General Information or Other (PAR) Event # 46072

Rep Org:	TRENTEC	**Notification Date / Time:**	07/06/2010 12:41 (EDT)
Supplier:	RONKEN INDUSTRIES INC	**Event Date / Time:**	05/25/2010 (EDT)
		Last Modification:	07/06/2010
Region:	3	**Docket #:**	
City:	CINCINNATI	**Agreement State:**	Yes
County:		**License #:**	
State:	OH		
NRC Notified by:	MARION MITCHELL	**Notifications:**	MALCOLM WIDMANN R2DO
HQ Ops Officer:	DONG HWA PARK		PART 21 VIA EMAIL
Emergency Class:	NON EMERGENCY		
10 CFR Section:			
21.21	UNSPECIFIED PARAGRAPH		

PART 21 REPORT CONCERNING FAILURE OF OIL-FILLED CAPACITOR

The information below is a summary of a report received via facsimile from Trentec dated July 6, 2010.

"Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect:

"The basic component containing the defect is a Ronken oil filled capacitor with a rating of 70 micro Farad-660 VAC @ 60 Hz. The part number is P91D23706H05 with a 06-06 date code (manufactured in 2006). The capacitor is commercially dedicated by Trentec for use in safety related applications. The associated Trentec part number is 7T20701 with a 06-06 date code.

"Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect:

"Trentec, Business Unit of Curtiss Wright Flow Control Corporation, 4600 East Tech Drive, Cincinnati, OH 45245

"Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply:

"The defect pertains to 70 micro Farad capacitors that failed in the inverter circuitry for the uninterruptible power supply (UPS) for the turbine driven auxiliary feedwater pump (TDAFWP). The failure of the capacitors was determined by an independent testing lab to be a manufacturing defect in which the internal spot-welded (no solder used) connection points on the capacitors were inadequate and resulted in poor/high resistance connection points which culminated in internal arcing at several of the connection points.

IE19
NRR

General Information or Other (PAR) Event # 46072

"The Auxiliary Feedwater (AFW) system for each unit consists of two motor driven pumps and one turbine driven pump. The TDAFWP UPS for each unit has an A and B section for system redundancy, with two 70 micro Farad capacitors used in each section. The capacitors currently installed in the Farley 1 TDAFWP UPS B section and Farley 2 TDAFWP UPS B section have the suspect date code (total of four).

"Given a loss of a TDAFWP UPS due to the capacitor failures, together with a single failure of one of the motor driven AFW pumps leaves the one remaining motor driven AFW pump to ensure the reactor coolant system is properly cooled via the steam generators during emergency conditions. However, two of the three AFW pumps are required to satisfy the flow demand for the most limiting associated design basis accidents and transients, i.e., feedwater line break, main steam line break, and loss of main feedwater. Accordingly, the flow demand is needed to mitigate the consequences of these events which can result in over pressurization of the reactor coolant pressure boundary, and to prevent uncovering the reactor core and potential radiological releases. Additionally, credit for operation of the TDAFWP is needed for coping with a station blackout event during which the TDAFWP is the only source of AFW.

"The date on which the information of such defect or failure to comply was obtained:

"Farley Condition Report 2010107145 was written on May 25, 2010 to determine 10 CFR 21 reportability of the capacitor failures. Trentec Failure Evaluation Plan was written on 6/7/10. Trentec's capacitor evaluation and report was completed 6/30/10.

"In the case of a basic component which contains a defect or fails to comply, the number and location of these components in use at, supplied for, being supplied for, or may be supplied for, manufactured, or being manufactured for one or more facilities or activities subject to the regulations in this part:

"The Ronken 70 micro Farad capacitors with 06-06 date code have only been supplied to the Farley Plant on PO number QP070496 for a quantity of 8 each, shipped 5/11/2007 with Trentec tag number 7T20701.

"The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action:

"Corrective actions have been scheduled for Farley Maintenance to replace the suspect 06-06 date code capacitors by July 30, 2010.

"Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees:

"Perform a failure analysis of any recently failed Trentec qualified Ronken 70 micro Farad capacitor to determine proper corrective action. Replace any Trentec qualified Ronken 70 micro Farad capacitor with a date code of 06-06. They should also be removed from stock to prevent their future use.

"In the case of an early site permit, the entities to whom an early site permit was transferred"

"Not applicable."

****

Received at: 07/06/2010 14:11

07/06/2010 TUE 13:59 FAX 5135283845 001/036

FAX

CURTISS WRIGHT Flow Control Company
Trentec

☒ Urgent ☐ Please Reply

Fax To:	**U.S. Nuclear Regulatory Commission**	Date Sent:	7/6/2010
Attention:	**Operation Center**	From:	Marion Mitchell, General Manager
Company:		Company:	Trentec
Phone:	301-816-5151	Phone:	513-528-7900
Number Pages:		Fax:	513-528-9292
cc:			

Subject: Re-submittal of Part 21 Reportable Condition Notification 70 F Oil-Filled Capacitor

Please accept our apologies as pages 9 and 10 were missing from Appendix A - Test Plan section of the Failure Evaluation Report in the previous submittal.

Thank You.

Trentec
4600 East Tech Drive, Cincinnati, OH, 45245
Phone 513.528.7900 Fax 513.528.9292
www.trentec.com

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CURTISS WRIGHT Flow Control Company
Trentec

June 30, 2010

Via Facsimile
U.S. Nuclear Regulatory Commission
Operation Center
Fac. 301-816-5151

Via Regular Mail
NRC's Document Control Desk
U.S. Regulatory Commission
Washington, DC 20555-0001

Subject: Part 21 Reportable Condition Notification – 70μF Oil-Filled Capacitor

Reference: Manufacture, Ronken Industries Inc, Part # P91D23706H05, (Date Code 06-06)

Dear Sir,

This letter provides information concerning the evaluation of a report completed by Exelon Power Labs (FAR-65155) on the failure of a 70μF capacitor, manufactured by Ronken Industries Inc, which is used within a UPS system installed in Southern Nuclear – Farley Station Unit 1 TDAFWP UPS "B" Section. Trentec provided this safety related capacitor for installation on a UPS system which was manufactured by Dependable Power System.

The failed capacitors were not returned to Trentec for evaluation therefore the investigation was performed after a review of the Exelon Power Labs report (FAR-65155), which was provided to Trentec by Southern Nuclear. The report identified the failure as being the result of poor quality resistance spot welds made during the manufacturing process. The report also identified physical impact to the capacitors. The poor resistance spot weld integrity was also noted on spare capacitors, which were not installed, in possession of Southern Nuclear, with the same Date Code (year-week) as the failed units.

Ronken's reply to the Exelon Power Labs report stated that the manufacturing process employed for spot welding has been in use since 1980. In 2007 Ronken reviewed and changed their welding process to add a soldering step after the resistance spot weld on the capacitor. Ronken performs a final testing (100%) after manufacturing on capacitors. Ronken stated that the connection point may have been compromised by the physical impact identified by Exelon report or by storage condition exceeding 90 degrees Celsius.

Trentec developed a plan to evaluate the capacitor's weld quality in question. The plan involved the pull testing of two (2) capacitors. Since the original capacitors were not returned to Trentec, the original qualification sample was pulled (Date Code 02-30) along with one capacitor manufactured

using the new welding process developed in 2007 (Date Code 10-10) was used as the second test sample. Trentec determined the operation of spot welding and/or soldering demonstrate both have sufficient holding force to preclude the "easily pulled away" separation described in the Exelon Power Labs Reports.

Trentec has determined that the capacitor failure is isolated to the identified Date Code 06-06. Trentec has reviewed its customer PO's and has determined that this capacitor Date Code 06-06 has only been provided to Southern Nuclear-Farley Station Unit 1 & 2 (total quantity of 8). Southern Nuclear – Farley Station Unit 1 &2 has a total of four (4) capacitors in service and will replace any Date Code 06-06 capacitors by July 30, 2010. Ronken Industries Inc has addressed the welding process in 2007 and based on the Trentec Evaluation Report no further action is required.

Regards,

Marion Mitchell
General Manager

Attached:

Trentec 10CFR Part 21 Report
Exelon Power Labs Report
Ronken Industries Inc Reply to Exelon Power Labs Report
Trentec Failure Evaluation Report

Trentec' 10CFR Part 21 Report to NRC

June 30, 2010

The following 10 CFR 21 written report is provided by Trentec, Business unit of Curtiss Wright Flow Control Corporation for Joseph M. Farley Nuclear Plant (Farley). The contents are in accordance with 10 CFR 21.21(d)(4).

(i) Name and address of the individual or individuals informing the Commission.

Mr. Marion Mitchell
General Manager
4600 East Tech Drive
Cincinnati, OH 45245

(ii) Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect.

The basic component containing the defect is a Ronken oil filled capacitor with a rating of 70 micro Farad-660 VAC @ 60 Hz. The part number is P91D23706H05 with a 06-06 date code (manufactured in 2006). The capacitor is commercially dedicated by Trentec for use in safety related applications. The associated Trentec part number is 7T20701 with a 06-06 date code.

(iii) Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect.

Trentec, Business Unit of Curtiss Wright Flow Control Corporation
4600 East Tech Drive
Cincinnati, OH 45245

(iv) Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.

The defect pertains to 70 micro Farad capacitors that failed in the inverter circuitry for the uninterruptible power supply (UPS) for the turbine driven auxiliary feedwater pump (TDAFWP). The failure of the capacitors was determined by an independent testing lab to be a manufacturing defect in which the internal spot-welded (no solder used) connection points on the capacitors were inadequate and resulted in poor/high resistance connection points which culminated in internal arcing at several of the connection points.

The Auxiliary Feedwater (AFW) system for each unit consists of two motor driven pumps and one turbine driven pump. The TDAFWP UPS for each unit has an A and B section for system redundancy, with two 70 micro Farad capacitors used in each section. The capacitors currently installed in the Farley 1 TDAFWP UPS B section and Farley 2 TDAFWP UPS B section have the suspect date code (total of four).

Given a loss of a TDAFWP UPS due to the capacitor failures, together with a single failure of one of the motor driven AFW pumps leaves the one remaining motor driven AFW pump to ensure the reactor coolant system is properly cooled via the steam generators during emergency conditions. However, two of the three AFW pumps are required to satisfy the flow demand for the most limiting associated design basis accidents and transients, i.e., feedwater

line break, main steam line break, and loss of main feedwater. Accordingly, the flow demand is needed to mitigate the consequences of these events which can result in over-pressurization of the reactor coolant pressure boundary, and to prevent uncovering the reactor core and potential radiological releases. Additionally, credit for operation of the TDAFWP is needed for coping with a station blackout event during which the TDAFWP is the only source of AFW.

(v) The date on which the information of such defect or failure to comply was obtained.

Farley Condition Report 2010107145 was written on May 25, 2010 to determine 10 CFR 21 reportability of the capacitor failures. Trentec Failure Evaluation Plan was written on 6/7/10. Trentec's capacitor evaluation and report was completed 6/30/10.

(vi) In the case of a basic component which contains a defect or fails to comply, the number and location of these components in use at, supplied for, being supplied for, or may be supplied for, manufactured, or being manufactured for one or more facilities or activities subject to the regulations in this part.

The Ronken 70 µF capacitors with 06-06 date code have only been supplied to the Farley Plant on PO number QP070496 for a quantity of 8 each, shipped 5/11/2007 with Trentec tag number 7T20701.

(vii) The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action.

Corrective actions have been scheduled for Farley Maintenance to replace the suspect 06-06 date code capacitors by July 30, 2010.

(viii) Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.

Perform a failure analysis of any recently failed Trentec qualified Ronken 70 micro Farad capacitor to determine proper corrective action. Replace any Trentec qualified Ronken 70 micro Farad capacitor with a date code of 06-06. They should also be removed from stock to prevent their future use.

(ix) In the case of an early site permit, the entities to whom an early site permit was transferred.

Not applicable.

RONKEN INDUSTRIES Inc.

9 WOLFER INDUSTRIAL PARK
SPRING VALLEY, ILLINOIS 61362
PHONE: (815) 664-5306
FAX: (815) 664-5308
E-MAIL: ronken@ronkenind.com

November 13, 2009

Subject:
Reply to Exelon Power Labs project number FAR-65155.
Ronken Industries Inc capacitor part number P91D23706H05 for Industrial & Marine Engine Services Co. part number 03700661.

Description of Capacitor:
70 MF 660 AC 60 HZ, Metallized Polypropylene Film Dielectric impregnated with a non-PCB fluid, 4 blade quick connect terminals, internal pressure sensitive interrupter, 4 round capacitor windings connected in parallel housed in a 1.97" x 3.66" oval x 9.00" high aluminum container. Date code: 06-06.

Construction of Capacitor:
The capacitor is constructed using low loss polypropylene film dielectric on which an extremely thin layer of metal has been deposited to one side to serve as the electrode. The two sheets are displaced forming a low loss non-inductive (extended foil) capacitor. Both ends of the winding are spray-metallized to provide a means to attach the tinplated copper tabs. The tabs are then spot welded to the rivet on the underside of the cover and the cover is sealed to the case by a double-lock roll seam. The unit is completely filled with LEKTROL, a non-PCB fluid that is biodegradable, low toxic, and environmentally compatible.

Analysis by Exelon Power Labs:
Exelon project number FAR-65155 report concludes the capacitor failed due to a manufacturing defect in which the internal spot-welded connection points on the capacitors were inadequate and resulted in poor/high resistance connection points, which culminated in internal arcing action at several of the connection points.

Ronken Industries Conclusion:
Final testing performed at Ronken Industries consists of 100 percent dielectric strength test from terminals to case and terminal to terminal. Also, capacity and dissipation factor is 100 percent tested. If the internal spot-welded connection points were inadequate, the capacity and dissipation factor test would have failed at final test.
We believe the connection points may have been compromised by a physical impact identified in the Exelon report titled "OBSERVATIONS and DATA" 2.), Exterior Condition, Photograph 3: Indentations or if the storage conditions exceeded the maximum temperature of 90 degrees Celsius.

Ronken Industries Corrective Action:
Ronken has been using the connection method of attaching the tinplated copper tabs to the windings using a resistance welder to fuse the metals together since the incorporation of Ronken in 1980. In 2007, Ronken designed a method to improve the quality and reliability of this connection by adding solder between the tab and the capacitor winding prior to welding. This improved the connection as a result of the solder penetrating the porous end of the winding and partially automated the process to reduce operator error.
In applications where high RMS currents are present, Ronken hand solders the connection.
For corrective action on this 70 MF capacitor, Ronken Industries will hand solder the tab to winding connection on all future orders.
The date code above (06-06) is the last date code to use the resistance only method on this 70 MF design. Ronken started using the method of adding solder with date code 07-38. See the below photo that illustrates the soldered connection.

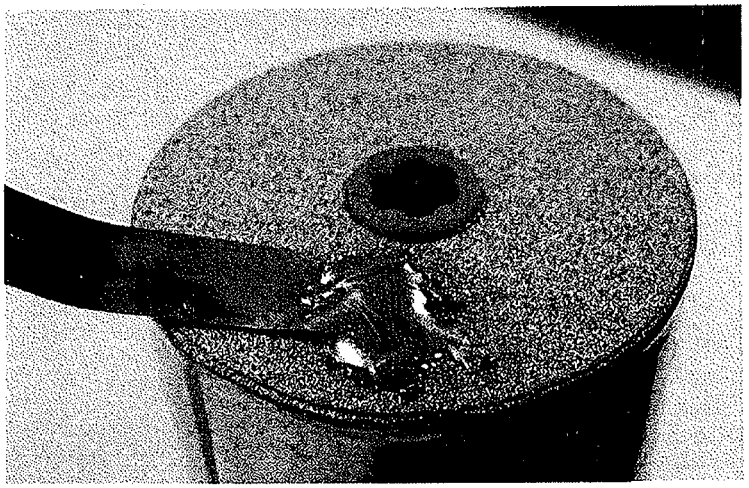

Photo of solder connection for high RMS current applications

Report generated by:

Jim Heider
Ronken Industries Inc
Wolfer Industrial Park
Spring Valley, IL 61362
e-mail: ronken@ronkenind.com

Exelon PowerLabs®

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610-380-2532 fax

To: **Vanderian Floyd, (334) 899-5156, EXT 2521, Southern Nuclear-Farley Station**

From: **Lance Walls, 610-380-2309**
lance.walls@exelonpowerlabs.com

Project Number: **FAR-65155**

Subject: **Failure Analysis of an Oil-Filled Capacitor.**
Manufacturer: Ronken, Part#: P91D23706H05,
Purchase Order#: FN092345

Date: **16 October 2009**

STATION DESCRIPTION OF PROBLEM

The capacitor was installed in the Unit 1 TDAFWP UPS 'B' Section when it failed.

CONCLUSIONS

The capacitor failed due to a manufacturing defect in which the internal spot-welded connection points on the capacitors were inadequate and resulted in poor/high resistance connection points, which culminated in internal arcing action at several of the connection points. The open connection points were observed in the as-found state of the capacitor. Additionally, it was further discovered that several of the remaining spot-welded connection points that were initially intact were also of poor integrity.

The new capacitor that was supplied was examined and it also had many poor spot-welded connection points of an identical nature as the failed capacitor, and would have most likely failed if it had been put into service.

COMMENTS & RECOMMENDATIONS

1.) An attempt was made to locate the OEM (Ronken) and obtain data and specifications on the subject capacitor. No website or any information on the subject capacitor could be obtained. It is unknown if the OEM is still in operation.
2.) Other capacitors of this type and date code that are at the station should be considered as suspect and susceptible to the same failure mechanism as the (2) capacitors analyzed in this project.

REQUIREMENTS

Perform a failure analysis on the capacitor. Provide a detailed report consisting of the Test Plan, Test Results, and Photographs.

TEST PLAN

1. Nameplate
2. External Condition
3. Electrical Testing: Test Capacitance, Leakage, and Dielectric Strength. Compare with known good capacitor.
4. Destructive: Disassembly and Internal Evaluation
5. Materials Analysis
6. Discovery

The assigned technician(s) are certified to perform the Project Test Plan.

Applicable Specification: *N/A* Year/Revision: *N/A* Hold Points: *No*

Test plan approved by: *Lance T. Walls* *09 /29 /2009*

(Qualified ANSI Level III Signature)

STATEMENT OF QUALITY

Testing was performed with standard equipment that have accuracies traceable to nationally recognized standards, or to physical constants, by qualified personnel, and in accordance with the **Exelon** PowerLabs Quality Assurance Program revision 20 dated 04/03/2009.

Technician(s): Lance Walls and John Diletto

Prepared by: Lance T. Walls
Sr. Electrical Engineer 10/08/2009

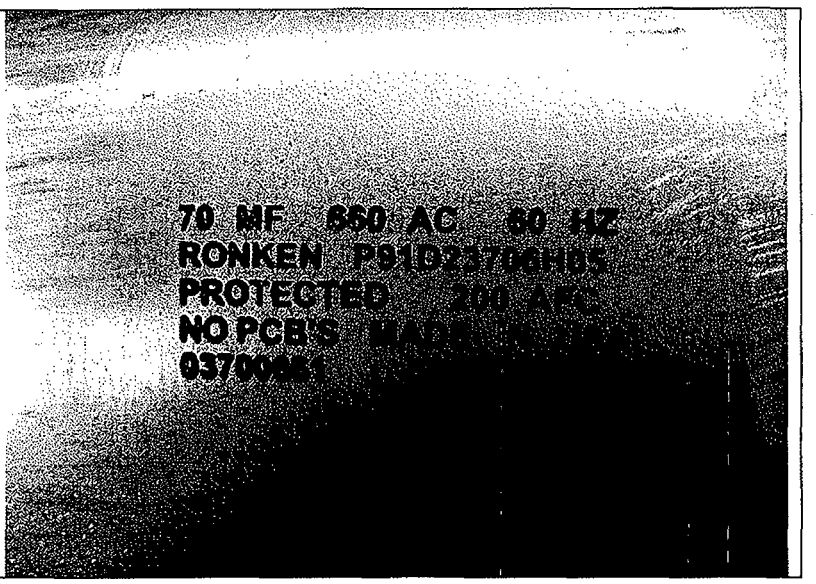
Reviewed by: John Diletto
Sr. Metallurgical/ Materials Engineer 10/08/2009

Approved by: Lance T. Walls
Sr. Electrical Engineer 10/16/2009

Project review and approval is electronically authenticated in Exelon PowerLabs project record.

OBSERVATIONS and DATA

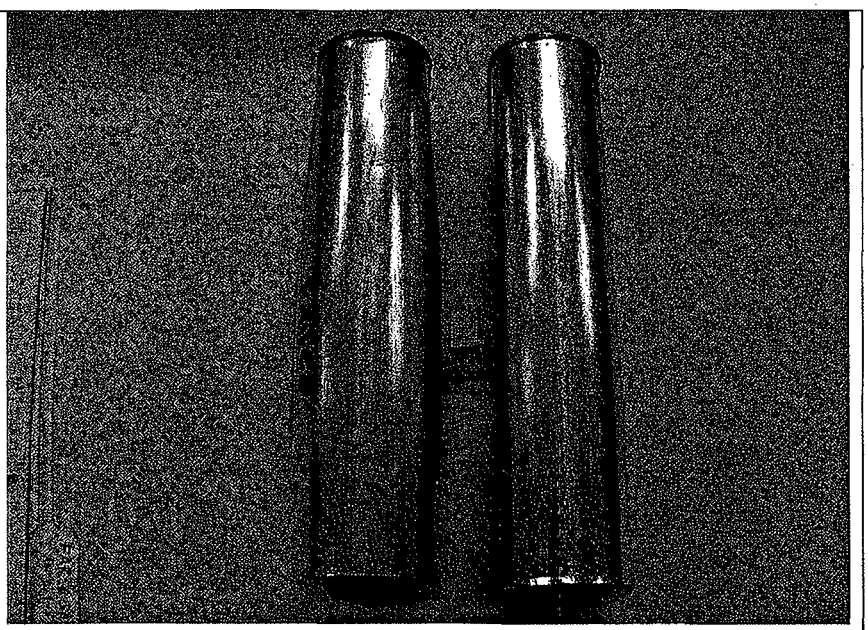
1.) Nameplate Data

Photograph 1: Nameplate Data **Manufacturer**: Ronken **Part**: P91D23706H05 **Ratings:** 70 MFD, 660 VAC @ 60Hz. **Date Code:** 06-06	

2.) Exterior Condition

Photograph 2: Exterior Condition The capacitor was bulged, primarily at the center area, which is the typical indication of internal pressure due to arcing or a fault event. The can was not breeched in any area, and no oil was observed on the outer surface. There was no bulging or deformation in the area of the terminals at the top of the can.	

Photograph 3: Indentations There were several indentations on the backside of the can (opposite nameplate). The indentations did not penetrate through the can exterior.	

Photograph 4: Comparisons With New Capacitor An unused and identical model capacitor was supplied with the failed subject capacitor. They were placed side by side for comparison purposes. Although it is clear the subject capacitor experienced some internal overpressure, the extent of the can deformation is not as extensive as has been observed in other similar type capacitor failures.	

3.) Electrical Testing: Test Capacitance, Leakage, and Dielectric Strength. Compare with known good capacitor.

Test	Failed Capacitor	New Capacitor
Capacitance (MFD)	17.35	69.8
Leakage (μA)	0.57	0.32
Terminal – Terminal Resistance @ 500 VDC (MΩ)	>999	>999
Terminals – Case Resistance @ 500 VDC (MΩ)	>999	>999

Table 1

A substantial effort was undertaken in attempting to obtain the OEM (Ronken) specifications and/or datasheets for the type and model of capacitor being analyzed, but no meaningful information pertinent to the specifications or the OEM could be obtained. The capacitance value of the failed capacitor was approximately ¼ of the nameplate value, which tended to indicate that at least a portion of the total capacitance was still present and that the pressure interrupter, which is located at the top of the can and opens the power circuit upon rapid/severe internal overpressure, did not deploy.

There was no presence of any fault circuit between the terminals or terminal to case.

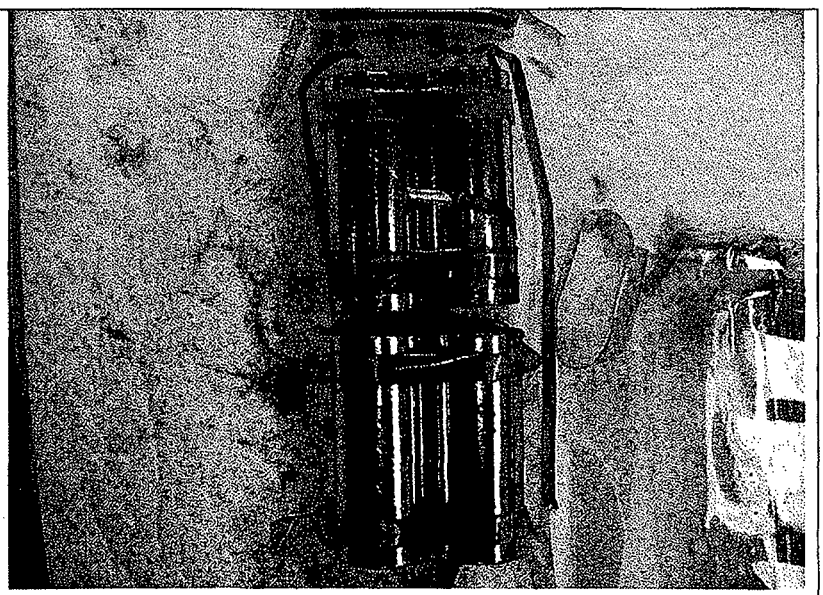
4.) Destructive: Disassembly and Internal Evaluation

Photograph 5: Internal Evaluation

The can was carefully opened along the seam where the side and top (terminal area) portions of the can are joined together. Internally, there were (4) individual capacitors connected in parallel.

The oil within the can was darkened to a black color.

None of the (4) individual capacitors exhibited signs of catastrophic failure.



Each of the four capacitors was given a unique identifier (#1 through #4), and the internal connection scheme is provided below in Figure 1.

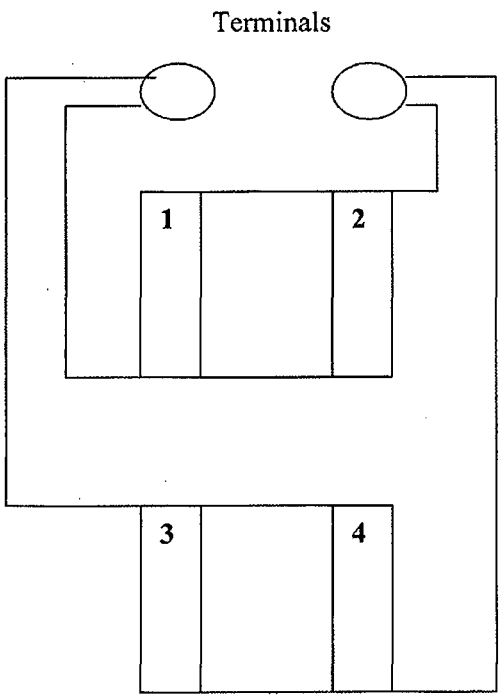


Figure 1

Initial observations revealed that as previously thought, the pressure interrupter did not deploy and open the power connections to the capacitive network. The #1 capacitor was still connected across the power source, with all of the other capacitors having either one or both of their connections removed. Each of the (4) capacitors had their individual capacitance measured:

1: 17.35 MFD
2: 16.80 MFD
3: 17.35 MFD
4: 17.38 MFD

The #2 capacitor had a slightly lower capacitance value than the other (3) units. Ideally, the individual capacitors would have 17.50 MFD of capacitance, which with a parallel connection of all (4) capacitors would equal the nameplate value of 70.0 MFD.

None of the capacitors failed in a catastrophic manner. Instead the spot-welded connections to the capacitors disbonded. Figure 2 below shows where the open circuits occurred

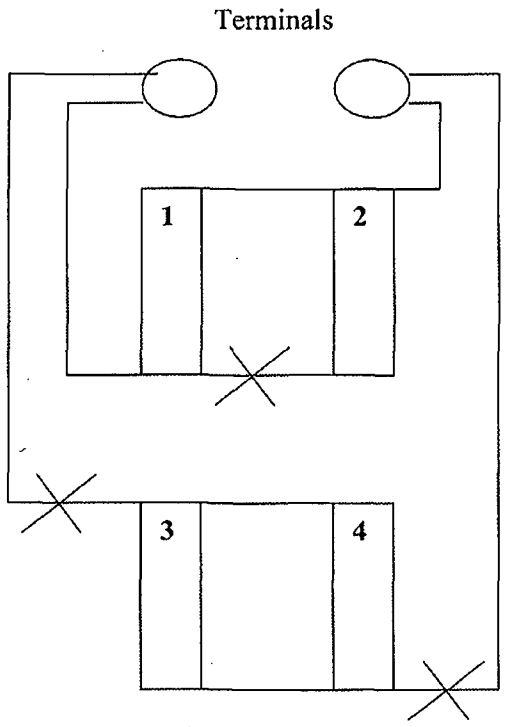


Figure 2

The 'X' locations denote where the open circuits occurred in the capacitive network. Capacitor #1 remained connected, which explains the as-found measured capacitance of 17.35 MFD in Table 1. Capacitors 3 and 4 were completely removed from the network with both ends being disconnected, and capacitor #2 had its lower lead disconnected.

Photograph 6: Disconnected Leads at Lower #2 and Upper #3 and #4.

Cap #1 Connection intact

Open Connection at #2

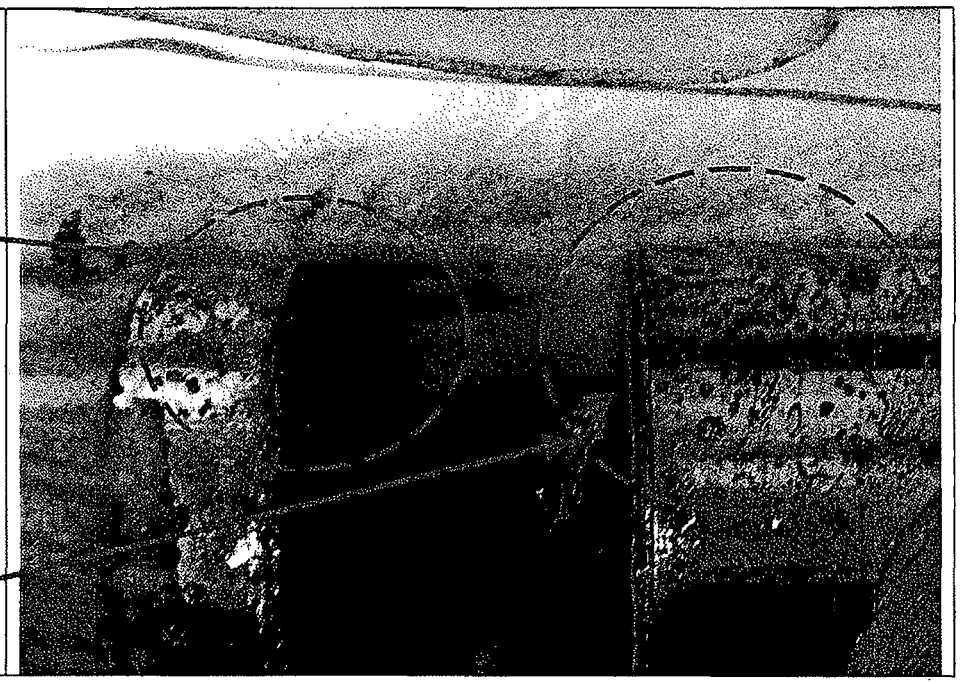
Open connection at #3 and #4

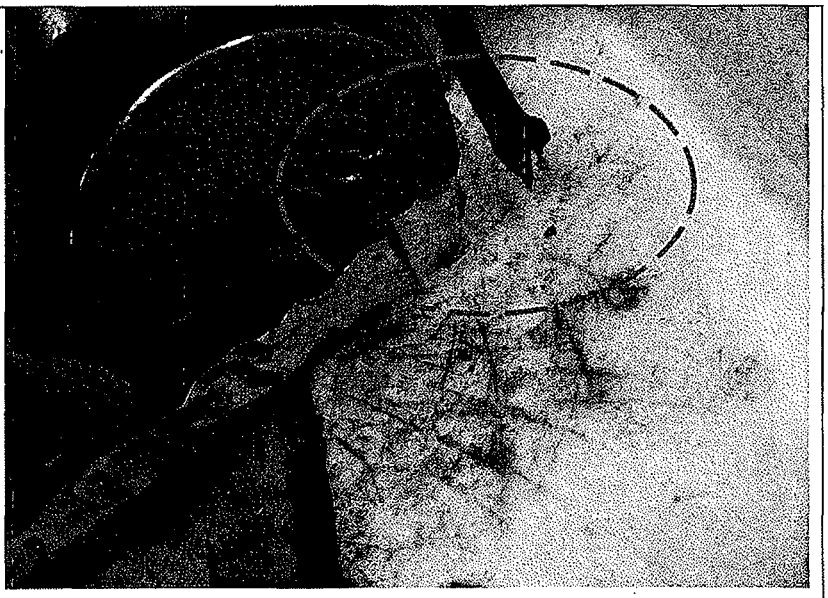
The circled area at the bottom of capacitor #2 indicates the presence of electrical arcing occurring as the connection degraded. Also, note disfigured appearance of the (2) ribbon conductors. Both ribbons exhibited indications of electrical arcing occurring, with metal erosion occurring. Most likely, the arcing and overheating gradually became worse over time eventually culminating in open circuits.

Photograph 7: Disconnected Leads at Lower #2 and Upper #4.

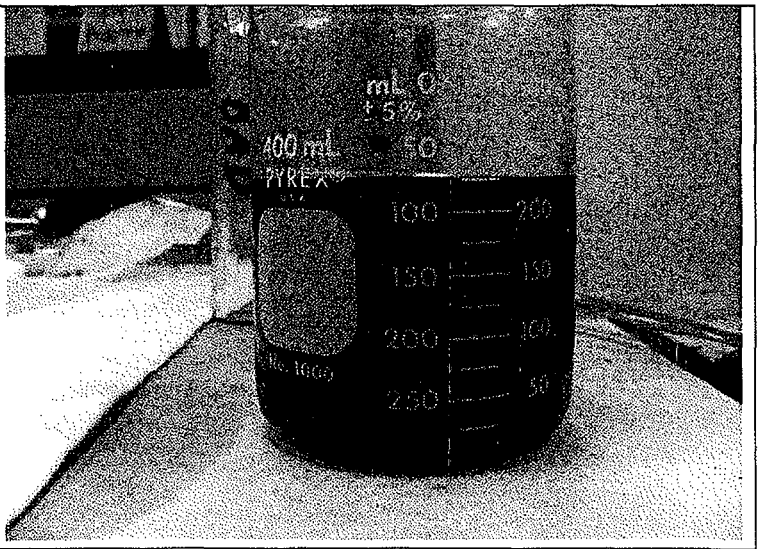
Signs of arcing on lower #2

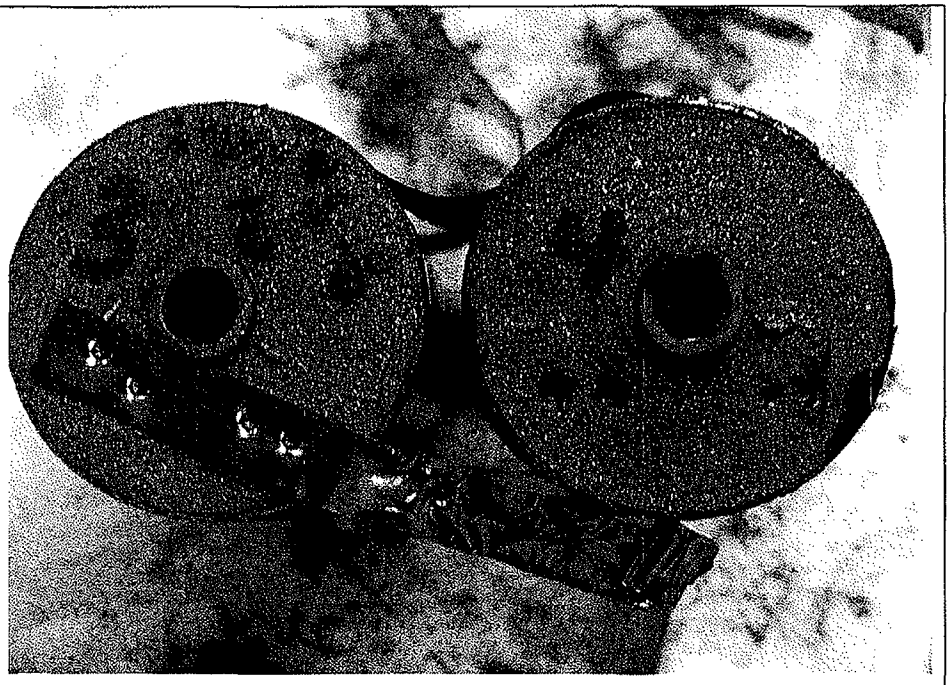
Signs of arcing on upper #4



Photograph 8: Open Circuit at Bottom of #4 The ribbon conductor that connects to the bottom of #3 and #4 travels downward from the terminal along the entire height of the capacitor network, and then completes a 90° bend at the connection point of bottom #4. It was at this 90° bend that the ribbon conductor burned open. The open conductor and indications of arcing are circled.	

It is believed that the ribbon cable connections at the bottom of #4 degraded, which precipitated the arcing action that eventually caused the ribbon conductor to burn open.

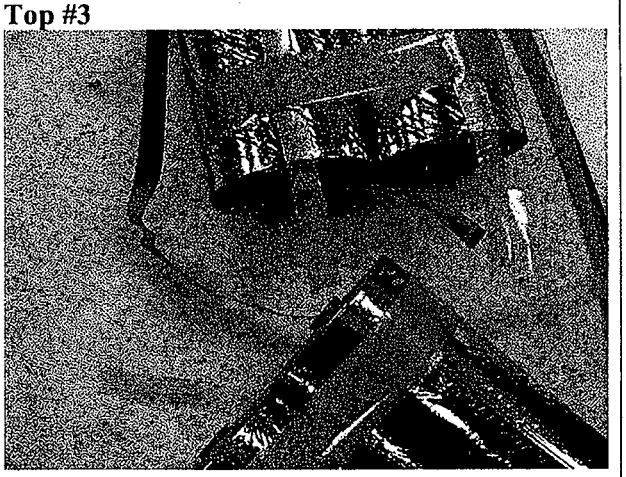
Photograph 9: Open Circuit at Bottom of #4 The oil that was removed from the capacitor had a darkened/black appearance, which indicative of arcing occurring over a period of time. The oil normally has a clear/transparent appearance.	

Photograph 10: Nature of Connections The ribbon conductor is connected to each capacitor via (4) spot-welded points. What was discovered was that many of the spot-welded connections were not bonded to the capacitor and were only making surface contact with the capacitor surface. Note the non-uniformity of depth on the (4) connection points on #4.	

It was discovered that manipulating/moving the capacitors even slightly caused some of the ribbon conductors to pull away from the their connection points on the capacitor surface.

When received, the failed capacitor had the following connections still intact: #1 Top, #1 Bottom, #2 Top, and #3 Bottom. Through very slight manipulation of the capacitors and very gentle movement of the ribbon conductors, the following discoveries were made.

#1 Top: All (4) welded connection points easily pulled away.
#1 Bottom: (2) connection points easily pulled away and (2) remained solidly connected.
#2 Top: (2) connection points easily pulled away and (2) remained solidly connected.
#3 Bottom: All (4) points were solidly connected.

Photograph 11: Top #1 and Top #2	Photograph 12: New Capacitor Bottom #2 and Top #3
	

The new capacitor that was supplied was opened in the same manner as the failed capacitor. The connection points on the new capacitor exhibited the same anomaly as the failed capacitor, where several of the welded connections were only making a frictional/surface engagement with the capacitor surface. Photographs 11 and 12 depict several of the open connections that were brought about by very gentle manipulation of the capacitors and ribbon conductors.

It must be pointed out that both the failed and new capacitors were never handled roughly or subjected to anything other than very careful handling. The removal of the capacitor networks from their respective cans was carried out very carefully.

Upon removal of the new capacitors from the can, all termination points were connected. While using the same numbering convention as with the failed capacitor, gentle manipulation of the capacitors and ribbon conductors revealed the following findings:

#1 Top: All (4) welded connection points easily pulled away.
#1 Bottom: (2) connection points easily pulled away and (2) remained solidly connected.
#2 Top: All (4) welded connection points easily pulled away.
#2 Bottom: All (4) welded connection points easily pulled away.
#3 Top: All (4) welded connection points easily pulled away.
#3 Bottom: All (4) points were solidly connected.
#4 Top: (2) connection points easily pulled away and (2) remained solidly connected.
#4 Bottom: All (4) points were solidly connected.

The date code of the new capacitor is 06/06, which is the same as the failed capacitor. Due to the nature of these findings, this failure is considered to have occurred due to manufacturing defects.

5.) Materials Analysis

No materials analysis was performed during the analysis.

6.) Discovery

No additional items of discovery were obtained above and beyond those already mentioned.