



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

September 28, 2006

Mr. Tom Rassau, Managing Director  
ABB, Incorporated  
Circuit Breaker Technology Solutions  
2300 Mechanicsville Road  
Florence, SC 29501

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION INSPECTION REPORT  
99901256/2006-201

Dear Mr. Rassau:

On September 18-21, 2006, an inspection team from the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection at your ABB, Incorporated (ABB) facility in Florence, South Carolina. The NRC team reviewed selected portions of your quality assurance program (QAP) and its implementation as it relates to your safety-related QAP controls on circuit breakers manufactured at this facility. At the conclusion of the inspection on September 21, 2006, Mr. Mark Lintz of my staff held an exit meeting to discuss the team's findings with you and your staff.

This was a limited scope inspection which focused on assessing your compliance with the provisions of Part 21 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 21), "Reporting of Defects and Noncompliance," and selected portions of 10 CFR Part 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," as it related to the manufacture of metal-clad low voltage and medium voltage circuit breakers. This NRC inspection report is not intended to endorse or approve your overall quality assurance or your 10 CFR Part 21 program. This inspection consisted of an examination of procedures and representative records, interviews with personnel, and work in process observations by the NRC inspection team.

During this inspection, the team observed that the ABB QAP was adequately documented and implemented in the areas reviewed. Based upon the limited review of records and discussions with ABB personnel, the inspection team concluded that the controls in ABB's 10 CFR Part 21 program and related QAP activities appeared to be acceptable. However, one weakness was identified regarding implementation of your quality assurance program. This weakness was associated with 10 CFR Part 50, Appendix B, Criterion X, "Inspection." The areas examined during the inspection are discussed in detail in the enclosed report.

In accordance with §2.390, "Public inspections, exemptions, requests for withholding," of 10 CFR 2, "Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders," a copy of this letter will be made available electronically for public inspection in the NRC Public

Mr. T. Rassau

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Document Room (PDR) or from the NRC's document system (ADAMS), accessible from the NRC Web site at <<http://www.nrc.gov/reading-rm/adams.html>>.

Sincerely,

***(/RA by E. Imbro for M. Mayfield)***

Michael E. Mayfield, Director  
Division of Engineering  
Office of Nuclear Reactor Regulation

Docket No. 99901256

Enclosure: Inspection Report 99901256/2006-201

Mr. T. Rassau

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Sincerely,

*(/RA by E. Imbro for M. Mayfield)*

Michael E. Mayfield, Director  
Division of Engineering  
Office of Nuclear Reactor Regulation

Docket No. 99901256

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**U.S. NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION  
DIVISION OF ENGINEERING**

**VENDOR INSPECTION REPORT**

Report No: 99901256/2006-201

Organization: ABB Incorporated  
Circuit Breaker Technology Solutions  
2300 Mechanicsville Road  
Florence, SC 29501

Vendor Contact: Terence Malloy  
Quality Assurance Manager  
(843) 665-4144

Nuclear Industry Activity: ABB manufactures low-voltage metal clad and medium voltage circuit breakers. These were originally designed and manufactured by ITE Corporation. ITE was purchased by Gould, Incorporated and later sold to Brown Boveri Company (BBC), Switzerland. BBC was later bought by ASEA from Sweden and became known as ABB.

Inspection Dates: September 18-21, 2006

Inspection Team Leader: Kamal Naidu, NRR/DE/EQVB

Inspector: Mark Lintz, NRR/DE/EQVB

Approved By: *(/RA by H. Hamzehee)* **09/28/06**  
Hossein Hamzehee, Chief  
Quality & Vendor Branch B  
Division of Engineering  
Office of Nuclear Reactor Regulation  
Date

**ENCLOSURE**

## **1.0 INSPECTION SUMMARY**

On September 18 - 21, 2006, U.S. Nuclear regulatory Commission (NRC) inspectors conducted an inspection at the ABB facility in Florence, SC. The inspection was performed to review selected portions of ABB's quality assurance and 10 CFR Part 21 programs. The NRC inspection bases were:

- 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," and
- 10 CFR Part 21, "Reporting of defects and Noncompliance." (Part 21)

During this inspection, no violations or nonconformances of NRC regulations were identified. However, one weakness, Observation 99901256/201-1, with multiple examples was identified and is discussed herein.

## **2.0 STATUS OF PREVIOUS INSPECTION FINDINGS**

The last NRC inspection at this facility was conducted in 1999.

## **3.0 INSPECTION FINDINGS AND OTHER COMMENTS**

### **3.1 10 CFR PART 21 PROGRAM**

#### **a. Inspection Scope**

To verify that ABB posted its procedures and information related to Part 21 at conspicuous locations, and whether selected ABB Quality Assurance (QA) personnel were trained in these procedures.

#### **b. Observations and Findings**

During this inspection, the NRC inspectors observed that copies of the Part 21 program documentation and implementing procedures, had been posted at one conspicuous location in the factory. During conversations with the QA personnel, the NRC inspectors determined that they were knowledgeable in the requirements of Part 21 reporting requirements, and they had been given training in the related procedures that ABB had developed.

#### **c. Conclusions**

ABB posted its procedures and related information in a conspicuous location at the Florence facility. Through interviews with the two QA personnel, and by reviewing training records of key ABB personnel, the NRC inspectors determined that in general key ABB personnel were knowledgeable in the Part 21 requirements. The NRC inspectors did not identify any adverse findings in this area.

### **3.2 REVIEW OF DESIGN CONTROL**

#### **a. Inspection Scope**

To verify that ABB implemented its QA program to satisfy Criterion III of 10 CFR 50, Appendix B, the NRC inspectors reviewed the ABB procedure and selected several drawings, verified if the drawings were current, and verified if any design changes were controlled in the same way as the original design drawings were approved and controlled.

#### **b. Observations and Findings**

Section 3, Design Control, dated June 7, 2006, of the ABB QA program, discusses the design process by defining the standard procedure and practices that ABB uses in the design and development process. The control requires design changes to be identified, documented, verified, and approved by engineering before it is implemented in production. The NRC inspectors reviewed a sample of drawings to verify if they were current, and whether revisions underwent the same review process as the original drawings, for example:

- Drawing D187917, Revision 34, dated July 14, 1977 (original manufacturer of ITE Equipment) Lower Frame Assembly, 5HK Spring Breaker.
- Drawing D187917, Revision 34, dated July 14, 1977 for Lower Frame Assembly, 5HK Circuit Breaker.
- Drawing 199197, Revision 6, dated February 24, 1969, for the Lower Frame Top Sheet for a 5HK 150-250-350 mVA Circuit Breaker.
- Drawing 187895, Revision 11, dated May 28, 1959, for the Jackshaft supports, item 8 - 1878 5-A, left hand side and item 10 - 187895-B right hand side.
- Drawing 701496 Revision 9, dated January 11, 1957, Arc Chute Retainer

#### **c. Conclusions**

The NRC inspectors determined that the drawings currently used by ABB were designed by ITE, the original designer and manufacturer of the 480-Volt metal-clad and 5-kV circuit breakers. The drawings were drawn, verified, and approved by different individuals. The NRC inspectors did not identify any adverse findings in this area.

### **3.3 REVIEW OF PROCUREMENT DOCUMENT CONTROL**

#### **a. Inspection Scope**

To verify the implementation of the ABB QA program related to Criterion IV, "Procurement Document Control," of 10 CFR 50, Appendix B, by reviewing the records to determine if ABB purchased items required for the manufacture of circuit breakers from the material specified in the relevant design drawings.

#### **b. Observations and Findings**

Section 4, Procurement Document Control, of the ABB QA program, dated February 10, 2005, discusses the ABB 10 CFR 50, Appendix B, system for procurement document control. The

NRC inspectors reviewed the material specified in selected drawings and verified that the materials specified were the same that were being purchased.

As an example, the NRC inspectors identified the material specified in selected drawings, and subsequently verified that the same material was specified in ABB purchase orders (POs) to its material suppliers. For example:

- Drawing 199197, Lower Frame for a 5HK 150-250-350 mVA circuit breaker, Revision 6, dated February 24, 1969.
- Drawing 187895, Revision 11, Left Hand Side Support for a jackshaft support, dated May 28, 1959.
- Drawing 708131, Revision 3, Arc Chute Retainer (red poly) for K-800 circuit breakers, dated February 23, 1996.
- Drawing 708131, Revision 3, Closing Springs for K-line circuit breakers, February 23, 1996.
- Drawing 187917, Revision 34, Lower Frame Assembly, 5HK Circuit Breaker, dated July 14, 1977.

c. Conclusions

The NRC inspectors determined that ABB specified the quality requirements of the material used to manufacture circuit breakers in the procurement documents by referencing the design drawing in the POs. The NRC inspectors did not identify any adverse findings in this area.

### **3.4 REVIEW OF CONTROL OF PURCHASED MATERIAL, EQUIPMENT, AND SERVICES**

a. Inspection Scope

The NRC inspectors reviewed the POs that ABB issued to various material suppliers (vendors) to determine whether ABB purchased the material specified in the drawings used to assemble the circuit breakers from vendors listed in either its Approved Vendors List (AVL) or its Nuclear Approved Vendors List (NAVL), and verified that the material met the requirements specified in its POs by requiring certified material test reports (CMTRs) and other documentary evidence.

b. Observations and Findings

Section 7 of the ABB QA Manual, "Control of Purchased Material, Equipment, and Services," Revision 0, dated February 10, 2005, discusses its system to control purchased material, equipment, and services. The NRC inspectors verified the implementation of this procedure by reviewing POs that ABB issued to its suppliers for the procurement of various material and components. For example:

- PO PF 31761, dated July 17, 2006, to a Charlotte, NC vendor for the purchase of 9000 pounds of steel.
- PO PF31898, dated August 15, 2006, to a Lancaster, SC vendor for several sheets of steel.
- PO PF 32035, dated August 18, 2006, to a Smithfield, Pennsylvania vendor for arc chute retainers.

c. Conclusions

The NRC inspectors determined that the reviewed POs reflected the requirements specified in the respective design drawings, and required the vendor to provide documents to confirm that the material conformed to the specified requirements. The NRC inspectors determined that even though ABB purchased C-1010 flat metal stock from a vendor, it did not periodically verify the existence of CMTRs at the vendor's premises because the vendor was on ABB's AVL. During the NRC inspection, the ABB QA manager inquired about CMTRs and was assured by the vendor that CMTRs were available for the C-1010 material supplied. In the future, ABB plans to perform audits at vendor facilities to verify the existence of CMTRs for materials supplied. The NRC inspectors determined that ABB purchased material from vendors listed on their AVL and NAVL. The NRC inspectors did not identify any adverse findings in this area.

### **3.5 INSPECTIONS**

a. Inspection Scope

To verify that ABB has a program of inspections for activities affecting quality to verify conformance with documented instructions and drawings for accomplishing the activity such as measures to control receipt inspections of purchased material and commercial-grade dedication.

b. Observations and Findings

(i) Receipt Inspections

QAP Section 10, Inspection, of the ABB QA Program discusses ABB's 10 CFR 50, Appendix B, system for controlling the receipt inspection. The NRC inspectors verified the implementation of this criteria by observing the receipt inspections that were being performed on September 19 and 20, 2006, on the following components.

(a) The NRC inspectors observed that closing springs for K-line 480-Volt circuit breakers had been receipt inspected. These springs are shown on Drawing 708131, and are purchased with the lower and upper spring eyes. ABB Engineering specified certain attributes to verify during receipt inspection. The receipt inspection record indicated that the values of these attributes were verified and that the springs were acceptable.

(b) The ABB receipt inspector had inspected and accepted "No OX-ID" type grease based on the results of a certificate from an approved testing laboratory. A vendor supplied a "special" grease in a one-pint can. ABB supplied the laboratory with a sample of this grease for chemical analysis. Based on a certificate from the lab that the grease had been tested and had been determined to meet the requirements, ASTM Standard D4048 for copper corrosion, the grease was determined to be acceptable.



(c) ABB issued PO PF 31761, dated July 17, 2006, for the supply of 9000 pounds of C-1010 steel. The receipt inspector measured the dimensions of the plate at several locations and determined them to be acceptable. ABB had inspected the supplier and had initially verified that the supplier had the CMTRs for the C-1010 metal supplied, and had placed the vendor on its AVL. ABB did not consider verifying its validity periodically. The QA engineers informed the NRC inspectors that, in the future, ABB will verify that the supplier had retained the CMTRs for the metal.

(d) ABB issued PO PF31898, dated August 15, 2006, for the supply of six sheets of steel. ABB provided the vendor with Drawing 199197, Revision 6, dated February 24, 1969, along with the initial PO. All the dimensions, including manufacturing tolerances, are provided on this drawing. Receipt inspections verified that the piece part met the dimensions specified in the drawing by using a template, and accepted the consignment.

(ii) Commercial Grade Dedication

ABB Engineering provided a specific number of dimensions to verify as the critical characteristics for QA to verify during receipt inspections. During receipt inspections, the NRC inspectors determined on a sample basis that each of the critical dimensions were verified.

(a) QAP Section 23, of the ABB QA Program, "Nuclear Safety-Related Dedication Program," Revision 0, dated September 14, 2006, discusses ABB's Part 21 system for commercial grade dedication. The NRC inspectors verified the implementation of this criteria by either observing or reviewing the documents related to the dedication of grease, a lower frame top sheet, arc chutes retainers, springs, and a lower case molding.

(b) The NRC inspectors observed that ABB inspectors document the results of the attributes verified on an inspection sheet that simply lists the values of the inspection but does not mention the specific characteristics that engineering specified. During the review of a dedication document for a spring, an auditor has to assume the overall length of the spring, the outside diameter of the spring, the diameter of the spring, and its elongation with a known load were being measured, because the specific critical characteristics that engineering specified were not being written on the inspection document. The NRC inspectors identified this item as Example 1 of an Observation to the ABB QA manager that, if the specific critical characteristics are identified in the dedication document, such a record would be readily auditable, and it would also help the ABB inspector who is performing the dedication to readily discern which attribute identified in the drawing he is verifying. Further, it would help ensure that ABB inspectors would perform the dedication to identify any errors, if they exist, as discussed in Observation Example 2.

In Example 2, the ABB inspector found one critical characteristic on a part card that he could not locate on the drawing. Eventually, the ABB inspector went to the cognizant engineer, who told him that the critical characteristic entry was

an error that should have been deleted from the part card when a second entry was added, about two years previously; thus, the ABB inspector allegedly verified this non-existent critical characteristic over a period of about two years. The ABB inspector then opened an ABB Non-Conformance Report in order to have the erroneous critical characteristic removed from that part card. On this same part card, a critical characteristic was listed that had two matching dimensions of the associated drawing. When the NRC inspectors discussed this issue with the ABB inspector, he gave a satisfactory response as to why he selected one drawing dimension over the other as the proper dimension to be compared with the critical characteristic.

c. Conclusions

The NRC inspectors did not identify any adverse findings in ABB's receipt inspection program, which verified that the materials received meet the quality requirements of the PO.

However, in ABB's commercial-grade dedication, it appeared that ABB inspectors verified the critical characteristics but documented the results in a manner that made it difficult to discern which specific critical characteristics had been verified. The NRC inspectors identified this as an Observation with two examples (Observation 99901256/201-1).

### **3.6 VENDOR AUDITS**

a. Inspection scope

To verify that ABB has established provisions for source evaluation to assure that purchased materials conform to procurement documents, and to assess the effectiveness of the control of quality at the contractor's facilities at intervals consistent with the importance, complexity, and quantity of the products being supplied.

b. Observations and Findings

The NRC inspectors identified that ABB evaluates vendors either by conducting an audit, through the Nuclear Industry Assessment Committee (NIAC), or by taking a survey for non-safety-related components. ABB has compiled an AVL for vendors for commercial grade items, and a NAVL for vendors supplying components exclusively for safety-related products.

ABB used the membership in NIAC and took credit for their audits in extending the validity of their continuation in the AVL or NAVL. ABB used information provided in NIAC audits for several vendors, including ABB Coral Springs, Lincoln Electric, and Transcat.

However, in 2005, ABB discovered that many of its vendors are located in the vicinity of Florence and that membership in NIAC was not necessary. ABB decided to use its staff to perform audits on suppliers.

The NRC inspectors verified that ABB purchased 9000 pounds of C-1010 steel from a Charlotte, NC supplier. The material was intended for the Lower Frame Assembly specified on Drawing D187917. The NRC inspectors verified that the supplier was on the NAVL, and that ABB took credit for an audit that NIAC had performed on December 9, 2004. The NRC inspectors reviewed the ABB audits performed on several suppliers, including:

- Herguth Laboratories, Vallejo, California
- Westinghouse Repair, Refurbishment, and Automated Services (RPAS), New Stanton, Pennsylvania
- ABB Incorporated, Bland, Virginia
- Future Cast Manufacturing, Pennsylvania

Additionally, the NRC inspectors reviewed a supplier's audit report that documented an audit performed by an ABB QA engineer on May 4, 2006, at Herguth Laboratories in which he verified several attributes, including organization and planning, procurement control, manufacturing/process controls, and material identification and control.

c. Conclusions

The NRC inspectors' review of audit/surveillance records determined that the ABB QA audit activities addressed and complied with the ABB quality program regarding the sample reviewed. The NRC inspectors did not identify any adverse findings in this area.

### **3.7 REVIEW OF NONCONFORMANCE REPORTS (NCRs)**

a. Inspection Scope

To verify that ABB implemented its QA program as it relates to Criterion XV, "Nonconforming Materials, Parts, or Components," of 10 CFR 50, Appendix B. The NRC inspectors reviewed the related ABB procedure, QAP 15, "Nonconforming Materials, Parts, or Components," and selected a sample of items from the ABB rejected item holding areas to determine the status and traceability of these items.

b. Observations and Findings

Section 15 of the ABB QA program discusses the methods and responsibilities for identification, documentation, and disposition of non-conforming material. The NRC inspectors reviewed NCR 36779SC.

ABB issued PO PF 32002 to a metal component stamping supplier for the supply of 210 links shown on Drawing 1A 82787 H01. The receipt inspector determined that the stampings supplied by the vendor did not meet the minimum hardness testing value required in the PO. The hardness number that the receipt inspector measured was below the required minimum value. As a result, the receipt inspector initiated NCR 36779SC to document the discrepancy. The corrective action recommended by engineering was to heat treat the links at the ABB plant itself because of time constraints. After receiving the heat treatment specified by engineering, the parts were to be returned to the Receipt Inspection area where the receipt inspector would

measure the hardness number and determine if the links met the hardness number specified in the PO.

ABB initiates external complaints (EC) when it receives adverse reports from customers. The NRC inspector reviewed EC Number US-FLOSC-36485, and determined that it documented that Southern California Edison Company (SCE) reported that the holes on the operating mechanism on a K600-S circuit breaker were incorrectly located. ABB evaluated the EC and determined that ABB had supplied a spare operating mechanism with a manufacturing error. ABB shipped a replacement mechanism without an error to SCE. Corrective action taken to preclude recurrence was to develop a tool to verify that the operating mechanism holes are drilled to meet the drawing.

The NRC inspectors reviewed EC Number US-FLOSC-36484, which documented that SCE reported the overall length of the two secondary trip latch bars for K600-S circuit breaker mechanisms were shorter than the normal ones. ABB replaced the shorter secondary trip latch bars with longer ones. ABB redesigned the part identified as Z716784X3 so that the redesigned trip bar works for all applications.

The NRC inspectors selected a sample of rejected items from the ABB rejected item holding areas, one of which was on the shop floor (FQC 2) and the other in the receiving area (FQC 1). The NRC inspectors found the NCR number of each item, then obtained the pertinent NCR of each item from the receiving inspector. The NRC inspectors verified that the NCR was associated with the item, and reviewed the information on each NCR: inspector, date, part number and description, PO number, quantity, defect description, root cause, holding area identity, vendor, buyer, disposition, cognizant engineer, and summary.

The NRC inspectors reviewed NCR 36751SC, which reported that a hole of diameter 0.125 inches had been omitted from 25 plates, and that one of the plate dimensions, which was to have been 5.884 inches, was actually 5.751 inches. The cognizant engineer noted that his discussion with the buyer had concluded that the latter dimension was acceptable, but that the omitted hole was required. The ABB facility was able to fabricate the hole in its shop, and the engineer and the buyer agreed that ABB would do so. The plates were being held in an area designated to store nonconforming items, identified as FQC 1, pending transmittal to the machine shop for the required holes.

The NRC inspectors reviewed NCR 35538SC, which reported that one lot of 100 switches, which was to have been furnished with a zinc plating, had been furnished with an unidentified plating. The receiving inspector had dispositioned the lot to be returned to the supplier.

The NRC inspectors reviewed NCR 36843JL, which reported 10-24 threads on a lot of 58 lower leads would not accept the thread gage, due to the plating process, which had been applied subsequent to the holes being drilled. The cognizant engineer had dispositioned the lot to be reworked to retap the 10-24 threaded holes, then replat them and reinspect them.

The NRC inspectors reviewed NCR 36817ST, which reported that a tab on a control contact molding had been broken during assembly. The cognizant engineer had dispositioned the molding to be scrapped.

c. Conclusions

Based on the areas reviewed, the NRC inspectors concluded that ABB's control of nonconforming materials generally met the requirements of QAP 15. The NRC inspectors did not identify any adverse findings in this area.

#### **4.0 ENTRANCE AND EXIT MEETINGS**

During the entrance meeting on September 18, 2006, the NRC inspection team discussed the scope of the inspection, outlined the areas to be inspected, and established interfaces with ABB staff and management. During the exit meeting on September 21, 2006, the NRC team discussed their observations and findings with ABB management and staff.

#### **5.0 PERSONNEL CONTACTED**

Tom Rosseau	Operations Manager, ABB**
Terry Malloy	Manager, Quality Assurance, ABB**
Will Weishuhn	Quality Assurance Inspector, ABB*
Kenneth Grice	Quality Assurance Inspector, ABB*
Chip Henry	Controller, ABB*
Debbie Rembert	Human Resources Manager, ABB*
Rick Tyner	Chief Engineer, ABB*
John Webb	Engineering Manager, ABB*
Luke Chassereau	Manager of Operations, ABB**
Billy Gerald	Inventory Control Manager, ABB*
Sandy Shunkwiler	Materials Manager, ABB*
Sam Farag	Marketing Manager, ABB*
Rachel Rogers	Product Manager, ABB*

\* Attended Exit Meeting

\*\* Attended Entrance & Exit Meeting