control Rod Drive (CRD) Hydraulic Control Units (HCUs) utilize Hancock isolation valves to allow maintenance of HCU components. These isolation valves are conventional small (one inch) gate valves. In August, 1985, GE notified Boiling Water Reactor (BWR) operators of valve failures at two BWRs. GE indicated that failures of certain valves could prevent a control rod from scramming and/or damage a CRD. At one plant a CRD failed to scram because the valve wedge had separated from the stem and prevented exhaust flow from the CRD. GE issued SIL 419 to discuss the incident and to recommend preventive maintenance measures to help prevent this type of occurrence in the future. The mechanism for the failures was attributed to intergranular stress corrosion cracking (IGSCC).

(2) GE identified this SIL as "Category 1"; an item "that could have an early impact on BWR plant availability, reliability, or safe operation." Further, GE recommended implementation at the utilities earliest convenience, but no later than three months after the SIL issue date, and that inspection results be reported to them.

2. Basis (continued)

(3) In September, 1988, a TVA nuclear overview group found that no action had been taken on this SIL (then three-years old) and recommended that BFN comply with the recommendation.

(4) Subsequently, BFN concluded and wrote the TVA Nuclear 'corporate' Nuclear Experience Review (NER) group that dye penetrant inspections would be performed on approximately 20 percent of the Unit 2 CRD HCU discharge manual isolation valves as recommended in SIL 419. The inspections were to be performed concurrently with other maintenance work on the HCU's and was expected to complete by March 24, 1989. Additional inspections of at least the SIL-recommended percentage would also be scheduled for each refueling outage.

(5) Since the mechanism of failure has been identified as IGSCC which is age dependent, and BFN is about 15 years old, BFN should be expected to have failures. And, in fact, Hancock valve failures have been documented at Browns Ferry.

(6) Each control rod drive system contains seven Hancock valves and, because of the materials of construction, are subject to intergranular stress corrosion. From discussions with personnel and document review, only three (GE value identification numbers 101, 102, and 112) of the seven valves in each CRD complex are being included in the inspection program. A failure of one of the other four valves will not cause inability to scram but can impede rod motion or cause alarm conditions which would require shutdown to repair.

(7) Contrary to the above, no valves were inspected and none were now scheduled to be inspected prior to start up.

b. Control Rod Drive System Valve Locks

(1) In February 1981, GE issued SIL 350, Control Rod Drive System (CRD) Valve Locks. GE indicated that: "CRD damage can occur if the CRD is scrammed and its scram discharge flow is blocked by an incorrectly closed Hydraulic Control Unit (HCU) maintenance valve." The SIL provided for a "Safe-Open Lock" device that when properly attached to two appropriate HCU valves would prevent valve closure and subsequent damage to the CRD.

2. Basis (continued)

(2) The ability to scram a CRD is also impaired if the CRD is scrammed and its discharge flow path is blocked by inadvertent closure of the outlet isolation valve or the scram discharge volume isolation valve. The SIL provided a method of providing greater assurance that the scram discharge flowpath is maintained open, thus minimizing the possibility of drive damage and/or impeding rod scram capability resulting from scramming against a closed discharge line.

(3) The SIL stated: "To protect both Maintenance personnel and the control rod drive from the potential high pressure of the CRD system, the Hydraulic Control Unit (HCU) maintenance procedures explicitly define the sequence in which the maintenance valves are closed to isolate the HCU as well as the sequence for reopening the maintenance valve to return the HCU to service." The SIL further states: "Removal of the damaged drive could result in a significant maintenance activity requiring removal of the vessel head and dissection of the drive parts."

(4) In December, 1982, BFN, in a reply for their action on this item responded: "The problem discussed requires no action for the following reasons:

"(a) Access is controlled to those valves since they are in a C-zone. Since the engineer must sign any special work permit for work in this area, no one is likely to perform unauthorized work on the valves.

"(b) Before startup, OI-85 requires these valves to be opened and signed off on a data sheet. Therefore, after any maintenance on the valves they are properly aligned for startup."

The BFN response missed the point of protecting against inadvertent closure of these important valves.

(5) The use of an unlocked C-zone to control a valve position is inappropriate and not adequate to secure valve positions. C-zones can be temporary. The conservative action to take would be to implement locking the valves as recommended by GE or provide a suitable equally positive alternate.

2. Basis (continued)

(6) The BFN response did not address the issue as to whether procedures at BFN explicitly incorporate the sequence in which valves are manipulated to protect personnel and CRDs from potential high pressures of the CRD system.

(7) In September, 1988, a TVA overview group brought the non-implementation of locking open these valves to BFN attention for reconsideration. However, no action was taken to lock the valves.

(8) The ORR Team notes that Grand Gulf Nuclear Station locked the valves in the open position.

c. Control Rod Drive Lay Up Procedures

(1) In August 1985, GE issued SIL 427, Control Rod Drive (CRD) Lay Up Procedures for an Extended Outage, concerning corrosion of CRDs during extended outages (greater than 28 days). GE indicated that corrosion data for nitrided XM-19 and 304 materials clearly showed that higher corrosion resulted from stagnant and creviced conditions. Consequently, GE recommended that for long-term lay up, utilities should continue normal cooling water flow and cycle the drives once per week.

(2) The SIL also provided an engineering judgment, that indicated corrosion increases if actions recommended were not implemented and that the indicated cycling was the most beneficial action to be taken.

(3) The ORR Team found that the CRDs had not been cycled on Unit 2 since core reload. This fact was brought to the attention of the Technical Support Supervisor.

3. Recommendations

a. Reevaluate the SIL recommendations noted above with regard to their accomplishment prior to restart.

b. Determine why those recommendations were not implemented in a timely manner and implement appropriate action to prevent recurrence.

c. Require system engineering to take technical responsibility for implementation of the hardware issues.

3. Recommendations (continued)

d. Review all applicable GE SILs and review other vendor recommendations concerning reactivity control, removal of core heat, and radiation containment to assure conservative analyses and actions were taken.

B. Implementation of Technical Details and Recommendations in Work Documents

1. Concern

Some work instructions do not contain important information and details needed to assure an accurate technical product.

2. Basis

a. Work Documents for Installation of Reactor Vessel Water Level Indication Modification

(1) The reference leg piping and the condensing pots of the Reactor Vessel Water Level System (RVLS) have been modified and replaced. The new installation incorporates pressure restricting orifices (PROs). They consist of a 1-inch socket blank coupling with one-quarter inch hole eccentrically located off the center of the coupling. Drawing notes require the orifice holes to be oriented ±5° off the vertical after installation and welding. The condensing pots are to be located at elevation 631'-0 ± 1/4".

(2) The two orifices located in the drywell exhaust duct are not accessible to verify post installation orientation of ±5° of vertical with full certainty. (The orientation of the orifice is important because it is an impediment to venting and a potential plug site from corrosion.)

(3) The precise location of the condensing pot is needed to establish reactor vessel water level setpoints. The work documents did not provide adequate instructions to assure proper installation nor require post installation verification.

b. Inspection Procedures for CRD Hancock Valves

(1) GE Service Information Letter, SIL 419, mentioned in Subsection A.2.a made specific recommendations to inspect the gates of manual isolation valves in the

2. Basis (continued)

CRD system. Specific areas and criteria were given. In August 1988, a BWR reported that in implementing the GE recommendation they had found deterioration of the stems which had not been previously reported. The report was disseminated via INPO Operating Experience Report (OER) 88-2838.

(2) The GE SIL states:

"(1) A liquid penetrant examination of the wedges of 10% of the [#] 112 valves during each refueling outage. Replace any wedges that show crack indications.

NOTE:

" The 112 valve is the only valve that can fail in the described mode (separation of the valve disc or wedge from the stem causing a blockage of flow) and not be detected by normal drive operation. As such, the examination sample size of 112 valves should be enlarged if crack indications are found.

"(2) A liquid penetrant examination of the wedges of the [#] 101 and 102 valves when their companion CRD is removed for maintenance. Replace any wedges that show cracks.

NOTE:

" The [#] 101 and 102 valves cannot be easily isolated from the reactor system but can be inspected when the CRD is removed for maintenance and the control rod is in the back seated position.

"(3) If higher than recommended torques are required to open a valve, then the top works of the valve should be removed at the first opportunity to determine the integrity of the stem to wedge connection. Consideration should be given to replacing the wedge even if a liquid penetrant test is negative.

2. Basis (co

NOTE:

" The above liquid penetrant inspections should be concentrated in the areas where the "L" shaped ears on the wedge project from the main portion of the wedge (See Figure 1). It is requested that these inspection results be reported to GE."

(3) Two local BFN Maintenance Instructions, MMI-7, Removal, Repair, Replacement, and Testing of Control Rod Drives - Unit 1, 2, and 3 and MCI-0-085-CRD001, Control Rod Drive Removal and Installation were modified only to state: "Initiate a Maintenance Request to perform a liquid penetrant examination of the wedges of the insert riser and withdrawal riser isolation valves for the CRD on which maintenance is to be performed."

(4) The scram discharge volume manual isolation valve, a third valve in the HCU complex, is being inspected by a valve Preventive Maintenance (PM) program. The PM implementing document simply stated: "Disassemble 20 percent sample of the scram discharge header isolation valves and perform liquid penetrant exam of wedge and stem." The PM references MMI-28, Control Rod Drive Hydraulic Control Unit Module (Repair Removal and Replacement). These instructions included a stem inspection but did not contain the important information given in the vendor recommendations.

(5) Maintenance and Systems Engineering personnel indicated that the valves would be disassembled and reassembled in accordance with MMI-51, Maintenance of CSSC/Non-CSSC Valves and Flanges. The specific details and important information given in the GE letter and the INPO OER did not exist in this instruction either.

c. RHR Pump Room Cooler

(1) In March 1989, a modification which changed out cables to the 2C RHR pump room cooler fan motor to meet Code of Federal Regulations, 10 CFR 50, Appendix R was completed. The post modification test, specified and performed by Modifications personnel per Work Plan 2123-89, was to "Verify rotation of fan is CCW". Satisfactory testing was verified by signature of a foreman and a construction engineer. The fan was subsequently found to be running backward.

2. Basis (continued)

(2) The post modification test should have been specific in direction of rotation viewed from a specified location. Retesting required as a result of disconnecting electrical connections to a rotating machine may require more than confirmation of direction of rotation. Phase current, shaft speed, terminal voltage and vibration may also need to be assessed.

(3) In interviews with Maintenance personnel it is common belief that when reconnecting leads the rotation of a 3-phase motor cannot be predicted, especially if the leads are not marked. Personnel indicated that they generally tag leads if they disconnect the leads, but when they get an unmarked motor or cables, they have no way of identifying or predicting direction of rotation. One person had heard of a phase rotation meter but said he had not used one in more than 17 years.

3. Recommendations

a. Require system engineers to account to management for the completeness of implementation of vendor recommendations or justify on a technical basis any non-compliance.

b. Incorporate the detailed SIL instructions of SIL 419 and INPO OER 88-2838 into a special maintenance instruction that ensures the performance, analysis and reporting of the inspection is properly and adequately executed.

c. Require that work documents incorporate vendor technical instructions as close to verbatim as possible once the decision is made to proceed with the vendor recommendations.

d. Provide training to personnel concerning tests of rotating electrical-driven equipment.

C. Conservative Application of Engineering Fundamentals

Safe reactor technology is founded on conservative application of engineering fundamentals. To achieve a defense in depth against release of radiation, many safety barriers are imposed between the environment and the fuel. Foremost is the need to instill keen sensitivity to the maintenance of critical safety functions and to the prevention of conditions that can lead to challenges of critical limits or safety systems. A key element is reactivity control.

1. Concern

BFN is not taking advantage of the opportunities to enhance control rod reactivity management and control rod drive system performance.

2. Basis

a. Estimated Critical Position (ECP) calculation:

(1) The ORR Team noted that BFN did not intend to calculate an Estimated Critical Position (ECP) of the control rods for the normal critical rod configuration for the next startup. (The team is aware of a predicted rod height for the Shutdown Margin Test.)

(2) A conservative approach would calculate a best estimated critical rod position for the normal rod configuration expected in the next startup as well as for any experimental configurations.

(3) There are other BWRs that calculate and predict ECP for new core initial startup. The adoption of ECP calculations would be an enhancement of reactivity control and a conservative measure to ensure there are no undetected core anomalies.

b. Rod Withdrawal Sequence

(1) The rod withdrawal sequence is developed by Reactor Engineering. The control rod sequence is provided to Operations for implementation. The same data is used to program the rod worth minimizer (RWM). If an inaccuracy exists in the rod withdrawal sequence, it will be propagated in the RWM.

(2) The ORR Team noted that a rod withdrawal sequence is not independently verified. There is no formal review documented and no endorsement of a rod withdrawal sequence by Nuclear Fuels.

c. Control Rod Drive System Impairment

Subsection A. above discussed three GE SILs which recommended actions that impact performance of the control rod drive system and hence reactivity control. These included recommendations to lock open strategic valves in the CRD system to preclude CRD damage, to inspect and repair CRD valves the failure of which could impact rod scram and on layup of the CRDs to forestall CRD corrosion and wear. In each of these issues, BFN response has not been timely.

3. Recommendations

a. To increase sensitivity to reactivity control, consider taking advantage of estimated critical rod height predictions and plotting inverse count rate curves, as criticality is approached.

b. Require independent verification of critical calculations and evolutions which effect core reactivity.

c. Instill in appropriate personnel the need to pay special attention to reactivity control systems and components. Special emphasis on shutdown capability should be given. A similar respect for core cooling and containment of radioactivity is also needed.

D. Reactor Vessel Water Level

1. Concern

The post modification tests, planned system testing, and training of personnel are not adequate to ensure proper operation of the modified reactor vessel water level (RVWL) system following startup.

2. Basis

a. Training of Personnel on Reactor Vessel Water Level Reference Leg Modification

(1) Interviews with operations personnel, and STAs indicated that there is inconsistant understanding of what the modification entailed.

(2) BFN recently completed training for operators, plant management, and STAs to enable them to more rapidly diagnose water level indication problems with emphasis on calibration of the various instruments at off-rated conditions and its effects on comparison between instruments. This was reported complete on 3/16/89. The training did not adequately cover the new installation. For example, the training information did not contain information on the theory of how pressure differential is developed that influences level indication as a function of temperature, power level, core flows and loop operator. The relationships (graphs) of actual versus indicated water level for various parameters (power, core flow, temperature, and pressure) as a result of the modification were not yet available.

2. Basis (continued)

b. Post Modification Testing (PMT)

(1) The specified post modification testing, PMT-191, Reactor Vessel Level Instrumentation, did not verify proper function of the modified reactor vessel level system. Specifically:

- The test checked that static pressure measured at a drain valve on the instrument line was within a specified tolerance at one reactor vessel water level.

- Flow through the instrument line was verified by ensuring that a specified pressure increase is not exceeded when demineralized water is pumped from the drain valve to the reactor vessel.

(2) This test merely proved that the line is unobstructed. A separate SI tests detector function. The specified PMT did not check items such as:

- Correlation of actual to indicated level. The one point check is done with the water level in the refueling cavity, above the reference legs. Therefore, an indication error due to construction location errors (e.g., condensate pot location) would not be detected. (Subsection B discusses installation issues.)

- The acceptance criteria (+1, -0 psig) equates to about 27 inches of water. Therefore, significant indication errors (e.g., due to trapped air) would not be cause for rejection. The specified accuracy of the pressure gauge was also inconsistent with the acceptance criteria.

- Because of the low flows involved (less than 1 gpm), the flow test was unlikely to detect problems with orifice or Marotta valve installation (e.g., if a Marotta valve were installed backwards). The valve is designed to close at flows greater than 1.7 gpm and 1000 psig. Even when closed it will pass 0.2 to 0.7 gpm.).

c. Prestartup and Power Ascension Testing

Technical Instruction, TI-149, Reactor Water Level Measurement, issued to check the reactor water level measurement prior to startup and during power ascension testing contained numerous deficiencies. For example:

2. Basis (continued)

(1) Precaution 4.2 stated that heatup rate should be maintained between 60° and 90° F/hr to avoid possible indicator mismatch. This is inconsistent with General Operating Instruction, 2-GOI-100-1A, Unit Startup from Cold Shutdown to Power Operation, which limits heatup to 50°F/hr below 215° and 90°F/hr (no lower limit) thereafter.

(2) Precaution 4.1 contained level mismatch limits at which control rod withdrawal must stop and corrective actions initiated.

- These limits differed from the mismatch limits permitted by Surveillance Instruction, SI-2, Instrument Checks and Observations. In general, greater mismatches were permitted by TI-149.

- Prerequisite 5.5 provided mismatch limits which differed from precaution 4.1, and, in some cases, SI-2.

- Section 7.3 required action if a mismatch occurs. It is unclear as to whether the limits of 4.1 or 5.5 would apply. Also note that SI-2 would be applicable during this test.

- Section 7.3.2 required that if a mismatch occurs the highest and lowest reading instruments be kept within scram setpoints "if possible". It was not clear why a manual scram should not be initiated if such a situation were to exist.

(3) Precaution 4.1 incorrectly listed instrument LI-3-62 (vs LI-3-62A); prerequisite 5.5 incorrectly listed instruments LI-3-203A, B, C, D (vs LIS-3-203A, B, C, D).

(4) Prerequisite 5.5 required that level indicators, LI-3-58A and 58B, agree within 10 inches. The cold startup procedure, 2-GOI-100-1A, states that these instruments normally read off scale (greater than 60 inches) when temperature is less than 212°F. It was not clear how this prerequisite would be met.

(5) SI-2 contained a note that level indicators, LI-3-52 and LI-3-62A, comparisons are not valid during single recirculation pump operation. This was not noted in TI-149.

(6) The Acceptance Criteria (section 8.0) was deficient:

2. Basis (continued)

- ° No tolerance was given for the requirement that water level be at the condensate chamber mid-plane.

- ° No mismatch criteria was given; that is, whether sections 4.1 and/or 5.5 or SI-2 apply.

(7) There was no comparison to an independent level indicator (e.g., test equipment) or between types of instruments (e.g., GEMAC to Yarway).

d. Future Testing

No documentation was available to indicate that further testing is being considered. Technical Support personnel knew of no additional testing and none, beyond TI-149 is reflected in the power ascension test program. However, one manager indicated that the testing to be performed prior to restart and during power ascension testing was still an open issue. He stated tests to show overlap with the flood up instrumentation (which was not modified), to check insulation adequacy, thermal expansion effect, etc., are being considered. He noted that one reference leg now ran through the Reactor Water Cleanup Pump Room and that the effect of ambient temperature in that room had been questioned.

3. Recommendations

a. A detailed technical review should be conducted to develop the required testing to demonstrate the ability of the RVWL system to fulfill its functions over its indicating range. This review should incorporate industry experience, such as the Plant Hatch test program. (The Team understands that testing at Plant Hatch, which varied water level over a wide range, identified system deficiencies.)

b. Personnel training should be reconducted prior to restart using lesson plans based on the modified system.

c. The root causes of the deficiencies in the test specified for this modification should be determined and corrective actions implemented. If warranted by the conclusion of this analysis, training and testing specified for other safety-related modifications should be reevaluated and corrected, as necessary.

VII. USE OF LESSONS LEARNED INFORMATION

Effective use of lessons learned information is necessary to achieve excellence. This section discusses concerns in the nuclear experience review program, in the performance of root cause determination and in utilizing information from BFN's Lookback Program.

A. Nuclear Experience Review Program

1. Concern

Nuclear experience review (NER) information was not receiving sufficient attention as part of the preparations for restart.

2. Basis

This concern was based upon several observations and personnel interviews which did not indicate the proper priority to nuclear experience review. For example:

a. Seventy-eight of the 130 open BFN NER items were late. Sixteen of those late items were classified as significant experience items by INPO.

b. The significance of the lateness of some NER items was illustrated by INPO, Significant Event Report, SER 88-017, Electrocutions and Injuries Incurred While Working Near Energized Electrical Equipment.

(1) This SER described how maintenance activities near energized electrical equipment resulted in three deaths and a number of injuries. These events demonstrated the importance of following electrical safety precautions and carefully supervising electrical work activities.

(2) This SER was transmitted to BFN Operations, Maintenance, and Industrial Safety by the BFN NER Engineer on June 8, 1988 with no action required. TVA 'corporate' NER subsequently requested a BFN response by September 30, 1988. Actions were then assigned with due dates of November 21, 1988 for Maintenance, April 14, 1989 for Operations, and May 1, 1989 for Materials. As of May 24, 1989 the actions were not complete according to NER records. This SER is on the list of significant late items which are reported weekly to BFN management.

(3) The ORR Team evaluation of the BFN clearance procedure identified concerns regarding the telephone acceptance of a clearance. The SER recommended face-to-face communication. See Section III.A for further details.

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2. Basis (continued)

c. During interviews, many operations personnel were weak on the lessons learned from the Three Mile Island (TMI) event. One licensed operator stated "that was a PWR problem." Training instructors stated that the lessons learned from TMI were last taught 3 years ago and that there was no plan to cover them as part of restart training.

d. Plant personnel were generally weak in knowledge of the lessons learned during the restart of Sequoyah Nuclear Plant (SQN). (Exceptions were that knowledge was good in the Chemistry and Radiological Control groups). The ORR Team noted that recent SQN experience on Unit 2 feedwater system problems causing trips, some of which were directly applicable to BFN, had not been entered into the NER program.

e. Training personnel had no plans for a special experience review related to startup. The Operations Superintendent intended to have experience review covered in restart training but no planning of the training had been initiated.

f. NER action items for the BFN Training organization were assigned by 'corporate' Training management at the Power Operations Training Center (POTC) not by the BFN NER group. The status of training items was not included in the BFN NER periodic status reports. As of May 31, 1989, there were 30 open items for BFN Training, none of which were late.

g. Personnel were weak on some BFN experience, e.g. the lessons learned from the 1984-1985 Unit 3 Mismatch of Reactor Water Level Indicators (License Event Report 85-006R2) were generally not well understood.

h. There were weaknesses in knowledge of significant industry experience items.

(1) Several instrument mechanics and operations personnel were unaware of problems with Rosemont transmitters.

(2) A Senior Reactor Operator did not know of a plant having a problem with bypassing the rod worth minimizer. INPO 87-015, Material For a Case Study on Control Rod Mispositioning and Reactivity Events, discussed four such events in Boiling Water Reactors (BWRs).

2. Basis (continued)

(3) A Shift Technical Advisor (STA) was unaware of the LaSalle Nuclear Power Plant power surge problem which is described in INPO SER 88-014, Scram Caused by Neutron Flux Oscillations.

i. STAs stated that they do no attend Operations meetings which discuss experience review. Their experience review is handled by required reading. Industry experience has shown that reading alone is insufficient to emphasize significant events and their lessons learned.

3. Recommendations

a. Place the necessary priority on experience review items to ensure that the backlog of late items is corrected prior to restart.

b. A special experience review should be performed for startup including past significant events and experience related specifically to startup, e.g. INPO document, Lessons Learned From Operating Experience of Startup Plants, and applicable SQN experience.

c. Strengthen the ongoing NER program by:

(1) Integrating STA personnel into experience review training along with Operations personnel.

(2) Placing greater emphasis on NER items in classroom and simulator training.

(3) Including applicable SQN experience in the NER program for BFN. Caution needs to be exercised to avoid an incorrect assumption that the PWR experience is not applicable to a BWR.

(4) More closely monitoring the status of all NER items to ensure they are maintained current.

(5) Include the status of NER items for which Training is responsible in the BFN NER periodic status reports.

B. Root Cause Determinations

1. Concern

While site management had recognized that root cause determinations needed improvement, there were certain aspects of the matter which were not receiving sufficient attention.

2. Basis

A review of some incidents and discussions with responsible individuals disclosed the following:

a. Engineered Safety Feature (ESF) Actuations needed further analysis.

(1) There has been a continuing trend of repetitive inadvertent ESF actuations.

(2) The Plant has recognized that the rate is high. Personnel were working on actions to reduce the ESF actuations.

(3) However, there has been no matrix analysis of the total set of ESF actuations to look for common causes. Industry experience has shown that a comprehensive matrix analysis of root causes and casual factors is often effective in reducing repetitive events.

b. There was insufficient coaching of personnel newly assigned to perform root cause determinations. As part of an overall move to hold line organizations more responsible and accountable, the responsibility for the performance of critiques and preliminary root cause determinations had recently been shifted to the line organizations. A check of one such critique revealed the following:

(1) The root cause for an incident, in which Maintenance personnel applied excessive nitrogen pressure to a valve operator breaking the diaphragm bonnet, was stated to be that the wrong pressure regulator was used. There was no reason stated as to why the improper regulator was used. Additionally, the action to prevent recurrence focused only on the specific task on which the error occurred. There was no evaluation for more generic implications.

(2) The corrective action was insufficient as a result of the lack of a root cause. The critique report included discussion of procedural deficiencies related to the incident which were not corrected. See Section IV.A.

(3) The critique report had been reviewed and approved by two levels of management.

2. Basis (continued)

(4) The engineer who had performed the critique/root cause evaluation believed his work was complete and correct. An interview determined that the engineer was performing only his second analysis after completing root cause training. He had not received any coaching during the performance of the root cause analyses. His understanding of the principles of root cause analysis and their application was weak.

3. Recommendations

a. For repetitive occurrence of similar problems, e.g., the ESF actuations, a matrix analysis should be performed to examine all causal factors for common cause(s).

b. Management at all levels should become more involved to ensure that root cause determinations are performed properly.

c. Newly trained personnel conducting their initial root cause analysis should do so under close coaching of an experienced analyst until proficiency is demonstrated.

C. Lookback Program

1. Concern

The operating experience obtained with various systems and equipment from the pre-1985 BFN operating period as part of the Operation Lookback Program has not been fully utilized to improve plant operations for the restart.

2. Basis

a. An Operability Review Lookback Program was initiated in August 1986 to "identify, categorize, and prioritize Unit 2 equipment problems which could significantly affect restart, operability, maintainability, or increase operator burden." Over 50 interviews of experienced operations, maintenance and support personnel were conducted, the data was entered into a data base, and some screening of interview information against other plant tracking systems was performed. The program was discontinued in October 1988 during a site organizational change.

b. On October 11, 1988, a memorandum was issued by the responsible manager which stated the "continuation of this project is in question". The memo stated that

2. Basis (continued)

approximately 150 potential deficiencies had been cataloged and addressed eight significant equipment problems identified by the program. There was no record of follow up action taken on that memorandum.

c. Technical Support, as part of preparation for Core Load, reviewed a listing of "Lookback" items which might have potential impact on that milestone but were not covered in other plant tracking systems. There were no identified plans to perform a similar review of the "Lookback" data to identify items not covered elsewhere which could affect power ascension and subsequent plant operation.

d. A Reactor Operator involved in the Lookback program implementation considered it had gleaned good data. He expressed concern that if some recurring types of problems are not corrected the plant availability will be impacted. He identified two specific concerns; however, these were determined by the ORR Team to be already scheduled for correction.

e. The termination of the program was not formally documented. A senior Operations manager did not know the program had been discontinued and was still expecting to see feedback from the program.

3. Recommendation

The computerized database developed from the "Lookback" program interviews should be reviewed to determine if any items not covered in other plant tracking programs should be further investigated or corrected for restart. Experienced Operations and Systems Engineering personnel should participate in this review.

VIII. CHEMISTRY

The Chemistry organization generally had programs in place which were improving its operations; some aspects were already near the level of proficiency desired for restart. The ORR Team concluded two areas needed additional attention.

A. Laboratory Operations

1. Concern

Chemistry analysts do not consistently demonstrate high standards of performance.

2. Basis

Observations by the ORR Team of routine chemistry sampling, preparation of samples, analyses, and sample counting showed that the programs established to monitor and improve analyst performance were not fully effective.

a. Analysts did not consistently have the procedure available or refer to it during sampling and analyses.

b. One instance was noted where samples were not marked with date and time.

c. Radiological practices were observed that may result in problems when the sample activity increases after startup.

(1) There was no surface on which to place equipment such as sample bottles, the radiation measuring instrument, the procedure, or paperwork at the radioactive liquid waste (radwaste) sample station.

(2) No frisking station was available near the radwaste sampling station.

(3) Some of the radioactive liquid was spilled outside of a beaker and onto the scales used to prepare a sample for counting. The wetted beaker was then moved to the counting chamber.

(4) The sample tubes in the radwaste sample station were not secured at the proper height. The analyst had to manually lift the tube to position the sample bottle, resulting in the potential contamination of both hands.

(5) Valves outside the radiological control boundary at the radwaste sampling station were operated with potentially contaminated gloves.

2. Basis (continued)

d. Several bothersome ("accepting the unacceptable") equipment problems were being tolerated in the analyst's routines as follows:

   (1) An automatic titrator had a semi-permanent catch basin installed under it because the stirring mechanism overflowed the beaker each time it was used. Although it was used daily, a permanent solution to the problem had not been pursued. When pointed out by the ORR team, a solution was found with little effort.

   (2) Plastic sleeves provided with the counting chambers to shim the special beakers that sit over the detector tube were shorter than the detector length. The analysts routinely taped the shims to hold them at the top of the detector. The method used to tape the shims had potential for contaminating the counting chamber. This routine was an "accepted" practice, in lieu of obtaining a permanent solution to the problem.

   (3) The item concerning the sample tubes in the radwaste sample station discussed in c.(4) above, also exemplifies this point.

e. The Chemistry Department had established a monitoring program for chemistry analysts which required each analyst to be observed weekly by the shift supervisor during a routine evolution. A complementary evaluation program was also established which required each analyst to do a monthly peer review. Review of the results of both of those monitoring programs revealed that the same types of deficiencies found by the ORR Team were being identified routinely.

3. Recommendations

Proper habits for use of procedures, questioning equipment or instrument problems, and handling radioactive samples and equipment should be firmly established before plant startup. To accomplish this, standards of performance should be improved for the chemistry analyst observation program to increase the general level of performance as follows:

a. Senior Chemistry Department participation in the analyst observation and monitoring program should be used to promote high standards and allow for the technical staff to effect improvements in equipment and procedures as well as analyst performance. Occasionally, such formal input from the 'corporate' Nuclear Chemistry staff would be useful as well.

3. <u>Recommendations</u> (continued)

b. Experts from the Radiological Control Department should be included in the program to observe the review of chemistry practices to improve the aspects of radiological control and ALARA (As Low As Reasonably Achievable) exposure reduction.

B. Post Accident Sample System (PASS)

1. <u>Concern</u>

The quality of procedures and operator training was not adequate to support proper post accident sampling performance considering the design and equipment limitations of the interim sampling system.

2. <u>Basis</u>

BFN will startup before the permanent post accident sampling system is installed. The interim post accident sampling system has design and functional limitations that make it most important to obtain these vital samples using the highest standards for radiochemistry and radiological controls performance. Therefore, the procedures and personnel performance (training) must be exemplary.

a. The Nuclear Manager's Review Group reviewed the status of NUREG 0737, Post Three Mile Island Action Plan, items in early 1989. Concerns with the PASS procedures and equipment, including the calculations for the procedures, were noted.

b. The ORR Team reviewed the PASS procedures and noted that they do not yet contain sufficient controls and information. Use has not been made of a comprehensive ALARA exposure review, nor have radiological protection measures been incorporated into the procedures to a sufficient extent. The procedures leave most aspects of radiological protection to be handled by the sample team on an and hoc basis.

c. All chemistry analysts and all Radiological Control (Radcon) technicians were expected to be trained and proficient in the use of the procedures and existing interim sampling procedures. That involved well over 100 people who had to maintain proficiency and be familiar with the aspects of PASS.

3. <u>Recommendations</u>

a. The PASS procedures should be improved to make them rigorously correct, and to treat all aspects of these critical tasks.

b. Consideration should be given to establishing small, highly trained PASS teams of Chemistry and Radiological Control Departments personnel. These teams should be available for all shifts. They should be provided with enhanced training and should be involved in procedure development.

c. The involvement of the Radiological Control organization should be increased in the PASS process, both in technical support of procedure improvement, and in the techniques for handling potentially extremely high levels of radioactivity in samples.

IX. RADIOLOGICAL CONTROL AND ENVIRONMENT

Radiological control programs are at or near the levels of proficiency and thoroughness which will support unit 2 restart. Two areas should receive additional attention; one of these, the need for a program to reduce radioactive liquid discharge to near zero, is not directly related to restart.

A. As Low As Reasonably Achieveable (ALARA) Exposure Reduction Program Enhancements

1. Concern

   Actions to minimize exposure and the spread of radioactive materials were not fully implemented.

2. Basis

   a. Although an active and broad ALARA program is established, emphasis on control of exposure at the first line (worker) level was lacking.

      (1) A program for advanced radiation worker training had been developed for all TVA plants. The BFN advanced radiation work training program is in the final draft stage.

      (2) This training program included excellent ALARA awareness principles and practices and the use of containment devices.

      (3) No schedule had been established to commence advanced radiation worker training at BFN. The selection of the persons to receive it had not been defined.

      (4) ALARA suggestions continued to originate primarily with the radiological controls personnel, indicating a general lack of ALARA awareness and emphasis throughout other BFN organizations.

   b. The use of glove bags and other containment devices to control radioactive material at the source (commonly used in industry) was not routinely practiced at BFN.

      (1) Although two jobs were recently done using containments successfully, extensive use of these principles is not practiced and is dependent on implementation of the advanced radiation worker training.

      (2) A system for testing glove bags and other containment devices using ultrasound has been set up and tested at BFN.

2. Basis (continued)

(3) Material had been gathered and the construction of training mockups for advance radiation worker training and glove bag training had been ordered.

3. Recommendation

Implement the advanced radiation worker training and the routine use of containment devices.

B. Radioactive Liquid Volume and Curie Release Minimization

1. Concern

An aggressive long-range program with appropriate goals was not established for the minimization of radioactive liquid volume and Curie release to near zero. While not related directly to the Unit 2 restart schedule, such a program would enhance BFN overall environmental posture.

2. Basis

a. Goals were established for reducing liquid radioactive waste, but a long range plan for liquid waste segregation and minimization to near zero discharge was not established.

b. There were many sources of water to the radioactive liquid waste (radwaste) system that are non-radioactive. These included cooling water streams and condensation from the atmosphere.

c. No plans or programs were established to segregate waste streams to minimize the volume of liquid designated as radioactive. This included the ground water inleakage, and other "non-radioactive" streams, which are heavy contributors to "radioactive" waste volume.

d. The monthly radioactive waste inleakage reduction report has consistently documented large discharges of water to the radwaste system due to improper equipment operation and maintenance failures and errors.

3. Recommendations

a. Establish an attitude of ALARA for liquid radioactive waste discharge.

b. Establish long-range plans and goals for near zero liquid radioactive discharge.

c. Increase the sensitivity of all plant personnel to the sources of water which ultimately contribute to radioactive waste.

X. EMERGENCY PREPAREDNESS

Two ORR Team members observed an emergency preparedness exercise conducted by BFN. High standards were lacking.

A. Standards of Performance

1. Concern

   An exercise to demonstrate emergency preparedness showed that sufficiently high standards were not set for the conduct, performance or critique.

2. Basis

   a. During observation of an emergency preparedness exercise conducted in preparation for the annual graded exercise, the ORR Team noted a number of shortcomings. The critiques and self assessments were not of a questioning, self critical nature and did not identify the following deficiencies:

      (1) Technical Support Center (TSC) and Operations Support Center (OSC) status boards were not used to full advantage. They were not kept current and data did not always have times posted.

      (2) Trending data for three changing plant parameters with elapsed time were improperly plotted on a uniformly spaced grid. These data were intended to assist the emergency response personnel in monitoring key plant parameters, but the failure to establish and use the time grid in uniform time increments negated the effectiveness of the plots.

      (3) The potential plume path was plotted in the TSC using a wind direction 32 degrees different from the posted wind direction.

      (4) Frequent briefings were not used effectively to keep participants informed. Four TSC briefings were given in 2 hours (includes initial and final statements).

      (5) Two data points from a previous exercise were still entered on the TSC offsite monitoring map at the end of the exercise.

      (6) The status of emergency response teams dispatched by the OSC director were not effectively communicated to or maintained in the TSC.

2. Basis (continued)

(7) Plant announcements were not used to frequently update all participants on the status of the event. Initial announcements were not made to inform participants when emergency response facilities were activated or who was in charge.

b. The location and rescue of the simulated victim was not timely (2 hours to locate the victim). Proper consideration was not given to the simulated high radiation area and the resulting doses that would have been received. Two rescue team members ran low on supplied air, but only one spare air bottle was immediately available.

c. Although critiques were convened immediately after the exercise, all players were not invited to participate.

d. In general, the exercise controllers did not critique the events using a high standard of performance and a questioning, conservative, critical attitude. For example, the only comment from the Control Room controller was that it went smoothly.

e. Controller and evaluator coverage was not provided for all participants; the RADCON technician in the TSC made technique errors that were not noted by the TSC evaluator for correction.

f. Log keeping and record keeping practices were not included in the critiques.

g. Status board information was not recorded for use in reconstruction of events or in critiques.

3. Recommendations

a. A higher level of performance should be used as the standard for the emergency preparedness program. It may be necessary to make use of experienced critical, observers to give perspective in the proper standards. The corporate emergency preparedness staff should maintain and uphold the high standard of performance.

b. A spirit of learning through the use of critical, conservative, and questioning self-assessment should be fostered through a system of thorough critiques. The methodology for conduct of drills and exercises should always meet NRC requirements, NUREG 0654, and INPO Good Practices.

c. Improve methodology and standards of performance used to conduct emergency preparedness exercises to maximize the benefit of the exercises as learning tools.

XI. OPERATIONAL READINESS

Many commitments related to restart have been made by BFN organizations. In addition to those of a regulatory nature to the NRC, commitments have been made to INPO and to senior site and 'corporate' Nuclear Power management. To ensure that a "BOW WAVE" of such commitments does not engulf last minute efforts near restart, more attention is essential now.

A. Operational Readiness Commitments

1. Concern

There were many commitments associated with operational readiness whose completion dates were slipping. If these readiness commitments are allowed to accumulate until just before restart, the restart momentum could impact the quality of commitment closeout and operator readiness.

2. Basis

a. The BFN Operational Readiness Program (ORP) includes 995 items in support of 411 performance objectives. The status was 38% (383 items) completed. There was a wide variance between site organizations in completing these items; some had all items completed and others had none. For example, one Material and Procurement Services (M&PS) manager stated that the evaluation plan for the M&PS ORP (consisting of some 20 performance objectives with 50 supporting items) was in "limbo," yet it was scheduled to be completed by June 23, 1989.

b. The manager who has overall site responsibility for the BFN ORP stated that he is now "shooting" for completion by August, 1989. However, detailed schedules to support that date were not yet available.

c. Of the 250 readiness related commitments in Volume 3 of the Nuclear Performance Plan only 40 were closed. The responsible manager stated that there was a prevailing attitude that there still is lots of time available. The number of other outstanding commitments to the NRC has been holding around 170.

d. At the same time in which site organizations will be closing out the operational readiness commitments described above, they will be doing many related activities: finishing physical work, closing major technical issues and other restart commitments, addressing outstanding items from the readiness review, from INPO and from the NRC. Many of these items will affect operator preparations for restart. Any "bow wave" effect could have a significant impact on Operations personnel.

2. Basis (continued)

   e. An overview of BFN operational readiness preparations by the Senior Management Assessment of Readiness Team (SMART) was described in a TVA letter to the NRC dated August 24, 1988 (RIMS A02 880824 030). The initial SMART meeting was scheduled for late August 1988. A TVA letter to the NRC dated September 20, 1988 (RIMS A02 880916 001) stated that the initial SMART meeting would be held to more closely coincide with the commencement of Unit 2 fuel loading activities. The SMART had not met.

3. Recommendations

   a. Complete the detailed scheduling of all operational readiness items in the site startup schedules (as has been initiated). Any changes anticipated to be made in the commitments should be processed as early as possible to facilitate orderly approval and to avoid an impression of last-minute changes to facilitate restart.

   b. Convene the SMART and include as regular agenda items schedule progress and the quality of commitment closure.

TVA 64 (OS-9-65) (OP-WP-5-85)

UNITED STATES GOVERNMENT

Memorandum

TENNESSEE VALLEY AUTHORITY

TO : Those listed

FROM : O. D. Kingsley, Jr., Senior Vice President, Nuclear Power, LP 6N 38A-C

DATE : April 21, 1989

SUBJECT: BROWNS FERRY NUCLEAR PLANT (BFN), UNIT 2 - NUCLEAR POWER OPERATIONAL READINESS REVIEW (ORR)

This supersedes my memorandum to Those listed dated December 23, 1988 (W00 881222 800).

As discussed with you by members of my staff, you have been selected to participate in the independent Nuclear Power ORR team for BFN unit 2. G. L. Rogers will be the team leader.

The objective of the ORR team is to review the qualification and motivation of personnel at BFN and the availability of necessary supporting resources for safe and reliable testing, operation, and maintenance of unit 2. Since most of you were involved in the ORRs at Sequoyah Nuclear Plant (SQN), I expect the use of this team to be the most efficient and effective way to conduct the BFN unit 2 review. Also, this will ensure that the work scope of the review will be essentially the same as the ORRs performed for SQN.

An organizational meeting will be held at 9 a.m. EDT on Monday, May 1, 1989, in the sixth floor conference room of Lookout Place in Chattanooga. The purpose of this meeting is to review the mission and scope of the ORR effort.

An administrative assistant will be provided by my office. The BFN site director should take timely steps to provide suitable accommodations and equipment for the team members. An experienced secretary should be provided by BFN.

D. Army, Gaithersburg, Maryland
F. N. Carlson, Idaho Falls, Idaho
P. Judd, Gaithersburg, Maryland
T. J. McGrath, LP 6N 38A-C
G. R. Mullee, BR 5S 168A-C
G. L. Rogers, LP 6N 38A-C
W. A. Spencer, Roseville, California
G. Toto, LP 6N 38A-C

CMH:CLB

cc: RIMS, MR 4N 72A-C
J. R. Bynum, LP 6N 38A-C
G. G. Campbell, POB C, Browns Ferry
S. B. Fisher, LP 5S 32E-C
C. H. Fox, Jr., LP 6N 38A-C
C. M. Hansen, LP 6N 38A-C
N. C. Kazanas, LP 5S 83E-C
F. L. Moreadith, WT 12A 12A-K
S. E. Wallace, LP 3N 75A-C
O. J. Zeringue, PAB E, Browns Ferry