



April 30, 1991

U.S. Nuclear Regulatory Commission
Vendor Inspection Branch
Division of Reactor Inspection & Safeguards
Office of Nuclear Reactor Regulation
Washington, DC 20555

SUBJECT: Part 21 Report (Follow-up to April 9, 1991 Report) ABB Power Distribution Inc.
Current Transformer (CT) Cracking

Gentlemen:

As reported on April 9, 1991, twenty-two cracked current transformers were discovered at Carolina Power and Light, Brunswick Nuclear Power Plant on February 21, 1991. Two additional current transformers at this factory have been identified as cracked since the filing of the preliminary report. The current transformer consists of a primary (center) conductor passing through a wire wound secondary and ground shield inside an epoxy case. The case is filled with an epoxy potting material encapsulating the secondary winding, ground shield, and a portion of the center conductor. The center conductor is insulated by the transformer neck for a distance above the potting compound surface. The potting compound provides protection for the secondary winding and ground shield, and together with transformer neck, provides the necessary insulation to prevent flashover from the primary conductor. As indicated in the problem description, hairline cracks were found in the potting material which potentially exposes the ground shield to atmosphere thereby providing an exposed arc path and reducing the voltage necessary to cause a flashover from the primary conductor. A cracked MCS-21 current transformer has been returned by Carolina Power & Light and was subjected to extensive testing.

Summary of Evaluation

An engineering representative visited the Brunswick Nuclear Plant on April 11, 1991. The engineer inspected five current transformers and noted that they all exhibited the same crack pattern. The cracks, approximately one inch in length, were all located on the stem of the current transformer.

The current transformer that was returned and tested was a MCS-21 current transformer, Part Number 401153T5, Serial Number 99450 and was built prior to 1975.

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All electrical test results were satisfactory and the crack in the potting compound did not significantly reduce the withstand capability below the required 60 KV Basic Impulse Level (BIL).

The corona level was satisfactory for a 15 KV system and the 60 Hz flashovers went from the primary conductor to the secondary terminals indicating the crack to be only superficial.

The following test results were documented:

1. Corona Inception/Extinction voltage: 12.0 / 9.9 KV.
Discharge magnitude at CIV/CEV 15 / <2 pC
2. 60 Hz Withstand: 35 KV for 1 minute
3. 60 Hz Flashover: 61 KV r.m.s. several times.
Flashover did not go through crack.
4. 400 Hz Applied Voltage: 200 V, 0.355 A, 18 seconds
5. Metering Accuracy:

<u>Burden</u>	<u>Sec. Current:</u>	<u>Ratio Correction</u> <u>Factor</u>	<u>Phase</u> <u>Angle</u>	<u>Accuracy</u> <u>Class</u>
80.1	0.5A	1.0028	+11.8	0.29%
	5.0A	1.001	+ 5.4'	0.13%
80.5	0.5A	1.0064	+20.1'	0.64%
	5.0A	1.0041	+10.3'	0.41%
81.8	0.5A	1.0164	+46'	1.64%
	5.0A	1.0105	+14.4	1.05%
82	0.5A	1.0225	+7'	2.25%
	5.0A	1.0115	-10'	1.54%

Recommended Inspection

It is recommended that inspections be initiated on current transformers encapsulated with epoxy (red in color) for cracking at the next plant shutdown and a preventive maintenance schedule be developed to inspect at intervals of 18 months thereafter.

Equipment Affected

All current transformers in low or medium voltage application. A copy of all types and catalog numbers affected is contained in Appendix "A".

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Corrective Action

Current transformers at Carolina Power & Light should be replaced within the next 18 months. In addition, in the case of Carolina Power and Light it is recommended that the boot covering be removed and the upper connection between the current transformer bar and the insulated bus be taped for additional security against a possible flashover between the current transformer "neck" and the boot sleeve I.D. This will seal off any potential arc path between exposed conductors and the potentially exposed ground shield, since the primary means of insulating the primary from the ground shield and secondary windings is the thickness of the neck material and the encapsulation of these parts in the potting compound. The tape should be acceptable for high voltage application. The dielectric strength of the tape repair should be sufficient to prevent a 60 KV flashover.

For All Other Users

Current transformers exhibiting cracks discovered as a result of this report should be replaced with Model II polyurethane based current transformers which can be obtained by following existing procedures for ordering spare parts.

Appendix "B" contains a list of nuclear power generating stations with ABB Power Distribution Inc. low voltage and/or medium voltage switchgear in Nuclear Safety Related Applications.

Additional Considerations

The cause of the cracking has not yet been identified. However, as evidenced by this report there is no failure expected due to this problem. The E-1 epoxy material is no longer supplied for 1E application as of January 1990.

Respectfully yours,



A.F. Kaiser
President

AFK/rg

Enclosures

cc: Office of Generic Communications
U.S. Nuclear Regulatory Commission
Washington, DC 20555

APPENDIX A

Components Used in NSR Installations

<u>Catalog #</u>	<u>C/T Type</u>	<u>Where Used</u>
*	TKM followed by Suffix 1, 2, 3, 4 K-Line Neutral Sensor	K-Line Low Voltage Switchgear K-Line Low Voltage Switchgear
401619 & 401621	LKM followed by Suffix 1, 2	LK Low Voltage Switchgear
401658, 401665, 401781 & 401786	LKM Neutral Sensor	LK Low Voltage Switchgear
401636	LK Sensor	LK Circuit Breaker
401644	LK Sensor	LK Circuit Breaker
*	MC, MCS, MCB, MCR followed by Suffix 5, 15, 20, 21, 25	HK Medium Voltage Switchgear
401717	LK Sensor (2500 thru 4200)	LK Circuit Breaker

* ALL CATALOG NUMBERS APPLICABLE TO THIS CT TYPE ARE INCLUDED IN APPENDIX A, SHEET 2

APPENDIX A

<u>TYPE</u>	<u>CATALOG #</u>	<u>TYPE</u>	<u>CATALOG #</u>
MC-5	401437	MC-15	400977
MC-5	400862	MC-15A	401026
MC-5A	401309	MC-15A1	401160
MC-5M	401043	MC-15AS	401042
MC-5M	401434	MC-15A1A	401601
MC-5M1	401179	MC-15A1S	401314
MC-5A1	401343	MC-15A1S	401191
MCB-5	401012	MC-15S	401197
MCB-5	401048	MC-15S	401086
MCB-5A	401024	MC-15S	401018
MCB-5AS	401048	MC-15M	401031
MCB-5M	401040	MC-15M1	401161
MCB-5MS	401744	MC-15M1S	401194
MCB-5MS	401040	MCB-15	401012
MCS-5	400990	MCB-15S	401036
MCS-5S	401056	MCB-15A	401024
MCS-5S	401339	MCB-15AS	401048
MC-25A1	401574	MCB-15AS	401591
MC-25A1S	401683	MCB-15M	401040
MC-25M	401577	MCR-15A	401480
MCS-20	401034	MCR-15A1	401514
MCS-21S	401193	MCR-15M	401479
MCS-21S	401124	MCR-15M1	401529
MCS-21S	401338	MCS-15	400990
MCS-21	401153	TKM	401181
MCS-21S	401538	TKM	401184
MCS-25	401572	TKM	401190
MCS-25S	401580	TKM	401310
		TKM	401344
		TKM	401174

APPENDIX BEpoxy Encapsulated Items in NSR Locations

Arizona Public Service	Palo Verde
Arkansas Power & Light	Arkansas Nuclear One
Baltimore Gas & Electric	Calvert Cliffs
Boston Edison (CT's Only)	Pilgrim
Carolina Power & Light	Brunswick
Carolina Power & Light	Shearon Harris
Cincinnati Gas & Electric	Zimmer
C.E.I.	Perry
Commonwealth Edison	Zion
Commonwealth Edison	LaSalle County
Connecticut Yankee	Connecticut Yankee
Consumers Power	Palisades
Consumers Power	Midland
Detroit Edison	Fermi
Duke Power	Oconee
Duke Power	McGuire
Duke Power	Catawba
Duquesne Light	Beaver Valley
Florida Power Corporation	Crystal River
Florida Power & Light	St. Lucie
Florida Power & Light	Turkey Point
Georgia Power	Vogtle
Gulf States Utilities	River Bend
Houston Lighting & Power	South Texas

APPENDIX BEpoxy Encapsulated Items in NSR Locations

Illinois Power	Clinton
Indiana & Michigan	Cook
Iowa Electric Light & Power	Arnold
Long Island Light	Shoreham
Systems Energy Resources (Formerly Mississippi Power & Light)	Grand Gulf
Niagara Mohawk	Nine Mile Point 2
Northeast Utilities	Millstone 3
Northern States Power	Prairie Island
Pennsylvania Power & Light	Susquehanna
Philadelphia Electric Company	Peach Bottom
Philadelphia Electric Company	Limerick
Portland General Electric	Trojan
Public Service Colorado	Ft. St. Vrain
Public Service Indiana	Marble Hill
Public Service New Hampshire	Seabrook
Public Service Electric & Gas	Salem
Public Service Electric & Gas	Hope Creek
SMUD	Rancho Seco
South Carolina Electric & Gas	Summer
South California Edison	San Onofre
TVA	Sequoyah
TVA	Watts Bar

APPENDIX BEpoxy Encapsulated Items in NSR Locations

TVA	Bellefonte
TVA	Hartsville
TVA	Phipps-Bend
TVA	Yellow Creek
Texas Utilities	Comanche Peak
Union Electric (Non 1E)	Calloway
Virginia Electric Power Company	Surry
Virginia Electric Power Company	North Anna
WPPSS	WNP
CFE (Mexico)	Laguna Verde
Taiwan Power	Kuosheng