

UNITED STATES NUCLEAR REGULATORY COMMISSION **REGION II** 101 MARIETTA STREET, N.W., SUITE 2900 ATLANTA, GEORGIA 30323-0199

Report Nos.: 50-390/94-08 and 50-391/94-08 Tennessee Valley Authority Licensee: 6N 38A Lookout Place 1101 Market Street Chattanooga, TN 37402-2801 Docket Nos.: 50-390 and 50-391 License Nos.: CPPR-91 and CPPR-92 Facility Name: Watts Bar 1 and 2 Inspection Conducted: January 31 through February 11, 1994 Inspectors. For M. M. Glasman, Resident Inspector Signed Construction W. P. Kleinsorge, Reactor Inspector, NRC J. C. York, Resident Inspector, NRC Consultant: W. S. Marini, Pegasus, Inc. (paragraphs 7, 8, and 9) Accompanying Personnel: P. J. Rush, Intern, NRC

Approved by:

P. E. Fredrickson, Section Chief Division of Reactor Projects

SUMMARY

Scope:

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This special inspection was conducted to review and assess the licensee's implementation of the Heating, Ventilation, and Air Conditioning Duct and Duct Supports Corrective Action Program at the 75 percent implementation milestone. This inspection focused on determining whether program objectives as described in the TVA Nuclear Performance Plan, Volume 4, and the Heating, Ventilation, and Air Conditioning Duct and Duct Supports Corrective Action Program were being implemented in a satisfactory manner. Other inspection elements included a review of open items pertinent to this corrective action program and a review of the Independent Verification Plan for this corrective action program.

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Results:

Based on the review of a sample of implemented modifications, associated calculations, and a review of the licensee's verifications, the inspectors concluded that the Heating, Ventilation, and Air Conditioning Duct and Duct Supports Corrective Action Program was being successfully implemented at the 75 percent milestone. One non-cited violation was identified containing three examples of failure to follow procedures.

REPORT DETAILS

1. Persons Contacted

Licensee Employees:

*J. Christensen, Site Quality Manager

- *T. Dean, Compliance Licensing
- *W. Elliott, Engineering Manager, Nuclear Engineering
- *D. Harrison, Project Manager
- *R. Johnson, Acting Engineering Manager
- *N. Kazanas, Completion Assurance Vice President
- *D. Koehl, Technical Support Manager
- *F. Laurent, Special Projects Manager
- *B. Majors, Quality Assurance Specialist
- *D. Malone, Quality Engineering Manager
- *W. Massie, Licensing Engineer
- *R. Mays, Regulatory Licensing
- *A. McLemore, Modifications Engineering Manager
- *R. Mende, Operations Manager
- *R. Milhiser, Vice President, Ebasco
- *D. Moody, Plant Manager
- *P. Pace, Compliance Licensing Supervisor
- *J. Scalice, Site Operations Vice President
- *M. Singh, Modifications Manager
- *W. Skiba, Quality Assurance Manager
- *W. Smathers, Project Engineer, Civil
- *S. Tanner, Special Projects Manager
- *J. Adair, Lead Civil Engineer
- F. Caramante III, Technical Specialist, Corporate Office
- K. Hauser, HVAC Task Manager
- H. Stevens, Civil Engineer
- *G. Pannell, Site Licensing Manager

Other licensee employees contacted included engineers, technicians, nuclear power supervisors, and construction supervisors.

NRC Personnel:

*G. Walton, Senior Resident Inspector, Watts Bar *K. Van Doorn, Senior Resident Inspector, Watts Bar *M. Glasman, Resident Inspector, Watts Bar W. Kleinsorge, Reactor Inspector, Region II *J. York, Resident Inspector, Surry *P. Rush, Intern

NRC Consultant:

*W. Marini, Pegasus, Inc.

*Attended exit interview

Acronyms, initialisms, and abbreviations used throughout this report are listed in the last paragraph.

2. Introduction

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The purpose of this special inspection was to determine whether the HVAC Duct and Duct Supports CAP was being implemented in accordance with the requirements of the program at the 75 percent implementation milestone. This inspection also examined the independent verification of the HVAC Duct and Duct Supports CAP conducted by the licensee's QA organization.

The HVAC Duct and Duct Supports CAP was established in November 1988 to assure that safety-related HVAC duct and duct supports are structurally adequate and in compliance with design criteria and licensing requirements. This CAP was developed to address a number of design and construction-related deficiencies identified by the licensee, contractors, employee concerns, and the NRC. These issues are documented in CAQs, NRC items, VSR DRs, and 10 CFR 50.55(e) reports. The total corrective actions require field modifications to 439 HVAC supports and over 12,000 feet of duct work.

The problems identified in the CAP were as follows:

- Discrepancies in design basis;
- Design output did not envelop all design parameters;
- Installations did not comply with design output;
- Discrepancies between installations and inspection documentation.

The CAP plan identified root causes that addressed the above problems and, respectively, these were:

- Incomplete design criteria due to inadequate control and documentation of engineering judgment;
- Failure of Engineering to completely implement design criteria and to conduct adequate design reviews;
- Fragmented, unclear, or inadequate installation requirements;
- Unclear inspection requirements.

To address these problems with HVAC duct and duct support designs, procedures, installations, and inspections, the CAP plan identified the following actions:

Complete and document the design basis;



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- Update the design output documents to be consistent with the completed design basis;
- Revise construction, maintenance, and QA procedures to incorporate design output requirements;
- Develop and implement a critical case evaluation of existing installations and identify appropriate corrective actions.

At the time of this inspection, the licensee has completed the above-cited actions. Remaining work to be completed consists of implementing required modifications and resolving emergent engineering issues associated with ongoing modification activities.

3. Independent Verification Plan for Heating, Ventilation, and Air Conditioning Duct and Duct Supports Corrective Action Program Plan (TI-2512/25)

The purpose of the IVP for the HVAC Duct and Duct Supports CAP was to provide a method to identify and determine the status of the verification activities of CAP issues as primary quality activities which require verification. Administration and implementation of the IVP is described in procedure QAI-5.01, Quality Verification Process, Revision 2. Procedure QAI-5.01 requires identification of commitments and issues pertinent to the CAP. These issues are then required to be audited by QA for adequacy. Administration and implementation of the IVP is the responsibility of the site QA organization.

The inspectors performed a review of the IVP for the HVAC Duct and Duct supports CAP, PWL <u>WE</u>, Revision 2, to determine if commitments and issues identified in the HVAC Duct and Duct Supports CAP were identified and also to determine the status of verification activities of these action items. In addition, to assess the adequacy of the verification audits for the HVAC Duct and Duct Supports CAP, the inspectors reviewed three audits performed by the licensee. Results of these reviews are listed below:

a. Monitoring Reports QWB-M-90-0054 and QWB-M-90-0085

The purpose of the licensee's reviews, both completed in February 1990, was to evaluate completed critical case walkdown data packages of HVAC duct and duct supports conducted in accordance with procedure TI-2012, Heating, Ventilating, and Air-Conditioning Duct and Duct Support Critical Case Walkdowns, Revision O. Four critical case walkdown packages were reviewed for accuracy, completeness, and legibility. Two minor measurement errors and failure to identify a companion angle beyond the end points of a span were identified by the licensee and documented on COTS reports.



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NA-WB-93-0045, HVAC 75 Percent Assessment

The purpose of the licensee's assessment was to evaluate implementation and adequacy of the HVAC CAP at the 75 percent milestone. This assessment was conducted by QA from May 17 to June 4, 1993, and from August 2 to September 4, 1993. The scope of this assessment included installed modifications, reviews for agreement between field configuration and design output, and a review of interfacing areas, such as HAAUP, IIP, and DBVP. Eight team members from departments including QA, QE, QC, and NE Civil participated in this assessment. As a result of this assessment, three PERs, one FIR, and one UNSAT IR were written.

Most of the findings cited in this assessment were related to implementation of the modifications to duct work and duct supports. Some of these items and the associated CAQs are listed below:

- Conflicts between modification requirements, actual duct sizes, and design basis calculations (documented on WBPER930280, closed);
- Inadequate design basis for tie rod and stiffener requirements (documented on WBPER930146, closed);
- Rotation of a support member not reflected on design output documents (documented on WBFIR930165, open);
- Excessive rivet spacing on a duct segment (documented on WBFIR930165, open).

The inspectors also selected PER WBPER930280 for detailed technical review to determine whether the licensee was adequately addressing the identified deficiencies documented in the PER. Details of this review are discussed in paragraph 6 of this report.

The overall conclusion of assessment NA-WB-93-0045 was that general installation of HVAC hardware was acceptable. The identified hardware and documentation errors found by QA were evaluated by NE as not having design or safety significance. The NRC inspectors concurred with these assessments.

Results of these reviews were satisfactory in that the major issues and commitments listed in the HVAC Duct and Duct Supports CAP were identified as action items in the IVP. In addition, audits selected for review by the inspectors adequately addressed associated action items.

No violations or deviations were identified during this review.



4.

Review of Critical Case Determinations (TI-2512/23)

In the initial stages of implementation of the HVAC CAP, the licensee determined that a 100 percent assessment of HVAC supports, duct work, and associated hardware was required to identify construction discrepancies and record specific design parameters. This involved performance of walkthrough inspections in accordance with procedure TI-2010, Engineering Walkthrough for HVAC Duct and Duct Supports, Revision 1. Walkthrough inspections provided a database by which similar duct and duct supports could be grouped and critical (bounding) cases could be identified.

Following identification of critical cases, detailed walkdown inspections were performed per procedure TI-2012, Heating, Ventilating, and Air-Conditioning Duct and Duct Support Critical Case Walkdowns, Revision 0. These walkdowns provided input to calculations for qualification of ducts and duct supports in accordance with design criteria WB-DC-40-31.8, Seismically Qualifying Round and Rectangular Duct, Revision 7. The results of these calculations determined whether existing duct and duct supports were acceptable as-is, or whether hardware modifications would be required for acceptable configurations per the design criteria in WB-DC-40-31.8.

To determine whether the licensee was correctly implementing the walkthrough and walkdown process, and whether the process of grouping supports into critical and bounded supports was being performed correctly, the inspectors sampled data from HVAC duct and duct support walkdown and walkthrough packages. The inspectors then sampled several calculations which qualified ducts and duct supports to ensure that walkthrough and walkdown data were properly incorporated into the calculations which qualified HVAC hardware configurations. Results of these reviews are listed below.

a. TVA Walkthrough and Walkdown Inspections of HVAC Duct Supports

Walkthrough data obtained in Attachment D to procedure TI-2010, Revision O, included duct support characteristics such as overall dimensions of structural members, support anchorage, baseplate discrepancies between the typical support drawing and actual as-built support, and identification of any non-HVAC attachments to supports.

Following completion of walkthroughs, a screening process was initiated in accordance with calculation WCG-1-581, HVAC System Analysis for Critical Case Evaluations, Revision 0, to group supports into critical case and non-critical bounded duct supports. Associations between supports were based on addressing the following characteristics:

- (1) conformance to configuration of typical type;
- (2) support located on an embedded plate;
- (3) conformance to anchor plate details;



(4) variance in support member types and sizes;

- (5) existence of non-HVAC attachments to the support;
- (6) support member lengths.

Grouping HVAC supports with similar configurations enabled qualification of similar supports using a single calculation. Duct supports with markedly different characteristics from other supports were evaluated by individual calculation and were classified as unique supports. The NRC inspectors determined that all aspects necessary to adequately group duct supports were addressed in calculation WCG-1-581, Revision 0. In addition, the inspectors reviewed the process of grouping supports in calculation WCG-1-650, HVAC Support and Duct Evaluation for HVAC DWG 17W910-04, Revision 1, and determined that this calculation accounted for all critical duct support characteristics.

Following categorization into groups, critical case HVAC supports from each group were selected to represent bounding cases. Bounding case supports were of the same or similar configuration as the other supports in their respective groups. In instances where critical case supports were slightly different from the other supports, the characteristics of critical cases were such that the same loads applied to all the supports in a particular group would result in the smallest margin to failure for the critical case support. Thus, an engineering evaluation of a critical case support would bound the other supports not specifically addressed by the calculation.

Dimensional data used in qualification calculations were obtained from procedure TI-2012 walkdowns. Walkdowns were completed to accurately describe certain features of a support, such as:

- (1) weld size, location, and length;
- (2) member dimensions;
- (3) baseplate characteristics;
- (4) support anchorage (bolt size, weld dimensions, etc.);
- (5) any additional unique characteristics important to qualify the support.

Duct support loading for analysis of critical case supports was obtained from an HVAC duct system seismic analysis. A worst-case loading from all supports within a particular group was used in the critical case calculation.

The inspectors selected and reviewed seven duct supports which were bounded by a critical case to ensure that similarities between the bounded and bounding supports were valid. Walkthrough data for bounded duct supports were compared with the walkdown data for critical cases. Table 1 identifies the HVAC duct supports reviewed by the inspectors to assess the adequacy of the licensee's methodology for grouping supports into critical cases and bounded supports. Table 1: Review of Walkthrough and Walkdown Data for HVAC Supports Walkdown

Duct Support	Walkthrough Package (TI-2010)	Package (TI-2012)	
0030-DW910-04H-2897	DGB-1 0030-DW910-04H-2997	DGB-1-2997	
0030-DW910-04H-2949	DGB-1 0030-DW910-04H-2997	DGB-1-2997	
0030-DW910-04H-2951	DGB-1 0030-DW910-04H-2997	DGB-1-2997	
0030-DW910-04H-2952	DGB-1 0030-DW910-04H-2997	DGB-1-2997	
0030-DW910-04H-2954	DGB-1 0030-DW910-04H-2997	DGB-1-2997	
0030-DW910-04H-2997	DGB-1 0030-DW910-04H-2900	DGB-1-2900	
1030-DW915-03H-1646	RB-41 1030-DW915-03H-1652	1RB-41	

The inspectors' review of walkthrough and walkdown data for the supports listed above found that in all cases the critical case support structurally bounded the characteristics of the applicable supports. In addition, based on a review of the criteria listed above to group duct supports and a review of related walkthrough and walkdown data packages, the inspectors determined that the approach to bound several duct supports based on an engineering evaluation of a single critical case is acceptable.

The inspectors then selected thirteen duct supports and their respective calculations for review. For each duct support, either the walkthrough or walkdown data sheets were reviewed and compared with the input to the calculation. The inspectors examined the duct support calculations to verify that: (1) finite-element models were representative of actual duct support and baseplate geometries; (2) appropriate boundary conditions were employed in the analyses; and (3) calculations to assess weld strength addressed actual documented weld sizes on the critical case duct supports. Table 2 lists duct supports and applicable calculations reviewed by the inspectors.

Table 2: Review of HVAC Duct Support Calculations

<u>Duct Support</u>	<u>Source Data</u>	<u>Calculation</u>
1030-DW920-05H-2081	TI-2012, RO pkg AB-24-2081	WCG-1-1230, R2
1065-DW920-10H-0241	TI-2012, R0 pkg AB-33-241	WCG-1-1240, R1
1030-DW920-08H-0335	TI-2010, R1 pkg AB-28	WCG-1-1235, RO
0030-DW915-05H-2900	TI-2012, RO pkg DGB-1-2900	WCG-1-650, R1
1030-DW920-23H-2100	TI-2010, R1 pkg AB-26	WCG-1-1230, R2
1030-DW920-23H-2877	TI-2010, R1	WCG-1-1230, R2
0030-DW910-04H-2902	TI-2010, R1	WCG-1-650, R1

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pkg DGB-1 0030-DW910-04H-2920 TI-2010, R1 WCG-1-650, R1 pkg DGB-1 TI-2010, R1 0030-DW910-04H-2938 WCG-1-650, R1 pkg DGB-1 0030-DW910-04H-2956 TI-2010, R1 WCG-1-650, R1 pkg DGB-1 1030-DW920-04H-0343 TI-2010, R1 50098.01-C-003 pkg AB-18 1030-DW915-03H-1652 TI-2012, RO WCG-1-696, R2 pkg 1RB-41 TI-2010, R1 1030-DW915-03H-1653 WCG-1-696. R2 pkg RB-41

For all cases listed above, the input to the calculation properly incorporated the information from the source data packages. The inspectors did not identify any discrepancies in either the approach or the results of the calculations.

During the inspection of support calculations, the inspectors noted that walkdown package AB-33-241 for support 1065-DW920-10H-0241 did not have second-party verification and WTC acceptance signatures. Initial inspection of this support was completed on May 21, 1991. However, a note was written on the cover sheet for the walkdown package stating that required second-party verification could not be completed because scaffolding to gain access to the support was removed. The note also stated that all information within the walkdown package shall be considered preliminary.

The inspectors reviewed calculation WCG-1-1240, Revision 1, and confirmed that the unverified data from walkdown package AB-33-241 was used in the qualifying calculation. Item 11 within Section 6.0 of procedure TI-2012, Revision 0, requires two-party verification of all recorded data.

In response to the above finding, the licensee initiated PER WBPER940084 documenting lack of second-party verification for walkdown package AB-33-241. Results of the licensee's investigation documented on WBPER940084 indicated that this was an isolated occurrence, in that walkdown package AB-33-241 was the only walkdown of over 340 walkdown packages completed by the licensee found to not have received second-party verification.

The failure to obtain second-party verification for data collected in the walkdown of duct support 1065-DW920-10H-0241, walkdown package AB-33-241, is identified as the first example of NCV 50-390/94-08-01, Failure to Follow HVAC Walkdown and Duct Construction Procedures. This item is discussed further in paragraph 5.

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b. Evaluation of HVAC Duct Spans

Calculation WCG-1-581, Revision 0, outlines the process for evaluating all duct work span encompassed by the HVAC CAP. It identifies the duct characteristics which represent the postulated critical failure points during a seismic event. Size and overall dimensions of duct spans, the absence (or presence) of stiffeners, companion angles, and the number and location of rivets retaining the duct work were some of the attributes which required attention during the walkthrough of HVAC duct. In addition, the methods to perform an engineering evaluation of duct work were outlined within calculation WCG-1-581. The licensee's analysis method to qualify HVAC duct was reviewed by the inspectors and found to be acceptable.

The inspectors selected calculation WCG-1-650, Revision 1, to review the implementation of the licensee's approach for qualification of duct work. This calculation pertained to duct work in the diesel generator building. The analysis was completed to evaluate compliance with design criteria WB-DC-40-31.8, Revision 7, and the applicable sections of the FSAR. Three duct spans were identified within the calculation as not being acceptable to the design criteria. In each case, a recommendation was included in the calculation which specified a method to correct the identified problem, such as installing additional rivets or stiffeners.

The inspectors' review of calculations WCG-1-650, Revision 1, and WCG-1-581, Revision 0, found that the licensee adequately addressed and implemented an approach to qualify HVAC duct to the applicable design criteria contained in WCG-1-650 and the FSAR.

For all duct spans and supports reviewed, the qualifying documentation required for these reviews was retrievable.

Within the scope of this inspection, one example of a non-cited violation was identified.

5. Walkdown Inspection of HVAC Duct and Duct Supports (TI 2512/23)

The inspectors performed walkdown inspections of 5 critical case duct supports, 3 bounded duct supports, 3 grouped supports, 6 unique supports, and 25 duct segments to verify that as-built configurations were in accordance with the as-built drawing, typical drawing, or the alternate record. Supports examined are listed in Attachment A. Duct segments examined are listed in Attachment B.

During the inspection of these 17 supports, the inspectors compared field observations with the typical support drawings, walkthrough data and/or walkdown data. Examination attributes included member and overall support dimensions; weld size, location, and quality; fastener size, type, and location; support location; overall support configuration, overall condition, and interferences.

Relative to the inspection of HVAC duct supports, the inspectors identified the following:

- Support 1030-DW920-05H-2081

The distance from the lower flange of the WF beam to the lower base plate edge, on the lower horizontal member, was indicated as 3-11/16 inches on Section 2-2 of walkdown drawing AB-24-2081. The inspectors found that the distance was 3 inches.

The distance between the overhead base plate and the overhead embed plate was indicated as 1-1/4 inches in Section 3-3 of walkdown drawing AB-24-2081. The inspectors found that the distance was 1/4 inch.

The plate washer dimension on page 51 of DCN M-16975A was erroneously indicated as 7/8 inch in two places. The inspectors found that the actual dimension was 1-7/8 inches. The licensee attributed this to a drafting error and indicated that these errors did not have an adverse impact on the calculations. The inspectors concurred with the licensee's assessment.

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Support 1030-DW920-05H-2082

The weld details of Sections A-A and P-P, shown on pages 662 of 1303 of calculation 500098.01-C-003, are conflicting. Section A-A accurately reflects the as-built-condition (the left vertical weld shown in Section P-P does not exist). The licensee indicated that this was a drafting error and that this incorrect weld information was not used in any evaluation. The inspectors verified this by review of calculation 50098.01-C-006 for the subject support.

Sixteen blind rivets were not properly seated. The licensee indicated that due to limited clearance between the rivet gun and the support, the rivets were installed at an angle. The inspectors held discussions concerning the suitability of this installation, and the licensee indicated that the subject support and ductwork are classified as a I(L) position retention feature. The improperly seated rivets carry only shear loads; as long as the rivets are firmly in place penetrating both the support and the duct sheet metal, they can resist intended shear loads and the configuration will perform its safety function. The inspectors concurred with the licensee's assessment.

Support 1030-DW920-05H-1709

The 1/4 inch stiffener plate, shown as Pc. 3 on Page 654 of 1808 of calculation 50098.01-C-003, was found to actually be 3/8-inch plate. This plate was installed to add to the lateral strength of



a support member designed to withstand downward vertical loads, and the 3/8-inch plate was aligned with the neutral axis of this support member. Therefore, the plate did not contribute to the strength of the support in the vertical direction and therefore, the dimensional differences are not significant.

Both the upper and lower jam nuts on the vertical rod shown on page 655 of 1808 of calculation 50098.01-C-003 were loose. This appeared to be a failure on the part of the installing craftsmen to tighten these jam nuts. The licensee indicated that the subject support was old program work. A WR, No. 247273, was initiated to correct the identified deficiency. Further, the licensee is in the process of performing area walkdowns for damaged, loose, and missing hardware in accordance with procedure MAI-1.9, Walkdown Verification for Modifications System/Area Completion and Damaged, Loose, or Missing Hardware, Revision 3. Loose hardware, such as cited above, are listed as verification attributes in this procedure, therefore, the inspector had reasonable assurance that this discrepancy would have been identified and corrected by the licensee.

Support 1030-DW-920-23H-2096

The fillet weld attaching the left ring section to the lower horizontal tube steel member, shown in <u>Elevation Looking South</u> on Page 4 of 5 of walkdown package AB-28-2096, was deposited over a blind rivet. The failure to properly prepare an expected weld area, by assuring that the area was free of all foreign materials, is a poor welding practice. The licensee, however, demonstrated to the inspectors that the weld was not adversely affected.

Support 1030-DW-920-81-2167

Walkthrough package AB-26, Page 292 of 347, indicates that the anchor bolts are 3/4-inch diameter. The inspectors found that the anchor bolts were 5/8-inch diameter and found that this condition was bounded by a critical case; therefore, design allowable stress limits were not exceeded.

Support 1030-DW915-03H-1652

The walkdown package was retrieved from microfilmed records, and Page 42, which was originally written on the back of page 41, was missing. Further review revealed that the back of this page had not been microfilmed. Since the original record was still available, the licensee was able to retrieve this page. This could have ultimately resulted in a lost QA record.

Although the deviations noted above did not result in exceeding any of the design allowable stress limits or require revisions to existing calculations, they were indicative of inattention to detail. 12 - 14 daym, dwys

The inspectors conducted a walkdown inspection of 25 HVAC duct segments (See attachment B) comparing field observations with the typical support drawings, walkthrough data and/or walkdown data. Examination attributes included member and duct dimensions; rivet spacing and location; duct stiffener and companion flange installation and location; weld location and quality; fastener size, type, and location; support locations; overall duct configuration; and interferences.

Relative to the inspection of the duct sections indicated above, the inspectors noted the following:

- Drawing 47W930 Sheet 2, Duct Run Sketch No.DRSK-CB-31, Revision P, specifies that the maximum span distance for 42-inch duct is 24 inches. Contrary to the above, the maximum span distance on 42-inch Class 1 safety-related duct section 47W930-2-813 was 26-1/8 inches. After identification of this issue by the NRC, the licensee issued PER WBPER840082 to address this item. The licensee indicated that calculation WCG-1-1241-S1 was prepared for accept-as-is disposition of this stiffener spacing. This is the second example of NCV 50-390/94-08-01, and is discussed below, in this paragraph.
 - Drawing 47A055-15, Mechanical Htg. Vent & A.C. Supports Typical Support No. 15, Revision 1, specifies that blind rivets attaching duct to support shall be on 3-inch centers starting and ending 1-1/2 inches from the duct corners. Contrary to the above, the blind rivets started at approximately 1/2-inch from the duct corners. Based on the inspectors' observations, the installing craftsman failed to follow the typical drawing requirements, and the QC inspector failed to identify this condition at the time of installation. The licensee indicated that the installation of these rivets was old program work, not within the scope of the walkthrough inspection, and had no impact on the suitability of the installation. The inspectors concurred with the licensee's assessment.
 - Procedure MAI-4.3, HVAC Duct Systems, Revision 7, Page 14 of 86, paragraph 6.3.10, requires that openings in ducts be covered to exclude foreign objects. Contrary to the above, access doors were removed and not replaced on duct sections 47W930-2-819 and 47W930-2-820, and a 3/4-inch-diameter opening from an abandoned conduit connection was not covered in duct section 47W930-2-820.

After identification of these issues by the NRC, the licensee issued WRs C-250152 and C-250153 to address these items. The licensee indicated that it was not the intent of procedure MAI-4.3 to require craftsmen to cover openings in ducts during modification activities to exclude the entry of foreign objects when work stops, regardless of the duration of that stoppage. However, when the work package is completed MAI-4.3 requirements in this area apply. Also MAI-4.3 requires removal of foreign



material prior to system turnover. The inspectors determined that this practice was acceptable.

Procedure MAI-4.3, HVAC Duct Systems, Revision 7, Page 81 of 86, Attachment G, Blind Rivets for Tinner's Rivets Substitution Requirements, specifies that for tinner's rivet spacing of 6 inches < Spacing ≤ 8 inches, two blind rivets shall be installed. Contrary to the above, two examples on Category I duct section 47W930-2-818 and one example on Category I duct section 47W930-2-803 were noted, where the space between tinner's rivets was 6 inches < Spacing ≤ 8 inches, and only one blind rivet was installed. After identification of this item by the NRC, the licensee issued PER WBPER940082 to document this nonconformance. The licensee indicated that rivets would be added where necessary to correct these discrepancies. This is the third example of NCV 50-390/94-08-01, and is discussed below, in this paragraph.

The failure to obtain second-party verification in accordance with procedure TI-2012 and the failure to install a duct stiffener and rivets in accordance with procedure MAI-4.3, as discussed above, are three examples of failure to follow procedures. This is a violation of 10 CFR 50, Appendix B, Criterion V, and is identified as NCV 50-390/94-08-01, Failure to Follow HVAC Walkdown and Duct Modification Procedures. This NRC-identified violation will not be subject to enforcement action because the licensee's efforts in correcting the violation meet the criteria specified in Section VII.B of the NRC Enforcement Policy.

The inspectors found that records required to support this inspection were retrievable.

In the areas inspected, two examples of a non-cited violation were identified.

6. Review of Condition Adverse to Quality Documents

The inspectors selected two PERs, WBP890111PER and WBPER930280, for technical review. Conditions adverse to quality are to be documented in PERs or other ACPs in accordance with procedure SSP-3.06, Problem Evaluation Reports, Revision 13. The inspectors reviewed these two PERs to determine whether the licensee properly addressed the cause of the problem, the extent of condition, and the corrective action to correct and prevent recurrence of the identified problems.

a. Review of PER WBP890111PER

On October 20, 1988, large cracks were identified on HVAC duct work downstream of the Electric Board Room Air Handling Units A-A and B-A. This was documented on PER WBP890111PER. The licensee stated in the PER that the cracks were the result of excessive turbulence in the duct air flow. The turbulent flow was due to poorly configured duct layout upstream of where the cracks were



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located. As part of the corrective actions associated with the PER, the inspectors found that the duct work was in the process of being rerouted to minimize the air flow turbulence and resultant vibrations.

The inspectors held discussions with licensee engineering personnel concerning the in-process modifications, observed the progress of these modifications, and determined that rerouting of the duct work and the addition of stiffeners would minimize the potential for a recurrence of duct cracking.

Following completion of the modifications, flow measurements will be taken downstream of the rerouted duct to assess the degree of turbulence in the duct flow. Additional modifications will be required if sufficient flow is not measured. The licensee indicated that the duct configuration which induced excessive vibration and resulted in duct cracking was unique to the subject configuration.

Based on a review of the corrective actions documented on PER WBP890111PER and an inspection of in-process modifications, the inspectors determined that the licensee is adequately addressing the problem.

b.

Review of PER WBPER930280

The licensee identified three HVAC-related items outlined in PER WBPER930280. This PER was initiated as a result of Assessment NA-WB-93-0045, the 75 percent assessment of the HVAC Duct and Duct Supports CAP. Three problems were identified on this PER. The first problem stemmed from a lack of recognition that DCN P-01189-A was a prerequisite for DCN M-17049-A. This resulted in a failure to address the changes made by P-01189-A in the qualifying calculation WCG-1-696. The second item in this PER concerned apparent conflicts between DCN M-08968-B and modification requirements, actual duct sizes, and design basis calculation WCG-1-582. This may have led to problems with qualification of typical type 15 duct supports. The third item addressed the lack of engineering-approved output for coped, clipped, or notched stiffener angles with bolted corner connections.

The inspectors reviewed the corrective actions documented on the subject PER and determined that the licensee adequately addressed each problem. In addition, the inspectors reviewed revised calculation WCG-1-696 issued to resolve item 1 in the PER and determined that the corrective measures were adequately implemented. The licensee closed WBPER930280 on December 8, 1993.

Based on a review of the problems identified in the PER and an inspection of completed corrective actions, the inspectors

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determined that the licensee has adequately addressed all issues documented in the PER.

Based on the above reviews, the inspectors found that the technical issues identified on the above PERs were properly addressed and resolved in that the licensee adequately documented the identified adverse conditions, determined the extent of condition, and implemented corrective actions and recurrence controls.

No violations or deviations were identified during this review.

7. Review of CATDs (TI 2512/25)

The scope of the HVAC Duct and Supports CAP encompassed one CATD, 11103-WBN-06. This CATD identified configuration and documentation discrepancies between as-designed and as-built conditions for four supports (1030-DW920-02H-0110, 0030-DW920-01H-1804, 0030-DW920-01H-1805, and 1030-DW920-02H-0109). The inspectors reviewed the status of this CATD in the following areas:

- Did the CATD corrective action plan contain appropriate corrective measures to assure that the identified issue was corrected?
- Were design activities essentially complete?
- Have the required hardware modifications been completed and appropriately documented?
- Will the CATD, when completed, adequately resolve the original concern?

The inspectors' review of the corrective action plan found that the proposed actions appropriately characterized the issue and provided a comprehensive approach for correcting the identified deficiencies. In addition, the inspectors' review of the required actions described in the CATD revealed no incomplete design activities. However, the licensee did not yet consider this CATD complete at the time of this inspection. As explained in Section 9 of this report, this CATD and the remaining open source issues will be reviewed for closure during the 100 percent CAP inspection.

No violations or deviations were identified during this review.

8. Review of Sargent and Lundy Vertical Slice Discrepancy Reports

The scope of the HVAC Duct and Duct Supports CAP referenced 19 VSR DRs. Of these, a sample of eight DRs (174, 176, 178, 304, 305, 317, 354, and 387) that identified specific support hardware deficiencies were reviewed during this inspection. Two additional DRs (4 and 167) that identified general design criteria deficiencies were also reviewed. Note that the licensee did not consider any of the above DRs closed at the time of this inspection, but the required engineering actions were

considered complete. Also, none of the DRs are design or safety significant. Therefore, the inspectors' review, as discussed in detail below, consisted mainly of a verification of the completed engineering actions.

DRs 4 and 167 each identified a number of individual design and hardware deficiencies (30 for DR 4; 14 for DR 167). Of these, the inspectors selected for review 26 that were related to design criteria. The items selected are identified as follows: 4b, 4c, 4d, 4e, 4f, 4g, 4h, 4i, 4j, 4ki, 4kii, 4kv, 41, 4m, 4n, 4o, 4p, 167a, 167b, 167c, 167d, 167g, 167h, 167i, 167m, and 167o. Corrective actions for each deficiency were outlined in HVAC Duct and Duct Support Design Basis (TP 1) Final Report, dated January 1990 (RIMS B26910614102). As stated in that report, the required corrective actions for these items involved revisions or additions to Design Criteria Document WB-DC-40-31.8, Seismically Qualifying Round and Rectangular Duct. The inspectors' review determined that the necessary revisions or additions were appropriately incorporated into Revision 7 (dated February 26, 1990) of the design criteria document.

The licensee addressed the eight hardware-related DRs by including them within the scope of walkthrough procedure TI-2010, Engineering Walkthrough for HVAC Duct and Duct Supports, Revision 1. An as-built sketch was prepared for each support and an engineering evaluation was performed to determine whether or not hardware modifications were required. Of the eight supports involved, only support 0031-DW930-09H-0980 (DR 354) was found to need modification. DCN C-02811-A was issued to implement the modification, but the field work was not complete at the time of this inspection. All of the remaining seven supports were determined to be acceptable as-is.

The inspectors reviewed the walkdown documentation for all eight supports, field-verified that the as-built sketches for the seven use-as-is supports depicted accurate information, reviewed excerpts of the associated backup calculations, and determined that the actions taken to resolve the identified deficiencies are acceptable. Table 3 below lists the support numbers, walkthrough packages, and calculation numbers for the affected supports. The NE closure documentation packages listed in Attachment C of this report contain the above-referenced information used in the inspectors' review.

Table 3: HVAC Supports and Documentation Inspected

<u>DR #</u>	<u>Support No.</u>	Walkthrough <u>Package</u>	<u>Calculation</u>
174	0031-DW930-09H-0987	CB-3	WCG-1-1232
176	0031-DW930-09H-0992	CB-3	WCG-1-1232
178	0031-DW930-09H-1008	CB-3	WCG-1-1232
304	0031-DW930-02H-0947	CB-7	WCG-1-1238
305	0031-DW930-01H-0723	CB-11	WCG-1-582
317	0031-DW930-02H-0939	CB-7	WCG-1-1238

 354
 0031-DW930-09H-0980
 CB-3
 WCG-1-1232

 387
 0031-DW930-01H-0722
 CB-11
 WCG-1-1233

No violations or deviations were identified during this review.

9. Actions on Previous Inspection Findings (92701)

The scope of the HVAC Duct and Duct Support CAP consisted of three previous inspection findings, which are discussed in detail below.

a. (Closed) CDR 50-390/87-21, Lack of Complete Controlling Design Input Requirements

This item was previously closed by NRC in IR 50-390/92-05. Therefore, no further review is required.

 b. (Open) CDR 50-390/86-54, Deficiencies With HVAC Duct Seismic Design Criteria

(Open) VIO 50-390/87-07-01, Failure to Identify, Evaluate, and Disposition Nonconforming Conditions In Accordance With Procedure and Drawing Requirements

These two items pertain to the entire scope of the HVAC Duct and Duct Supports CAP. As reported in IR 50-390/91-26 and IR 50-390/91-29, the licensee's programmatic corrective actions and recurrence controls have been reviewed and accepted by NRC, leaving completion of the required hardware modifications as the only action remaining to be verified for closure of both of these items.

Although the licensee stated that hardware modifications associated with HVAC duct and duct supports were in excess of 50 percent complete, the inspectors found that there was not a method for bounding the population of modifications resulting from any one source issue to facilitate inspection of individual items associated with these source issues.

The licensee provided a listing of approximately 30 DCNs issued to modify/add/delete supports as a result of the total HVAC CAP effort but indicated that it was never the intention of the program to directly tie individual support modifications to a specific source issue. The licensee's approach to documenting completion of hardware modifications was that if all of the issued DCNs are complete, then the work associated with each individual source issue must be complete. Inspection of modifications associated with these items must therefore take place during the 100 percent inspection of the HVAC Duct and Supports CAP.

No violations or deviations were identified during this review.

10. Exit Interview

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The inspection scope and findings were summarized on February 11, 1994, with those persons indicated in paragraph 1. The inspectors described the areas inspected and discussed in detail the inspection results. Dissenting comments were not received from the licensee. Proprietary information is not contained in this report.

<u>Item Number</u>	<u>Status</u>	Description and Reference
390/86-54	Open	CDR - Deficiencies With HVAC Duct Seismic Design Criteria (paragraph 9.b)
390/87-07-01	Open	VIO - Failure to Identify, Evaluate, and Disposition Nonconforming Conditions in Accordance With Procedure and Drawing Requirements (paragraph 9.b)
390/94-08-01	Open	NCV - Failure to Follow HVAC Walkdown and Duct Modificatior Procedures (paragraphs 4 and 5)
390/94-08-01	Closed	NCV - Failure to Follow HVAC Walkdown and Duct Modificatior Procedures (paragraphs 4 and 5)

11. List of Acronyms and Initialisms, and Abbreviations

AC	Air Conditioning
ACP	Administrative Control Program
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
САР	Corrective Action Program
CAQ	Condition Adverse to Quality
CATD	Corrective Action Tracking Document
CDR	Construction Deficiency Report
CFR	Code of Federal Regulations
COTS	Corrected on the Spot
DBVP	Design Baseline Verification Program
DC	Design Criteria
DCN	Design Change Notice
DR	Discrepancy Report
DWG	Drawing
FIR	Finding Identification Report
FSAR	Final Šafety Analysis Report
HAAUP	Support Analysis and Update Program
Htg.	Heating

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HVAC	Heating, Ventilation, and Air Conditioning
ID	Identification
IIP	Integrated Interactions Program
IN	Information Notice
Inc.	Incorporated
IR	Inspection Report
IVP	Independent Verification Plan
MAI	Modification and Addition Instruction
NCV	Non-Cited Violation
No.	Number
NE	Nuclear Engineering
NRC	Nuclear Regulatory Commission
Pc.	Piece
PER	Problem Evaluation Report
PWL	Projects Work List
QA	Quality Assurance
QAI	Quality Administrative Instruction
QC	Quality Control
QE	Quality Engineering
RIMS	Records Information Management System
SSP	Site Standard Practice
TI	Technical Instruction
TVA	Tennessee Valley Authority
UNSAT	Unsatisfactory
VENT	Ventilation
VIO	Violation
VSR	Vertical Slice Review
WBN	Watts Bar Nuclear Plant
WF	Wide Flange
WTC	Walkdown Team Coordinator



	HVAC Supports Inspected					
Support No.	Type (Critical Case. Unique, Grouped Bounded)	Typical Drawing	Style	Drawings Used for Field Inspections	Comments	
1030-DW920- 05H-2081	Unique calculation Contained in WCG-1-1230	47A055-189	2 Rectangular Ducts Cantilever Frame	AB-24-2081 Detailed Walk-Down DCN M-16975-A	Dimensional deviations were noted between the support and its supporting documentation. The dimensional differences do not affect structural adequacy. See Para. 5.	
1030-DW920- 05H-2082	CAT I(L) Field Walk-Through Evaluation 50098.01-C-00 6	47A055-173	Rectangular Duct Multiple-Brac Cantilever Frame	AB-24 Walk-through	A drafting error was identified in the walk-through package. Problem was noted with riveting. Structural adequacy was not affected. See paragraph 5.	
1030-DW920- 05H-1709	CAT I(L) Field Walk-Through Evaluation 50098.01-C-00 6	47A055-095	Rectangular Duct Trapeze Rod Support	AB-24 Walk-through	Discrepancy with stiffener plate thickness in the walk-through package, two jam nuts loose. See paragraph 5.	
1030-DW920- 23H-2095	Bounded by 2030-DW920-28 H2157 Contained in WCG-1-1230	47A055-188	Round Duct Multiple-Brac ed Cantilever Frame	AB-26-2095 Detailed Walk-Down		



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	HVAC Supports Inspected							
Support No.	Type (Critical Case. Unique, Grouped Bounded)	Typical Drawing	Style	Drawings Used for Field Inspections	Comments			
2030-DW920- 28H-2157	Bounding Of 1030-DW920-23 H-2095 Contained in WCG-1-1240	47A055-212	Round Duct Multiple-Brac ed Cantilever Frame	AB-33-2157 Detailed Walk-Down				
0031-DW930- 04H-1092	Unique Support	47A055-205	Rectangular Duct Cantilever Frame	CB-10-1092 Detailed Walk- Down				
0031-DW930- 04H-1093	Unique Support	47A055-205	Rectangular Duct Cantilever Frame	CB-10-1093 Detailed Walk- Down				
1030-DW920-	Grouped With:	47A055-081	Round Duct	AB-26-2096	Welded over a rivet			

2030-DW920- 28H-2157	Bounding Of 1030-DW920-23 H-2095 Contained in WCG-1-1240	47A055-212	Round Duct Multiple-Brac ed Cantilever Frame	AB-33-2157 Detailed Walk-Down	
0031-DW930- 04H-1092	Unique Support	47A055-205	Rectangular Duct Cantilever Frame	CB-10-1092 Detailed Walk- Down	
0031-DW930- 04H-1093	Unique Support	47A055-205	Rectangular Duct Cantilever Frame	CB-10-1093 Detailed Walk- Down	
1030-DW920- 23H-2096	Grouped With: 2030-DW920-23 H-2163 2030-DW920-23 H-2167 Contained in WCG-1-1230	47A055-081	Round Duct Cantilever Frame	AB-26-2096 Detailed Walk-Down	Welded over a rivet. Structural adequacy was not affected. See paragraph 5.
2030-DW920- 23H-2163	Grouped With: 1030-DW920-23 H-2096 2030-DW920-23 H-2167 Contained in WCG-1-1230	47A055-081	Round Duct Cantilever Frame	AB-26-2163 Detailed Walk-Down	



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	HVAC Supports Inspected					
Support No.	Type (Critical Case. Unique, Grouped Bounded)	Typical Drawing	Style	Drawings Used for Field Inspections	Conments	
2030-DW920- 23H-2167	Grouped With: 1030-DW920-23 H-2096 2030-DW920-23 H-2163 Contained in WCG-1-1230	47A055-081	Round Duct Cantilever Frame	AB-26-2167 Detailed Walk-Down	Walk-through documentation erroneously over stated the support anchor bolt size as 3/4" vice 5/8". Structural adequacy was not affected.	
1030-DW915- 03H-1645	Bounded by 1030-DW915-03 H-1652 Contained in WCG-1-1230	TYP.DWG. 47A055-100 (Ref)	Rectangular Duct Cantilever Frame	DCN-M-17049-A DCAs-M-17049-01, 16,22,24,29 F-24143-A F-24275-A F-23328-A		
1030-DW915- 03H-1646	Bounded by 1030-DW915-03 H-1652 Contained in WCG-1-1230	TYP.DWG. 47A055-100 (Ref)	Braced Rectangular Duct Cantilever Frame	DCN-M-17049-A DCAs-M-17049-01, 12,13,14,15,16, 29 F-24143-A F-23328-A		
1030-DW915- 03H-1652	Critical Case Contained in WCG-1-1230	TYP.DWG. 47A055-101 (Ref)	Braced Rectangular Duct Cantilever Frame	1RB-41 DCN-M-17049-A DCAs-M-17049-01, 17, 18, 20, 21, 29	Back page of record was not microfilmed. See paragraph 5.	



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HVAC Supports Inspected						
Support No.	Type (Critical Case. Unique, Grouped Bounded)	Typical Drawing	Style 、	Drawings Used for Field Inspections	Comments	
1030-DW915- 05H-1684	Critical Case Contained in WCG-1-703	TYP.DWG. 47A055-85 (Ref)	Rectangular Duct Tube Steel Box Frame Cantilever	1RB-43		
1030-DW915- 05H-1685	Critical Case Contained in WCG-1-703	TYP.DWG. 47A055-118 (Ref)	Round Duct Wide Flange Box Frame Cantilever	1RB-39 DCN-M-17525-A DCAs-M-17525-01, 02,03 F-23410-A		
1030-DW915- 05H-1687	Critical Case Contained in WCG-1-703	TYP.DWG. 47A055-120 (Ref)	Rectangular Duct Tube Steel L-Shape Cantilever	1RB-43		
1030-DW915- 03H-4517	Contained in WCG-1-695	TYP.DWG. 47A055-75 (Ref)	Rectangular Duct Cantilever Frame	DCN-M-17367-A DCAs-M-17307-02, 05 F-24116-A F-23512-A		

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Attachment B	
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Duct Segments Examined

_	Segment I	D Drawing	Comments
	803	47W930 Sheet 2	Rivet spacing violation one example
	807	47W930 Sheet 2	
	808	47W930 Sheet 2	
	809	47W930 Sheet 2	
	810	47W930 Sheet 2	
	811	47W930 Sheet 2	
	813	47W930 Sheet 2	Stiffener span violation
	818	47W930 Sheet 2	Rivet spacing violation two examples
	819	47W930 Sheet 2	Access door left off
	820	47W930 Sheet 2	Access door left off Abandoned electrical penetration hole not sealed with temporary cover
	821	47W930 Sheet 2	
	822	47W930 Sheet 2	
	823	47W930 Sheet 2	,
	824	47W930 Sheet 2	
	825	47W930 Sheet 2	
	826	47W930 Sheet 2	
	164	47W915-03	
	166	47W915-03	
	169	47W915-03	
	171	47W915-03	
	143	47W915-03	
	146	47W915-03	
	150	47W915-03	
	151	47W915-03	

Attachment C

Documents and Calculations Reviewed

Documents Reviewed:

1. Procedures

2 1 2

MAI-4.3, HVAC Duct Systems, Revision 7

MAI-5.1A, Expansion Shell Anchors (SSD) Installation, Revision 2

MAI-5.1B, Wedge Bolt (WB) Anchor Installation, Revision 12

MAI-5.1C, Undercut (UC) Anchor Installation, Revision 7

MAI-5.4, Concrete Removal, Repair, Grouting, and Dry Packing, Revision 5

G-32, Bolt Anchors Set in Hardened Concrete, Revision 16

G-51, Requirements for Grouting and Dry Packing of Baseplates and Joints During Construction, Modifications and Maintenance, Revision 4

G-53 ASME Section III and Non-ASME Section III (Including AISC, ANSI/ASME B31.1 and ANSI B31.5) Bolting Material, Revision 7

NEP-3.1, Calculations, Revision 2

Design Criteria WB-DC-40-31.8, Seismically Qualifying Round And Rectangular Duct, Revision 7, dated February 26, 1990

TI-2010, Engineering Walkthrough for HVAC Duct and Duct Supports, Revision 1.

TI-2012, Heating, Ventilating, and Air-Conditioning Duct and Duct Support Critical Case Walkdowns, Revision O

2. Calculations

50098.01-C-003, Category I(L) HVAC Ducting and Supports - Walkthrough Data and Screening Evaluation, Revision 0, dated December 7, 1992 (RIMS B18921207153)(Pages 48, 49, 50, 55, 197, 198, and 211 of 1808)

WCG-1-581, Revision O, HVAC System Analysis for Critical Case Evaluations

WCG-1-650, Revision 1, HVAC Support & Duct Evaluation for HVAC DWG 17W910-04

Attachment C

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Documents and Calculations Reviewed (Continued)

3. Other Documents

HVAC Duct and Duct Support Design Basis, (TP 1), Final Report, Revision 0, dated January 1990 (RIMS B26910614102)

NE Closure Documentation for VSR DR-174 (RIMS T30930209906) NE Closure Documentation for VSR DR-176 (RIMS T30930209905) NE Closure Documentation for VSR DR-178 (RIMS T30930209904) NE Closure Documentation for VSR DR-304 (RIMS T30930209903) NE Closure Documentation for VSR DR-305 (RIMS T30930209907) NE Closure Documentation for VSR DR-317 (RIMS T30930209902) NE Closure Documentation for VSR DR-317 (RIMS T30930209902) NE Closure Documentation for VSR DR-354 (RIMS T30930209900) NE Closure Documentation for VSR DR-354 (RIMS T30930209900)