



SOLIDSTATE CONTROLS

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U.S. Nuclear Regulatory Commission

Document Control Desk

Washington, DC 20555-0001

Attention: Document Control Desk
Subject: Notification of Potential Defect - 10CFR Part 21
Product: AMETEK Charger Control Board, X302, 80-9214031-90

AMETEK Solidstate Controls Inc. is submitting the following revised Report of a Potential Defect in accordance with the requirements of 10CFR Part 21. The potential defect was discovered September 23, 2024, and investigations have been ongoing. Duke Energy Carolinas, LLC. submitted an interim report on October 28, 2024, reference EN# 57402. This revision includes items that were initially omitted unintendedly. There is no change to the affected users, purchase orders, findings, or resolution. Only the "Component Description" section was revised to include additional variations of the charger control board variations.

Please contact me if you require any further information.

Sincerely,

Ethan Salsbury
Director of Quality
Ametek Solidstate Controls



COMPONENT DESCRIPTION:

AMETEK Solidstate Controls part number 80-9214031-90 is a charger control printed circuit board with a locator ID of X302. During evaluation, AMETEK identified two failed capacitors in two separate cases. The details of the failed capacitors are provided below.

- Capacitor C35
 - o AMETEK part number: 03-010003-00
 - o Manufacturer: Sprague
 - o Manufacturer Part Number: TE1202
 - o Description: CAP,ELC,5UF,25V

- Capacitor C36
 - o AMETEK part number: 03-011006-00
 - o Manufacturer: Sprague
 - o Manufacturer Part Number: 199D4769090E6V1
 - o Description: CAP,ELC,47UF,20V,TAN,20%

The capacitors are installed in charger control board, part number 80-9214031-90, which can be modified to create a variation of the charger control board, listed below.

Charger Board Variation	Description
80-9214041-90	PCB ASSY CHGR 6SCR 24VDC
80-9214039-90	PCB ASSY CHGR 6SCR 48VDC
80-9214056-90	PCB ASSY, BAT CHG, 3/6 SCR, 130VDC
80-9214055-90	PCB ASSY, BATCHG, 12 SCR
80-9214036-90	PCB ASSY,BAT CHG,12 SCR
80-9214035-90	PCB ASSY,BAT CHG,12 SCR
80-9214051-90	PCB ASSY,BAT CHG,12 SCR,130VDC,MASTER
80-9214057-90	PCB ASSY,BAT CHG,12 SCR,130VDC,MASTER
80-9214052-90	PCB ASSY,BAT CHG,12 SCR,130VDC,SLAVE
80-9214058-90	PCB ASSY,BAT CHG,12 SCR,130VDC,SLAVE
80-9214038-90	PCB ASSY,BAT CHG,6 SCR,130VDC
80-9214032-90	PCB ASSY,BAT CHG,6 SCR,260VDC
80-9214037-90	PCB ASSY,BAT CHG,6 SCR,260VDC
80-9214029-90	PCB ASSY,BAT CHG,12 SCR
80-9214030-90	PCB ASSY,BAT CHG,12 SCR

The list provided in the appendix section includes AMETEK job numbers from the previous 10 years which included the charger control board, either as a spare part replacement or installed in new equipment.

PROBLEM YOU COULD SEE:

Three failures were reported by Duke Energy between August 21, 2024 and September 17, 2024. One failure showed signs of intermittent operation. This charger control board returned from Duke McGuire, PCB serial number R301857005 from equipment serial number C69374, is documented in AMETEK FAR 24-005. This C35 capacitor had failed after approximately 5 years of operation.



The second charger control board was replaced after approximately 8 years in operation when the DC output voltage was fluctuating on charger C43185 at Duke Catawba. FAR 24-006 captures this condition with PCB serial number R9182003. The failure is attributed to a premature failure of the C36 capacitor.

The third board, serial number R301857002, did not demonstrate failures experienced by the customer during the evaluation and the board performed as expected. This board was also returned from Duke Catawba. Since AMETEK was unable to recreate the issue, the failure mode could not be determined.

In the repeatable instances, the capacitors were observed to fail prematurely, resulting in an inability to maintain voltage output (C36 capacitor failure) of the charger and loss of output/inability to turn on (C35 capacitor failure).

EFFECT ON SYSTEM PERFORMANCE:

With these failures, the charger can see fluctuations in voltage and loss of charging ability during normal operation. C35 failures will create noticeable fluctuations on the panel voltage meter and could prevent startup. A C36 failure will prevent the charger from reaching full voltage and will not meet the charging requirements of the battery. A low voltage alarm will indicate a failure at specified voltage output ranges of the charger. This is specific to the charger settings.

CAUSE:

Capacitor C35 experienced an end-of-life failure. The capacitor case opened, allowing electrolyte to escape, degrading the capacitor's performance. Upon arrival at AMETEK Solidstate Controls, the C35 capacitor showed no signs of capacitance. The capacitor was sent to the manufacturer (Vishay) for further evaluation (reference CAR S-51-5-1). The manufacturer was not able to identify any similar failures with this part within the quality records from prior years.

The charger control board is on a 10-year replacement schedule. Based on aging analysis reports and the limited instances of failures identified with this component in this nature, there is not concern of a reduced lifespan in the application.

Capacitor C36 failed due to a hole in the manganese dioxide layer, resulting in high leakage according to the failure analysis conducted by the manufacturer (Vishay, reference CAR IL24007). This appears to be a manufacturing defect. This failure also appears to be an isolated incident as AMETEK does not see widespread failures of this component.

ACTION REQUIRED:

AMETEK does not see either failure as a widespread or systemic issue. Both cases could be assignable to common cause variation in the manufacturing process and outliers in the lifespan. Potential mitigating actions to avoid similar issues include:

- Inspect C35 capacitors for brown discoloration, indicating leakage of electrolyte
- Replace boards at regularly scheduled intervals
- Monitor output voltage of the charger, specifically evaluating fluctuations and/or low voltage (e.g. below battery voltage)
- Ensure printed circuit boards with electrolytic capacitors do not exceed the two-year shelf life.

AMETEK SOLIDSTATE CONTROLS CORRECTIVE ACTION:

Considering the rarity of these failures and the apparent cause being isolated incidents, AMETEK does not see an immediate design or component change as a warranted action.



AMETEK will be conducting further design evaluations on PCB 80-9214031-90 and considering design and/or component changes that will further enhance the reliability of the charger control board. This is expected to extend through June 2025 with a new charger board available after September of 2025.



APPENDIX – AMETEK Jobs with Charger Control Boards

The list below includes all job numbers since 2014 that include the charger control board in the equipment or as a spare part. Jobs beyond this timeframe would be outside of the 10-year replacement schedule. 960-prefix job numbers also correspond to the prefix of the equipment serial number. 46-prefix numbers correspond to spare part orders.

Owner	Site	Job Number	PO Number
ALABAMA POWER COMPANY	FARLEY NUCLEAR PLANT	46003377	SNA31574-0313
		46003453	SNA31574-0326
		46004902	SNA31574-0433
		46005204	SNA31574-0459
AMETEK CTS GMBH	STERNENHOFSTRASSE 15	46002768	PO-CH312467
BEIJING CHUANDE SUN MECHANICAL	UNAVAILABLE	46003639	CHD20210407-SCI-2
		46003918	CHDSCI202211020
		46004017	CHDSCI20220117
		46004078	CHD20190523-SCI
		46004493	CHD20230403-SCI
CHINA NUCLEAR	UNAVAILABLE	46002744	PO-CH312467
		46002767	PO-CH312467
		46002769	PO-CH312467
CONSTELLATION ENERGY	BRAIDWOOD	46002234	00623517 REV 001
		46002506	00664653 REV 001
		46003738	822696
		46004065	1342214
		46004589	1396585
	BYRON	46003548	807620
		46004434	01386643 REV. 001
		46004543	01394958 REV. 001
		46004912	01433566 REV. 004
		96000075-1	542478
		96000075-13	542478
		96000075-16	542478
	DRESDEN STATION	46004977	01453174 REV. 003
		46000995	00519913 REV 001
		46001096	525376
		46001328	544449
		46004018	01343933 REV 002
		46004988	01451816 REV 003
	EXELON NUCLEAR - THREE MILE ISLAND	46002192	00624114 REV 001
	FITZPATRICK	96000151-1	00703581 / CONTRACT # 00703580



Owner	Site	Job Number	PO Number
		96000151-3	00703581 / CONTRACT # 00703580
	GINNA NUCLEAR PLANT	46001297	00542360 REV 001
		46003252	00725166 REV. 001
		46003886	1336197
	NINE MILE POINT	46000944	7735939
		46001193	532715
		46001251	00538275 REV 001
		46001598	00564024 REV. 002
		46003712	816974
		46003838	1331325
		46004470	01386397 REV. 001
		46004603	01398303 REV 001
		46004898	01436061 REV 001
	QUAD CITIES	96000169-1	806177
		96000169-3	806177
	UNAVAILABLE	46001330	00544170 REV 002
		46001462	00550335 REV 002
	DOMINION	MILLSTONE POWER STATION	46001640
46001675			4500277156
46002099			4500372847
46002225			4500406038
46005340			4500951237 REV 001
96000166-1			70375163
96000166-11			70375163
96000166-3			70375163
96000166-4			70375163
NORTH ANNA		46002963	70352307
		46003250	4500598907
		46004311	4500810353 REV 1
		96000149-1	70351611
SURRY POWER STATION		46001368	4500213884
		46001476	4500232076
		46001525	4500243562
		46001551	4500251471
		46003850	4500711808
		46004035	4500744839
		46005194	4500937728 REV 1
	46001937	3034660	
DUKE ENERGY	CATAWBA NUCLEAR	46002034	03041345 REV 001
		46002337	03059504 REV. 001
		46002340	3059268



Owner	Site	Job Number	PO Number
		46002384	03067022 REV. 004
		46002742	3079463
		46004028	3138955
		46005212	3187309
		46005294	3190444
	H.B. ROBINSON PLANT	46002021	03040504 REV 001
	HARRIS NUCLEAR PLANT	46003151	03106503 REV. 001
		46004114	03142492 REV. 001
	MCGUIRE NUCLEAR STATION	46000945	179364
		46001556	3006705
		46002258	3054819
		46002386	3064507
		46004733	3169093
		46005288	03172055 REV. 002
		46005301	3190750
	OCONEE NUCLEAR STATION	46001011	181126
		46001167	00190159 REV. 002
		46001439	3000213
		46002808	3076169
		46003051	03103593 REV. 001
		46004031	03139080 REV. 001
46005232		03188200 REV 002	
ROBINSON NUCLEAR PLANT	46003176	03107594 REV. 001	
UNAVAILABLE	46002895	3097443	
ELECTRONUCLEAR	UNAVAILABLE	46000999	4500169804
		46001480	4500182470
		46003921	4500045399
ELETROBRAS TERMONUCLEAR	ELETRONUCLEAR	46002856	4500014326
	UNAVAILABLE	46004637	4500067052
ENERGY HARBOR	BEAVER VALLEY	46001250	45463437 REV. 001
		46001255	45462004
		46001302	45467183
		46001350	45470158 REV. 1
		46001718	45487072
		46001988	45506321
		46002209	45518276
		46002312	45526656
		46002683	45548538
		46003913	45665891
		46004052	45669397



Owner	Site	Job Number	PO Number
		46004058	45669675
		46004082	45670958
		46004094	45671611
		46004158	55141197
		46004583	45686562 REV 1
		46005226	45696203
		46005411	45698341 REV 1
	DAVIS BESSEE NUCLEAR POWER	46001806	45497222
		46002720	45547187
		46004385	45681660
46004698		45688690	
52002691		45562767	
ENERGY NORTHWEST	COLUMBIA GENERATING STATION	46005374	00365532 REV 001
		46003338	356788
		46004751	00363066 REV 2
		46005225	00363947 REV 001
		96000178-1	PO 00359222 / CONTRACT 359223
		96000178-3	PO 00359222 / CONTRACT 359223
ENTERGY	ARKANSAS NUCLEAR ONE	46001028	10406654 REV 001
		46002003	10502024
		46002069	10508415
		46002639	10570331 REV 001
		46003085	10599747
		46003127	10602234
		46003535	10632253
	BEAVER VALLEY	46002580	45542082
	GRAND GULF NUCLEAR	46002319	10534064 REV. 002
	PALISADES NUCLEAR PLANT	46003246	10608305
	PILGRIM NUCLEAR POWER STATION	46001527	10456449
	RIVER BEND	46002901	10589321
		46003396	10620711
		46003430	10623935
		46003713	10642084
	WATERFORD 3 NUCLEAR	46003538	10629046
		96000100-1	10475893
		96000130-1	10511769
	UNAVAILABLE	46002846	10587780



Owner	Site	Job Number	PO Number
GEORGIA POWER CO	HATCH NUCLEAR PLANT	46003416	SNG10240812
	VOGTLE 1 AND 2 ELEC GENERATING PLANT	46003080	SNG10220964
		46004847	SNG31574-0428
		46003436	SNG31574-0323
	UNAVAILABLE	46004882	SNG31574-0435 REV 1
		46004961	SNG31574-0441 REV 5
		46005274	SNG10346696
		52003312	SNG10297872
INDIANA MICHIGAN POWER CO	DC COOK	46003048	1598354
		46003162	1598781
		46003679	1602726
	UNAVAILABLE	46003113	1598628
KHNP	UNAVAILABLE	46003031	563764
		46001072	RMA C88013
		46001657	K150432631
		46001869	K160440591
MJT INC	KHNP	46005055	K240097051
NEXTERA ENERGY	SEABROOK STATION	46003197	2408952
		46003301	2413582
		46003846	CONTRACT 02430613 / PO 02431350
		46004243	2445454
		46005148	02470765 REV 001
		96000189-1	2453687
		96000189-17	2453687
	TURKEY POINT	46001421	2337821
		46001638	2346823
		46003653	2419331
		46004395	02451619 REV 1
		96000187-3	2449022
NEXTERA ENERGY	POINT BEACH	46003269	02411945 REV. 002
		46003499	2420260
		96000185-1	2447219
		96000185-3	2447219
NPP KRSKO	VRBINA 12	46002993	3190403/913
	UNAVAILABLE	46003285	3200463/913
		46004784	3231326/913
		46001204	3141685/913,REV.0
		46004820	3231838/913
		96000067-1	3140571/913



Owner	Site	Job Number	PO Number
		96000067-3	3140571/913
		96000067-6	3140571/913
PACIFIC GAS & ELECTRIC	DIABLO	46004016	3501284379
		46004070	3501289141
		46004242	3501306085
		46004809	3501348070 REV 2
		46005243	3501378513
	UNAVAILABLE	46001101	3501009294
		46001202	3501024017 REV 1
		46001408	3501046038
		46003341	3501233228
		46003503	3501247083
		46004389	3501318864
STP NUCLEAR	UNAVAILABLE	46000979	171506
		46001085	175371 REV 001
		46001116	176685 REV 001
		46001152	178499
		46003572	252909
		46003951	261075
		46004116	265082
		46004507	275684
TVA	KENTUCKY HYDRO PLANT	46004602	7449561 REV 1
	SEQUOYAH NUCLEAR PLANT	46004677	7504684
		46004978	7603646 REV 1
		46005002	7611854 REV 1
		46002019	2758244 REV 1
		46002962	5716603
		46003211	6132093 REV 1
		46003513	6644298 REV. 1
		46003553	6700783 REV. 1
		46003805	6710757
		96000164-10	6245126
		96000164-11	6245126
	96000164-13	6245126	
	TVA SPRING CITY	46001936	2465931 REV. NUM. 1
	WATTS BAR NUCLEAR PLANT UNIT 1	46002678	4850297
		46002706	4920007 REV 1
		46002951	5679332
		46002367	3538599 REV 1
		46002956	5601172



Owner	Site	Job Number	PO Number
		46003575	6719867 REV. 3
		46005454	7713908
VISTRA ENERGY	COMANCHE PEAK	46003599	1072497
		46003945	1138637
		46003955	1146461
		46004111	1183108
		46004394	1756857
		46005056	2471748
		46001291	B 0207303 123
		46001756	343184
		46002454	522832
		46002482	526151
		46003745	1114824 REV 1
		46004090	1178113
		46004161	1194861
		46004452	1971507
		46004572	2242661
XCEL ENERGY	PRAIRIE ISLAND NUCLEAR	46003243	4000015358 REV. 1
		46004112	4000024637
		46004427	4000028917