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Department of Nuclear Energy
Building 130

February 5, 1993

Mr. Harold Polk
U.S. Nuclear Regulatory Commission
Mail Stop 12H26
Washington, DC 20555

Dear Mr. Polk:

Enclosed is the Brookhaven National Laboratory (BNL) input for the Check Valve Inspection conducted at the St. Lucie Nuclear Power Plants, Units 1 and 2, during the week of January 25-29, 1993.

Several concerns or unresolved items regarding the inservice testing program are presented in this report. This includes the IST Program not identifying testing for all the safety related directions and the existence of inadequate test procedures for full-stroke testing valves in accordance with Generic Letter 89-04, Position 1 and closure testing in accordance with the Code. Other areas of review where satisfactory results were obtained are also discussed.

If you have any additional questions or comments, please do not hesitate to contact me.

Very truly yours,

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BNL INPUT ON THE CHECK VALVE INSPECTION CONDUCTED AT THE ST. LUCIE NUCLEAR POWER PLANTS, UNITS 1 AND 2, DURING THE WEEK OF JANUARY 25-29, 1993

1. SUMMARY

During the week of January 25-29, 1993, a team of NRC and BNL staff conducted an inspection of the Unit 1 and 2 St. Lucie Nuclear Power Plant's Check Valve Inspection Program. This inspection was performed using Temporary Instruction TI-2515/110, "Performance of Safety Related Check Valves". The scope of work performed by the BNL technical specialist included an assessment of the following:

•The licensee's Check Valve Inspection Program documentation, control, and the qualification of personnel involved with its implementation.

•The licensee's check valve application review documentation and integration into the Check Valve Inspection Program.

•The licensee's Inservice Testing Program including the program's scope and documentation, personnel qualification, incorporation of Safety Evaluations, integration of the IST Program into the Check Valve Inspection Program, and testing methodology, as it relates to check valves.

During the inspection, the team found the Check Valve Inspection Program, including the valve application design review, to be well established and an effective means of controlling check valve degradation. Despite the lack of program documentation, the program had a number of strengths including the expanded scope of the program, establishment of a data base for 576 check valves to record maintenance histories, and the detailed maintenance procedure.

The team, however, identified a number of deficiencies and weaknesses in the IST Program. These include the following:

•The IST Program does not specify testing for all safety related functions for certain valves.

•There is no document that addresses the basis for not including all Quality Group A, B, or C safety related components in the IST Program.

•There are numerous valves that are not addressed in the Administrative Procedures, 1 and 2-0010125 and 1 and 2-0010125A, which address IST test procedures, or where the procedures referenced in the Administrative Procedures are incorrect.

•Inadequate test procedures exist for full-stroke testing valves in accordance with Generic Letter 89-04, Position 1 and closure testing in accordance with ASME Section XI.

•Licensee's testing procedures depend on subjective acceptance criteria.

2. PERSONS CONTACTED

J. Connor, Section Supervisor for Testing Code Group, Technical Support Staff
S. Mohn, IST Engineer, Technical Support Staff
G. Pustover, Mechanical Lead, Site Engineering
P. Fulford, Site Engineering Supervisor
J. Martin, Valve Specialist, Mechanical Maintenance Engineering Group
T. Sanders, Lead Valve Specialist, Mechanical Maintenance Engineering Group

3. AREAS INSPECTED

3.1 Check Valve Inspection Program

The check valve program defined by procedure GMP-01, "Check Valve Inspection Program" and documented in the Check Valve Inspection Database incorporated 576 check valves for both units. This database is approximately 80% complete and includes valve size, type, function, manufacturer, model, maintainability priority, quality group, inspection frequency, and maintenance history. The licensee's maintenance personnel described the remaining 20% as missing valve nameplate data and maintenance histories. The database, when complete, will contain maintenance reports back to 1985. A total of 28 plant systems, including the seven systems identified in INPO SOER 86-03, "Check Valve Failures or Degradation", are included in the Check Valve Inspection Database as "monitored" valves, i.e., valves for which the maintenance history is monitored. Of the 576 check valves monitored, 332 valves are scheduled for inspection at least once every ten years. This includes all the check valves in the IST program (220 check valves), valves identified during the licensee's detailed review of the seven systems identified in the SOER and the instrument air system, additional valves with a poor maintenance history and/or a high maintainability priority, and valves whose failure can significantly affect personnel safety and plant operation (e.g., extraction steam valves). Approximately 50 valves are inspected that are not in the IST Program nor were identified in the design application review of the seven SOER systems and instrument air system. Additionally, 59 of the check valves to be inspected are non-safety related. The valves' maintainability priority (1 to 5) was established based on its ability to be isolated, accessibility during operation, its affect on Technical Specification limiting

conditions of operation and affect on plant efficiency or "aesthetics." During the review of the valves which had been assigned to the Check Valve Inspection Program, the inspectors found that no formalized method existed to determine which valves should be placed into the program nor were there documented bases for all the valves that were included in the program.

Each of the inspected valves was assigned an inspection frequency based on the design application review, maintenance history, and Generic Letter 89-04, Position 2 requirements. The three valve specialists in maintenance engineering approve the completed inspection data sheets and review the results to determine adverse maintenance history trends and the need for modifying the inspection frequencies, the inspection populations, and inspection methods based on "good engineering judgement" or vendor recommendations. Additionally, the maintenance engineers are directed to initiate a modification request when repetitive or chronic problems are identified. However, no documented basis existed for determining the inspection frequencies beyond those documented in the design application review documentation and the Generic Letter. The design application review recommended near term inspection actions and inspection frequencies for selected systems. The other valves are scheduled to be inspected over a ten year period, spread evenly, such that all the valves will be inspected at least once before 1999. Each of the valves subject to inspection is initially inspected at least once every ten years. As of the date of the inspection, the licensee has only decreased the inspection intervals based on poor maintenance histories, not increased them. The feedwater pump check valves are an example where the inspection interval was shortened due to a poor maintenance history. The design application review recommended inspecting these valves "every second refueling outage," while the licensee's database requires inspecting them every refueling outage.

To date, 182 individual check valves had been inspected at both units, at least once, since the program was initiated in 1987-1988. Of these valves, the licensee estimates that approximately two-thirds were inspected solely as part of the Check Valve Inspection Program. The Check Valve Inspection Program depends entirely on disassembly and inspection. The licensee is investigating non-intrusive methods, but, no credit was given to these methods at the time of the inspection.

The inspectors reviewed the maintenance procedure GMP-01, "Check Valve Inspection Program", Revision 6. This procedure addresses each type of check valve separately (i.e., swing, tilting disc, lift/piston, duo-check and stop check valves) and provides detailed instructions for the disassembly and inspection, including measurement of critical parameters which are used for trending purposes (e.g., disc stud, hinge pin, and bore

dimensions). A strength of the program is that the inspection procedure is required to be performed any time a monitored check valve is disassembled.

Based on the above review, the inspectors concluded that the licensee was sensitive to check valve degradation and failure concerns, was actively progressing in the establishment of a check valve reliability program, and that the assigned personnel were knowledgeable and proactive. The program appeared to be dynamic in its application and capable of being improved as additional data from inspection activities, industry feedback and ongoing maintenance activities became available for input to the program.

3.2 Design Application Review

The inspectors reviewed the design application review documents prepared by the licensee's engineering department or a consultant, which were reviewed by the engineering department. These documents comprised the engineering studies conducted to select and assess some of the check valves incorporated into the Check Valve Program. The documents titled, "Check Valve Application Review," dated October 20, 1988 for both Unit 1 and 2, contained a listing of all check valves in the systems discussed in SOER 86-03 (321 valves) at the time of this inspection, and then identified from that list those check valves which were considered to be in critical applications, based on safety function, location in high-energy lines, and size (for the non-safety related valves). The critical valves were subjected to a detailed design application and maintenance history review, while the remaining valves were classified as lower priority and would be evaluated later. All safety related valves and non-safety related valves greater than 2" in high energy lines were subject to this review. Although the low priority valves had not been subject to a design application review at the time of the inspection, they are included in the database unless they have a low maintainability priority and no adverse maintenance history. Additionally, the inspectors reviewed the design application review of the Unit 1 and 2 instrument air system which was performed by the licensee in 1990 and 1991. Seven Unit 1 Quality Group B air system valves were not evaluated in 1991 and were identified for evaluation under REA SLN-88-025-12. This evaluation is scheduled to be performed August 1993. These valves are included as "monitored" valves in the Check Valve Inspection Program, but no inspections are scheduled. Two of the corresponding Unit 2 valves are inspected every 54 months and four are scheduled every 108 months (~every ten years).

Check valves were grouped in the design application review based on system, function, manufacturer, size, and valve type. A design application review, including unit walkdowns and isometric reviews, was performed for orientation and location of the valves. Calculations of minimum velocity requirements were performed for

the check valves. The calculations and design application review followed the guidance contained in EPRI NP-5479 for valve application factors, and input for valve data was obtained from available vendor information, or contacts with vendor representatives where required. A consultant prepared a computer program which calculated minimum velocity, considering upstream piping configurations and valve physical variables, and a quantitative prediction of wear and fatigue life (low, medium, high), based on the specified flowrates and their duration, the severity of disc motion and its frequency and the materials used in the hinge pin/bushing area and the disc stud. These parameters were used, in addition to the maintenance history, to determine the inspection requirements.

The design application review recommended replacement of the MSIV accumulator check valves with a valve design having a soft seating material. The licensee reported that engineering is also evaluating the feedwater pump discharge check valves and intake cooling water pump discharge check valves due to poor maintenance histories. The design application review identified these valves as problem valves, i.e., valves with a high usage and wear index and a maintenance history. Replacement of the valves was not, however, recommended in the design application review documents.

The inspectors reviewed the design application review documents against the Check Valve Inspection Database. No deficiencies were found. The inspection interval recommendations given in the design application review were, in some cases, decreased based on the valves maintenance history or maintainability priority, e.g., the feedwater check valves. The inspectors found the design application review to be a strength due to the consideration given to the factors beyond flow, location and orientation, and the evaluation of the air systems. The inspectors also reviewed the check valve database and found that its ongoing use in identifying individual valve parameters and summarizing valve maintenance history for all potential check valves was a strength.

3.3 Check Valve Inservice Testing Program

Inservice testing (IST) was being performed under the recently issued Revision 4, dated January 25, 1993, (Unit 1) and Revision 2, dated August 11, 1992, (Unit 2) of the IST program. Revision 2 of the IST Program, for both Units 1 and 2, incorporated the guidance contained in Generic Letter 89-04. The staff reviewed Unit 1's Revision 2 and transmitted a Safety Evaluation, dated February 26, 1992. The staff has not reviewed Unit 2's Revision 2 as of the date of the inspection. Revision 3 of the Unit 1 IST Program incorporated changes based on the October 17, 1990 letter from the NRC. Revision 4 incorporated changes identified during the licensee's self assessment in preparation for this inspection.

The staff's evaluation of Unit 1's Revision 3 had not been transmitted to the licensee as of the date of the inspection. Unit 2's IST Program is scheduled to be revised for the second inspection interval which begins August 8, 1993. The inspectors reviewed the licensee's current Unit 1 IST Program and verified that the anomalies, associated with check valves, identified in the February 26, 1992 Safety Evaluation were appropriately incorporated.

The inspectors reviewed selected check valves in plant systems. The reviews were conducted to verify that selected valves were properly included in the ASME Section XI IST Program; that test procedures reflected testing of all safety-related functions; that the test procedures correctly reflected valve testing requirements; and that the guidelines and issues of GL 89-04 were adequately addressed in the valve testing.

A total of 60 valves were selected for review from the main steam, feedwater and auxiliary feedwater, component cooling water, containment spray, intake cooling water, safety injection, instrument air and emergency diesel air start and fuel oil systems.

The inspectors noted a number of deficiencies relative to the IST program. For example, the Unit 1 containment spray discharge valves (V-7269 and 7270) were determined to have a safety related function in both the open and closed direction, as identified in the licensee's IST Basis Document, dated July 10, 1992. The IST Program, however, does not address the closed safety function. The licensee has proposed revising the current relief request (VR-22) to use disassembly and inspection to verify the valve's full-flow and closure capability. This deficiency will remain an open item, pending the review of the revised relief request.

The licensee's IST Basis Document provides an explanation of the valves and pumps included in the IST Program, their safety function, and required testing; and identified selected valves that are not included and the reason. The inspectors identified a number of check valves in the Check Valve Database that are categorized by the licensee as Quality Group A, B, or C, but are not included in the IST Program or the Basis Document. In the licensee's letter to the staff, L-92-224, dated August 12, 1992, the licensee provided an explanation on how the IST Program was developed. This letter states that a narrative description was prepared for each component "that "could" potentially be included in the IST program scope." The licensee provided an acceptable explanation why selected valves identified by the inspectors were not included in the IST Program, however documentation does not exist for all valves. This was noted as a weakness. The IST Program includes numerous valves that, although safety related, are not required to be designated as ASME Code Class 1, 2, or 3 in

accordance with Regulatory Guide 1.26 and are, therefore, not required to be tested in accordance with Section XI. As discussed in the Minutes to Generic Letter 89-04, the "IST Program is a reasonable vehicle to provide a periodic demonstration of the operability of pumps and valves not covered by the Code." The licensee has proposed revising the IST Program to clearly identify those components outside the scope of 10CFR50.55a and Section XI.

The inspectors reviewed selected IST test procedures. The IST periodic test procedures are contained or referenced in Administrative procedures No. 2-0010125 and 1-0010125, Schedule of Periodic Tests, Checks, and Calibrations, and 2-0010125A and 1-0010125A, Surveillance Data Sheets. The inspectors found a number of valves that are required to be tested in accordance with the IST Program that are not addressed in these procedures, for instance, the Unit 2 diesel air start valves, V-59156, 59158, 59159, 59236, 59203, 59204, 59205, 59206. These valves are tested in accordance with the diesel generator procedure, 2-2200050A. However, this procedure does not reference Section XI or the IST Program, and changes could be made without the knowledge of the IST personnel.

Additionally, the Unit 1 and 2 instrument air valves, V-18290, 18291, 18294, 18295, are not addressed in procedures 1(2)-0010125A. The instrument air valves are tested in accordance with procedures 1(2)-1300057. The licensee has agreed to revise procedures 1(2)-0010125A to address these valves. The inspectors reviewed procedures 1(2)-1300057 for their adequacy and determined that the test procedure leak tests two and three valves in series. The Unit 2 valves are categorized by the licensee as "AC" and accordingly the Code requires individual valve leakage rates be determined. The licensee has agreed to submit relief requests to address this inadequate testing procedure.

A number of valves are not tested in accordance with the procedures referenced in procedure 1(2)-0010125A. Procedure 1-0010125A references procedure OP-1300051 to test the instrument air valves V-18279 and 18289 in the closed direction. This procedure, however, requires that these valves be open. The licensee informed the inspectors that these valves are tested in accordance with procedure, OP-1300057. The Unit 1 diesel fuel oil valves, V-17214 and 17204, are required to be tested in accordance with 1-2200050A and B per procedure 1-0010125A. The inspectors reviewed this procedure and determined that this procedure does not full-stroke open the valves in accordance with the Generic Letter. The licensee provided a Letter of Instruction, LOI-T-57, Revision 1, which is used to full-stroke these valves. The licensee has agreed to revise the references to the correct procedures.

The inspectors noted that Procedure 1-0010125A has not been

revised to delete valves V-8448 and 8492 which had their internals removed per PCM 541-191. PCM 541-191 in addition to removing the internals of valves V-8448 and 8492, added valves V-8372 and 8373 to the main steam system in December 1991. The flow diagram, 8770-G-079, Sheet 1 was revised October 16, 1992 (Revision 31) to incorporate this design change. The inspectors noted the significant delay in updating this control room drawing. Additionally, the IST Program was not revised until January 25, 1993, over a year after the valves were installed. The valves have not been tested quarterly or at cold shutdowns in accordance with Section XI. A relief request, number VR-41, that proposed to disassemble and inspect these valves at refueling outages in lieu of testing the valves closed quarterly or during cold shutdowns, was recently prepared and submitted to the staff. The licensee stated that there has not been a Unit 1 refueling outage since the valves were installed. The relief request's basis states that it is impractical to test these valves with steam due to personnel safety. The relief request does not discuss the impracticality of testing these valves at cold shutdowns utilizing a medium other than steam. There are test connections in the system that would allow leakage tests. The licensee has agreed to revise the relief request to address cold shutdown testing. This deficiency will remain an open item, pending staff review of the revised relief request.

The inspectors' review of IST procedures identified a number of check valves that are not full-stroke tested in accordance with Generic Letter 89-04. Generic Letter 89-04, Position 1 states that verification that the maximum required accident condition flowrate through the valve is an acceptable full-stroke test. The Unit 1 auxiliary spray line valve, V-2431 is not full-flow tested in accordance with the Generic Letter and no relief request is included in the IST program. Procedure 1-0010125A states that the method used to verify the full-stoke is to "Initiate auxiliary spray, observe Delta T requirements and ensure proper PZR response." Additionally, the inspectors found the main steam to auxiliary feedwater pump turbine valves, V-8130 and 8163, to be verified full open by verification that the auxiliary feedwater pump meets the Section XI required pump discharge head and vibration requirements at cold shutdowns. The procedure does not require measurement of steam flow through the valve as required by the Generic Letter. Additionally, in reviewing Unit 2 relief request VR-31 for these valves, the inspectors noted that the relief request is inconsistent with the IST Program tables, which states that the full-flow test will be performed at cold shutdowns. The relief request states that the full-stroke test of valves V-8130 and 8163 will be performed at refueling outages.

The licensee's procedures were found to rely on subjective acceptance criteria. The procedures were found to contain such criteria as verify leakage "is not significant", "verify a

temperature change", "observe Delta T requirements and ensure proper PZR response". Such criteria may be interpreted differently by different individuals performing the test. Although the reverse flow closure verification does not require the determination of a leakage rate and the partial-stroke test does not require the determination of flowrate, the inspectors noted that, where practical, the licensee should make these acceptance criteria more objective, or quantifiable. This would reduce the possibility of a severely degraded valve being declared acceptable.

The emergency diesel generator and associated support systems were also reviewed to assess the degree to which safety-related skid mounted check valves were addressed in the IST Program and Check Valve Inspection Program. Selected check valves were reviewed against the list of check valves in the IST program, and no deficiencies were identified. For valves not included in the IST program, their inclusion in the Check Valve Inspection Program database was reviewed. Four non-safety related "valve assemblies" were identified in the Unit 1 diesel air start system that were not included in the check valve maintenance program database. These untagged valve assemblies contain two small check valves. The licensee agreed to provide component identification tags and add them to the check valve database.

Periodic test procedures for the component cooling and intake cooling water pumps were reviewed to determine the method for confirming the adequacy of idle pump discharge check valve function in a parallel pump situation, and no deficiencies were identified. The inspectors observed that the licensee confirmed backseating of idle pump valves by assuring that the running pump flow characteristics were not degraded and the pump is not rotating backwards The inspectors concluded that this method of backseat verification is acceptable.

3.4 Walkdown Observations

There was no check valve testing or maintenance being performed during this inspection. Walkdowns were conducted on the diesel generator air start system to assess the installed configuration of the "valve assemblies" discussed in 3.3, above.

4. DOCUMENTS REVIEWED

4.1 Flow Diagrams

8770-G-079, Sheet 1, Revision 31, Main Steam
8770-G-078, Sheet 131, Revision 11, Safety Injection
8770-G-078, Sheet 130, Safety Injection
8770-G-088, Revision 25, Containment Spray and Refueling Water
8770-G-085, Sheet 2, Revision 24, Instrument Air
2998-G-096, Sheet 1 and 2, Emergency Diesel Generator
2998-G-085, Sheet 2, Instrument Air
8770-G-080, Sheet 3, Feedwater
8770-G-082, Sheet 1, Intake Cooling Water
8770-G-083, Sheet 1, Component Cooling Water

4.2 Procedures

GMP-01, Revision 6, Check Valve Inspection Program.

Administrative Procedure No. 2-0010125, Revision 43, Schedule of Periodic Tests, Checks, and Calibrations.

Administrative Procedure No. 1-0010125, Revision 90, including Temporary Change Request TC#1-93-1, Schedule of Periodic Tests, Checks, and Calibrations.

Administrative Procedure No. 2-0010125A, Revision 31, Surveillance Data Sheets.

Administrative Procedure No. 1-0010125A, Revision 28, Surveillance Data Sheets.

Operating Procedure No. 1-1300051, Revision 16, Local Leak Rate Test.

Operating Procedure No. 1-1300057, Revision 2 including Temporary Change Request TC#1-92-96, Instrument Air Accumulator Tests.

Operating Procedure No. 2-1300057, Revision 2, Instrument Air Accumulator Tests.

Operating Procedure No. 1-0700050, Revision 39, Auxiliary Feedwater Periodic Test.

Operating Procedures No. 2-2200050A and B, Revision 3, 2A and 2B Emergency Generator Periodic Test and General Operating Instructions.

Technical Staff Department Letter of Instruction No. LOI-T-57, Revision 1, Unit 1 and 2 Diesel Oil Transfer Pump Flow Test.

4.3 Letters

JPN-PSL-90-1081, S.A. Valdes to T.E. Roberts, Check Valve Application Review (Unit 2 Instrument Air system), July 16, 1990

JPN-PSL-88-3208, S.A. Valdes to T.J. Vogan, St. Lucie Unit 2 Check Valve Application Review, October 20, 1988.

JPN-PSLP-91-0149, S.A. Valdes to T.E. Roberts, St. Lucie Unit 1 Instrument Air Check Valve Application Review, May 30, 1991.

JPN-PSL-88-3223, S.A. Valdes to T.J. Vogan, St. Lucie Unit 1 Check Valve Application Review, Revision 1, October 20, 1988.

L-92-224, D.A. Sager to USNRC, Additional Information In-service Testing Program-Revision 2, August 12, 1992.

4.4 Other Documents

Check Valve Function & Priority Report (from Check Valve Database), dated January 24, 1993.

Second Ten-Year Inservice Inspection Interval Inservice Testing Program for Pumps and Valves, St. Lucie Nuclear Power Plant Unit No. 1, JNS-PSL-203, Revision 4.

St. Lucie Unit 1 Inservice Testing Program Basis Document, Revision 0, July 10, 1992.

First Ten-Year Inservice Inspection Interval Inservice Testing Program for Pumps and Valves, St. Lucie Nuclear Power Plant Unit No. 2, JNS-PSL-204, Revision 2.

St. Lucie Unit 2 Inservice Testing Program Basis Document, Revision 0, July 10, 1992.