Siemens Marine Solutions
Commissioning & Field Services Report

REPORT BY: Loren Bailey Jr
REPORT NO: n/a
DATE: 8/05 to 8/08/2014
JOB NO.: 5002295945
REPORT PERIOD: 8/05 to 8/08/2014

DISTRIBUTION:
SII/CS/Marine-Services

1. SERVICE / PROJECT NAME IDENTIFICATION:
Washington-State-Ferry, WSF “Tacoma” Investigation of “July-29th” Incident

2. CUSTOMER & WORK LOCATION:
Owner / Operator: WSF
Vessel Name: “TACOMA”
IMO No.: 1052576
Contact Person: Staff C/E Ben Davis
Work Location: Eagle Harbor
City / State / Zip: Bainbridge, WAQ
3. **EQUIPMENT IDENTIFICATION**

Propulsion System Switchboard End 2  
Siemens Switchgear Unit (Made In Canada)  
ID# ASEZ278  Other ID# 88-111-795-001  
TYPE: 8BK20  KV: 4.76  
AMPS: 1200  CYCLES: 60  
B.I.L. KV60  DATE: April/95  

(Ref. picture #1)
AS FOUND CONDITION

- Switchgear was De-energized on arrival and the rear bottom panel covers were removed on sections 4 and 5 for (Gen # 4 and # 3)
- Feeder breakers for the Generators were removed, and so were the Surge arrestors and mounting bracket (Surge Arrestor were bad and the brackets were bent out of shape).
- Extensive damage in the rear of switchgear section 4 (Gen. #4) burnt insulators and melted disconnect contact fingers on all three phases,

(Ref. picture #2)
5kv rated red shrink tubing discolored and burnt.

(Ref. picture #3)
Damage to all three surge arrestors.

(Ref. picture #4)
Mounting brackets for the surge arrestors and frame damage,

(Ref. picture #5 and #6)
Red plastic boards with individual phase shutters badly burnt.
(Ref. picture #7, #8 and #9)

5KV 500 Marine type cables with extra damage.

(Ref. picture #10)
- Damage in the Voltage Transformer drawer of switchgear section 4 (Gen. #4) burnt insulators, All three voltage transformers, and blown fuses,
Red gastic boards with individual phase shutters.

- Extensive damage in the rear of switchgear section 5 (Gen. #3) burnt insulators, 5KV 500 Marine type cable with external damage, damage to all three surge arrestors, some mounting brackets and frame damage, red gastic boards with individual phase shutters badly burnt, disconnect contact fingers on all three phases tinsel strength bad on the springs, 5kv rated red shrink tubing discolored

(Ref. picture #2)

- Extensive damage in the Voltage Transformer drawer of switchgear section 5 (Gen. #3);
  All three Voltage Transformers, fuse clips and fuses, secondary control power wiring,

(Ref. picture #12)
Uninsulated braded wiring from fuse clips and from surge arrestors to the bus,

(Uninsulated braded 8/16" copper wire from bus to surge arrester)

(Ref. picture #13)

Red glastic boards with individual phase shutters.

(Ref. picture #8)
5.5KV, 0.5E, Type 35/94 HRC fuses

The shutter assemblies for the Voltage transformers for Gen. #3 and #4 all need to be replaced.

(Ref. picture #9)
ACTION TAKEN

- Performed device testing.
- Disassembled some bus and other parts in order to do troubleshooting and testing.

WRITTEN BY:

Loren Bailey Jr.
Sr. Field Service Technician
Customer Services
WSF - Tacoma
Propulsion System Switchboard Parts List
Recommended for repair
Extra spare parts recommended by
WSF-Engineering

- 2ea. Red glastic boards 29"x14"x¾" w/ all mounting holes drilled out and shutter mounting holes cut out.
- 2ea. Red glastic boards 30¾"x26½"x¾" w/ all mounting holes drilled out and shutter mounting holes cut out.
- 6ea. Disconnect fingers w/ total of 4 fingers on each.
- 18ea. 5kv Red insulators 6"H x 3¾"to 3¾" W
- 12ea. Single phase shutters (to install on red boards)
- 9ea. 5Kv Surge Arrestors: 3EFI C48-0, UR 4.8Kv, IN 1KA, K1994
- 6ea. Voltage Transformers: 35/35:1 ratio, 4200/120v, B.I.L. 60Kv, 300/300VA @ 30°C PTW3-1-60-SDO2298
- 6ea. BUSSMAN High Voltage fuses Type: H.R.C. ABWNA, 5Kv, 0.5E, 50000A Interrupting, 5½" L x 1" W
- 12ea. Fuse clips (to mount on VT's for the BUSSMAN High Voltage fuses).
- 20' roll of 3/8" Braided uninsulated copper wire.
- Uninsulated wire lugs w/ 10/23" screw hole, to fit on braided copper wire.
- 20' roll of ¾" Clear tubing (to put on the 3/8" Braided uninsulated copper wire).
- 2ea. Rear panel cover brackets.
- 2ea. Surge Arrestor mounting brackets.

- 3ea. Disconnect fingers w/ total of 4 fingers on each.
- 9ea. 5kv Red insulators 6"H x 3¾"to 3¾" W
- 3ea. 5Kv Surge Arrestors: 3EFI C48-0, UR 4.8Kv, IN 1KA, K1994
- 6ea. Voltage Transformers: 35/35:1 ratio, 4200/120v, B.I.L. 60Kv, 300/300VA @ 30°C PTW3-1-60-SDO2298
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Siemens Marine Solutions
Commissioning & Field Services Report

REPORT BY: Loren Bailey Jr
REPORT NO: n/a
DATE: 8/05 to 8/08/2014
JOB NO.: 5002295945
REPORT PERIOD: 8/05 to 8/08/2014

DISTRIBUTION:
SII/CS/Marine-Services

1. SERVICE / PROJECT NAME IDENTIFICATION:
   Washington-State-Ferry, WSF "Tacoma" 3AF Circuit Breaker Initial Examination

2. CUSTOMER & WORK LOCATION:
   Owner / Operator: WSF
   Vessel Name: "TACOMA"
   IMO No.: 1052576
   Contact Person: Staff C/E Ben Davis
   Work Location: Eagle Harbor
   City / State / Zip: Bainbridge, WAQ


3. **EQUIPMENT IDENTIFICATION**

    Propulsion System Switchboard End 2
    Siemens Switchgear Unit (Made In Canada)
    ID# ASEZ278       Other ID# 88-111-795-001
    TYPE: 8BK20       KV: 4.76
    AMPS: 1200        CYCLES: 60
    B.I.L. KV60       DATE: April/95

    Siemens Circuit Breakers
    TYPE: 3AF 1052.4
    VOLTAGE RATING: 4.76 Kv
    CURRENT RATING: 1200A
    CONTROL VOLTAGE: 20 TO 26 VDC

**AS FOUND CONDITION**

- Gen.# 4 breaker was sitting out of the switchgear area on a cart and Gen.# 3 breaker was sitting on deck in the switchgear #2 area.
- Both circuit breakers had black debris from fault all over them. #4 Gen. breaker had excessive amount of black debris.
- #4 Gen. breaker was missing it's name plate ID tag, and when doing the Integrity test on the vacuum bottles "B" phase failed. When doing the open timing test I found that timing was higher then expected based on previous 3AF breaker testing on the Puyallup ferry boat.
- #3 Gen. breaker I found that timing was also higher then expected.
**ACTION TAKEN**

- Inspected and tested 2 Siemens 3AF circuit breakers.
- The breaker testing performed included:
  - Contact Resistance testing in Microhms using a digital low resistance ohmmeter.
  - Insulation Resistance testing in Ohms using a 500 to 5000Vdc Megger.
  - Vacuum integrity testing of the Vacuum bottles using a 30KVAC hi-pot. Vacuum integrity testing was done as per manufactures operation maintenance booklet SG-3158-01, pg.29
  - Using a AC temp. power supply and a AC/DC rectifier in line for testing the electrical functions of the Closing and Tripping coils.
  - Timing test on the opening circuit using a Vanguard CB 7000 test set.
  - Checked wiring, micro switches, and aux. switches in the breakers.
- Had to clean the vacuum bottles off on both #3 and #4 Generator breakers before doing the vacuum integrity testing of the bottles.

**WRITTEN BY:**

Loren Bailey Jr.
Sr. Field Service Technician
Customer Services
MEDIUM VOLTAGE VACUUM CIRCUIT BREAKER TEST REPORT

Customer: WASHINGTON STATE FERRIES
Substation: Propulsion Switchboard # 2
Location: Tacoma Ferry
Feeder/Cubicle: # 3 Gen.
Unique ID: 

Nameplate Data

Manufacturer: Siemens
Type / Style: 3AF 1052-4
YR / Serial Number: CAN - 6535
IB Number: 60kV
Voltage Rating: 4.76kV
Current Rating: 1200A
Interrupting Rating: 31.5kA
Trip Coil / Close Coil: 20 TO 29 VDC

Inspection

Primary Fingers:
Vac. Contact Wear Indicators:
Vac. Contact Wipe Indicators:
Clean Bottles and Insulation:
Auxiliary Contacts:
Control Circuit Wiring: 

Charging Motor Operation:
Clean and Lubricate Mechanism:
Racking and Shutter Mechanism:
Mechanical Interlocks:
Electrical Charge Test:
Electrical Close and Trip Test:
Relay Trip Test:

Code Legend
A= Like New Condition
B= Good Condition
C= Poor Condition Requires Correction
D= Corrections Made
E= Unacceptable Condition Do Not Use!
NA= Not Applicable

Operation As Found: 8567
Operation As Left: 8571

Contact Gap / Wear Indication:

A Phase B Phase C Phase

OK OK OK

Electrical Tests

Insulation Resistance

As Found Readings in Gig-Ohms @ 2500 VDC
A-G > 500 A-B > 500 A-A' > 500
B-G > 500 B-C > 500 B-B' > 500
C-G > 500 C-A > 500 C-C' > 500

As Left
A-G > 500 A-B > 500 A-A' > 500
B-G > 500 B-C > 500 B-B' > 500
C-G > 500 C-A > 500 C-C' > 500

Control Wiring (Tested at 500 VDC)

2G

HIPOT Across Open VAC Contacts @ 14 kV AC or DC

Phase A (MA) Phase B (MA) Phase C (MA)
0.7 - Pass 0.7 - Pass 0.7 - Pass

Environmental Conditions

Indoor/Outdoor
Clean / Dirty
Wet / Damp / Dry
Temp (Degree C)
Relative Humidity (%)

Selection
Indoor
Dry
22%
40

Contact Resistance

Readings in Micro-Ohms

As Found As Left
A 27.6 A 27.6
B 30.8 B 30.8
C 31.6 C 31.6

COMMENTS

Satisfactory for Continued Service No Requires Repair Yes Repairs Made During Maintenance No

NOTE: Time Test - ms - cy

A0  - 55.95 - 3.34 1) Breaker is rated 3 cy. Did time test from close to open on breaker.
B0  - 55.80 - 3.35 2) Vacuum integrity testing was done as per manufacturers operation maintenance booklet SG-3156-01, pg.29
C0  - 55.50 - 3.33

Job No: 5002295945 Tested By: L.Bailey Jr. Date Tested: 8-15-2014 ID #

K. Rolley

810 SW 34th Street, Renton, WA 98057 425.656-4385

F1096AB-SW Rev. 0
Siemens Industrial Services
A business of Siemens Energy and Automation, Inc.

MEDIUM VOLTAGE VACUUM CIRCUIT BREAKER TEST REPORT

Customer: WASHINGTON STATE FERRIES
Substation: Propulsion Switchboard #2
Location: Tacoma Ferry

Nameplate Data

<table>
<thead>
<tr>
<th>Manufacturer: Siemens</th>
<th>Voltage Rating: 4.76kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type / Style: 3AF 1052-4</td>
<td>Current Rating: 1200A</td>
</tr>
<tr>
<td>YR / Serial Number: CAN - ?</td>
<td>Interrupting Rating: 31.5kA</td>
</tr>
<tr>
<td>IB Number: 60kV</td>
<td>Trip Coll / Close Coll: 20 TO 29 VDC</td>
</tr>
</tbody>
</table>

Inspection

<table>
<thead>
<tr>
<th>Primary Fingers: B</th>
<th>Charging Motor Operation: B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vac. Contact Wear Indicators: B</td>
<td>Clean and Lubricate Mechanism: C</td>
</tr>
<tr>
<td>Vac. Contact Wipe Indicators: B</td>
<td>Racking and Shutter Mechanism: NA</td>
</tr>
<tr>
<td>Clean Bottles and Insulation: D</td>
<td>Mechanical Interlocks: B</td>
</tr>
<tr>
<td>Auxiliary Contacts: B</td>
<td>Electrical Charge Test: B</td>
</tr>
<tr>
<td>Control Circuit Wiring: B</td>
<td>Electrical Close and Trip Test: B</td>
</tr>
<tr>
<td>Operation As Found: 9106</td>
<td>Relay Trip Test: NA</td>
</tr>
<tr>
<td>Operation As Left: 9110</td>
<td></td>
</tr>
</tbody>
</table>

Contact Gap / Wear Indication:

A Phase: OK  B Phase: OK  C Phase: OK

Electrical Tests

<table>
<thead>
<tr>
<th>Insulation Resistance</th>
<th>As Found</th>
<th>Readings in Gig-Ohms @ 2500 VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-G &gt; 500</td>
<td>B-C &gt; 500</td>
<td>B-B' &gt; 500</td>
</tr>
<tr>
<td>C-G &gt; 500</td>
<td>C-A &gt; 500</td>
<td>C-C' &gt; 500</td>
</tr>
<tr>
<td>Control Wiring (Tested at 500 VDC)</td>
<td>1G</td>
<td></td>
</tr>
</tbody>
</table>

HIPOT Across Open VAC Contacts @ 14 kV AC

Phase A (MA) | Phase B (MA) | Phase C (MA) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7 - Pass</td>
<td>0.7 - Pass</td>
<td>fail @ 8kV</td>
</tr>
</tbody>
</table>

Environmental Conditions

Indoor/Outdoor
Clean / Dirty
Wet / Damp / Dry
Temp (Degree C)
Relative Humidity (%)

Selection
Indoor
Dirty
Dry
22%
40

Contact Resistance

<table>
<thead>
<tr>
<th>Readings in Micro-Ohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>As Found</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
</tbody>
</table>

COMMENTS

Satisfactory for Continued Service

| No | Requires Repair | Yes |

NOTE: Time Test - ms - cy
1) Breaker is rated 3 cy. Did time test from close to open on breaker.
2) Vacuum integrity testing was done as per manufactures operation maintenance booklet SG-3158-01, pg.29
3) Name plate missing

Job No: 5002295945
Tested By: L. Bailey Jr.
Date Tested: 8-15-2014
ID # F1098AB-SW

K. Rolley
810 SW 34th Street, Renton, WA 98057
425.656-4385
Rev. 0
**BREAKER TIMING RESULTS - 60 Hz**

**SHOT NUMBER**: 0001  
**DATE**: 11/29/2011  
**TIME**: 15:19:38

**COMPANY**: WSF  
**STATION**: Puyallup Ferry  
**CIRCUIT**: SEW  
**MFR**: Siemens  
**MODEL**: 3AF1052 4  
**S/N**: CAN 0767  
**OPERATOR**: LB

**TEST**: OPEN

<table>
<thead>
<tr>
<th>CONTACT TIME</th>
<th>BOUNCE WIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH</td>
<td>TIME CYCLE</td>
</tr>
<tr>
<td>1</td>
<td>041.50</td>
</tr>
<tr>
<td>2</td>
<td>040.80</td>
</tr>
<tr>
<td>3</td>
<td>040.90</td>
</tr>
</tbody>
</table>

**DELTA TIME** <mS>: 000.80

**TRAVEL ANALYSIS** T1

| STROKE | in | 00.00 |
| SPEED | ft/s | 00.00 |
| OVER-TRAVEL | in | 00.00 |
| BOUNCE BACK | in | 00.00 |

**SPEED ANALYSIS**:
- **POINT 1**: 01.12 in
- **POINT 2**: 05.12 in

**V1 NOMINAL VOLTAGE**: 0 VOLTS  
**V1 MINIMUM VOLTAGE**: 0 VOLTS  
**INITIATOR CURRENT**: 19.5 AMPS

**SHOT LENGTH**: 1 SECOND  
**INSERTION RESISTOR**: NO  
**TRIGGER**: INTERNAL

---

**Vanguard Instrument Co., Inc.**, 1999-2009  
**1820 S. Hillman Ave., Ontario, CA 91761**  
**TEL**: (909) 923-9390  
**FAX**: (909) 923-8391  
**REF**: 2.047  
**OPERATION**: 0798  
**SERIAL NUMBER**: 70204  
**CLOSED THRESHOLD**: 017  
**OPENED THRESHOLD**: 200  
**SAMPLE**: 044  
**VOLTAGE**: 054  
**RESISTIVE CONTACT FILTER**: 001 SAMPLES
**BREAKER TIMING RESULTS - 60 Hz**

<table>
<thead>
<tr>
<th>SHOT NUMBER:</th>
<th>0002</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE:</td>
<td>11-30-11</td>
</tr>
<tr>
<td>TIME:</td>
<td>12:13:21</td>
</tr>
<tr>
<td>COMPANY:</td>
<td>WSF</td>
</tr>
<tr>
<td>STATION:</td>
<td>PUYALLUP FERRY</td>
</tr>
<tr>
<td>CIRCUIT:</td>
<td>GEN 2 SPARE</td>
</tr>
<tr>
<td>MFR:</td>
<td>SIEMENS</td>
</tr>
<tr>
<td>MODEL:</td>
<td>GAF1062 4</td>
</tr>
<tr>
<td>S/N:</td>
<td>CAN 0957</td>
</tr>
<tr>
<td>OPERATOR:</td>
<td>LB</td>
</tr>
<tr>
<td>Test:</td>
<td>OPEN</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CONTACT TIME</strong></th>
<th><strong>BOUNCE WIPE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>CH</td>
<td>TIME</td>
</tr>
<tr>
<td>1</td>
<td>040.80</td>
</tr>
<tr>
<td>2</td>
<td>040.90</td>
</tr>
<tr>
<td>3</td>
<td>041.30</td>
</tr>
</tbody>
</table>

**DELTA TIME (mS):** 0.50

<table>
<thead>
<tr>
<th><strong>TRAVEL ANALYSIS</strong></th>
<th><strong>T1</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>STROKE</td>
<td>00.00</td>
</tr>
<tr>
<td>SPEED</td>
<td>00.00</td>
</tr>
<tr>
<td>OVER-TRAVEL</td>
<td>00.00</td>
</tr>
<tr>
<td>BOUNCE BACK</td>
<td>00.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SPEED ANALYSIS:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>POINT 1 = 01.12 in</td>
</tr>
<tr>
<td>POINT 2 = 05.12 in</td>
</tr>
</tbody>
</table>

| **V1 NOMINAL VOLTAGE:** | 0 VOLTS |
| **V1 MINIMUM VOLTAGE:** | 0 VOLTS |
| **INITIATOR CURRENT:**  | 19.0 AMPS |

| **SHOT LENGTH:**       | 1 SECOND |
| **INSERTION RESISTOR:** | NO |
| **TRIGGER:**           | INTERNAL |

VANGUARD INSTRUMENT CO., HPN (C) 1998-2009
1520 S. HELLMAN AVE, ONTARIO, CA 91761
TEL (909) 923-9390 FAX (909) 923-9391
REV 2.047
OPERATION 0092
SERIAL NUMBER 70204
CLOSED THRESHOLD = 017 OPENED THRESHOLD = 200
SAMPLE = 044 VOLTAGE = 364
RESISTIVE CONTACT FILTER = .001 SAMPLES
# Breaker Timing Results - 60 Hz

**Shot Number:** 0002  
**Date:** 12/01/11  
**Time:** 06:33:26

**Company:** WSF  
**Station:** Puyallup Ferry  
**Circuit:** Spare  
**Mfr:** Siemens  
**Model:** SCAF1052 4  
**S/N:** CAN 0763  
**Operator:** LB

## Contact Time

<table>
<thead>
<tr>
<th>CH</th>
<th>Time Cycle</th>
<th>Bounce</th>
<th>Wipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>(mS)</td>
<td>(mS)</td>
<td>(in)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>041.20</td>
<td>02.47</td>
<td>000.30</td>
</tr>
<tr>
<td>2</td>
<td>040.80</td>
<td>02.45</td>
<td>000.20</td>
</tr>
<tr>
<td>3</td>
<td>040.60</td>
<td>02.44</td>
<td>000.10</td>
</tr>
</tbody>
</table>

**Delta Time (mS):** 000.60

## Stroke Analysis

- Stroke: in 00.00
- Speed: ft/s 00.00
- Over-Travel: in 00.00
- Bounce Back: in 00.00

## Speed Analysis:

- Point 1 = 01.12 in
- Point 2 = 05.12 in

## U1 Nominal Voltage = 0 Volts  
U1 Minimum Voltage = 0 Volts  
Initiator Current = 19.5 Amps

## Shot Length:

- 1 second
- Insertion Resistor: No  
- Trigger: Internal

---

Vanguard Instrument Co., HPN (C) 1998-2009  
1920 S. Hollman Ave, Ontario, CA 91761  
Tel: (909) 923-9380 Fax: (909) 923-9391  
Rev: 2.047  
Operation: 0004  
Serial Number: 70204  
Closed Threshold = 01.7  
Opened Threshold = 200  
Sample = 044  
Voltage = 064  
Resistive Contact Filter = 001 Samples
**BREAKER TIMING RESULTS - 60 Hz**

**SHOT NUMBER:** 0002  
**DATE:** 12/01/11  
**TIME:** 11:12:09

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>WSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATION</td>
<td>PUYALLUP FERRY</td>
</tr>
<tr>
<td>CIRCUIT</td>
<td>GEN 1</td>
</tr>
<tr>
<td>MFR</td>
<td>SIEMENS</td>
</tr>
<tr>
<td>MODEL</td>
<td>3AP1052-4</td>
</tr>
<tr>
<td>S/N</td>
<td>C8N 0769</td>
</tr>
<tr>
<td>OPERATOR</td>
<td>LB</td>
</tr>
</tbody>
</table>

**TEST:** OPEN

**CONTACT TIME**  
CH TIME CYCLE BOUNCE WIPE  

<table>
<thead>
<tr>
<th></th>
<th>&lt;ms&gt;</th>
<th>&lt;ms&gt;</th>
<th>&lt;in&gt;</th>
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<tbody>
<tr>
<td>1</td>
<td>044.40</td>
<td>02.66</td>
<td>000.20</td>
</tr>
<tr>
<td>2</td>
<td>047.60</td>
<td>02.96</td>
<td>000.10</td>
</tr>
<tr>
<td>3</td>
<td>047.60</td>
<td>02.86</td>
<td>000.10</td>
</tr>
</tbody>
</table>

**DELTA TIME** (ms): 003.20

**TRAVEL ANALYSIS T1**  
STROKE in 00.00  
SPEED ft/s 00.00  
OVER-TRAVEL in 00.00  
BOUNCE BACK in 00.00

**SPEED ANALYSIS:**  
POINT 1 = 01.12 in  
POINT 2 = 05.12 in

**U1 NOMINAL VOLTAGE = 0 VOLTS**  
**U1 MINIMUM VOLTAGE = 0 VOLTS**  
**INITIATOR CURRENT = 19.3 AMPS**

**SHOT LENGTH:** 1 SECOND  
**INSERTION RESISTOR:** NO  
**TRIGGER:** INTERNAL
## Breaker Timing Results - 60 Hz

**Shot Number:** 0003  
**Date:** 12/01/11  
**Time:** 14:29:38

**Company:** WSF  
**Station:** Puyallup Ferry  
**Circuit:** 1 Prop Xfmr  
**Mfr.:** Siemens  
**Model:** 3AF1052 4  
**S/N:** CAN 0771  
**Operator:** LB

### Test: Open

<table>
<thead>
<tr>
<th>CH</th>
<th>Time Cycle</th>
<th>Bounce Wipe</th>
<th>Delta Time</th>
<th>Bounce Back</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>043.60 02.62</td>
<td>000.20 00.00</td>
<td>000.50</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>043.10 02.59</td>
<td>000.10 00.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>043.10 02.59</td>
<td>000.10 00.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Travel Analysis T1

- **Stroke:** in 00.00
- **Speed:** ft/s 00.00

### Speed Analysis:

- **Point 1:** 01.12 in
- **Point 2:** 05.12 in

### U1 Nominal Voltage: 0 Volts  
**U1 Minimum Voltage:** 0 Volts  
**Initiator Current:** 19.4 Amps

### Shot Length:

- **1 Second**
- **Insertion Resistor:** No
- **Trigger:** Internal

---

Vanguard Instrument Co., MIP (C) 1998-2009
1920 S. Hillman Ave., Ontario, CA 91761
Tel (909) 922-9350 Fax (909) 922-9351

Rev: 2.047  
Operation: 0027  
Serial Number: 72024  
Closed Threshold = 017  
Opened Threshold = 200  
Sample = 044  
Voltage = 064  
Resistive Contact Filter = 001 Samples
**BREAKER TIMING RESULTS - 60 Hz**

**SHOT NUMBER:** 0004  
**DATE:** 12/01/11  
**TIME:** 16:01:39

<table>
<thead>
<tr>
<th>COMPANY:</th>
<th>WSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATION:</td>
<td>PUYALLUP FERRY</td>
</tr>
<tr>
<td>CIRCUIT:</td>
<td>3 PROP XFMRI TO 1 PX</td>
</tr>
<tr>
<td>MFR:</td>
<td>SIEMENS</td>
</tr>
<tr>
<td>MODEL:</td>
<td>3AF1052 4</td>
</tr>
<tr>
<td>SN:</td>
<td>CAN 0770</td>
</tr>
<tr>
<td>OPERATOR:</td>
<td>LB</td>
</tr>
</tbody>
</table>

**TEST:** OPEN

<table>
<thead>
<tr>
<th>CH</th>
<th>TIME CYCLE</th>
<th>BOUNCE WIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>039.00</td>
<td>02.34</td>
</tr>
<tr>
<td>2</td>
<td>039.00</td>
<td>02.34</td>
</tr>
<tr>
<td>3</td>
<td>039.70</td>
<td>02.38</td>
</tr>
</tbody>
</table>

| DELTA TIME (ms): | 000.70 |

**TRAVEL ANALYSIS T1**

<table>
<thead>
<tr>
<th>STROKE</th>
<th>in</th>
<th>00.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPEED</td>
<td>ft/s</td>
<td>00.00</td>
</tr>
<tr>
<td>OVER-TRAVEL</td>
<td>in</td>
<td>00.00</td>
</tr>
<tr>
<td>BOUNCE BACK</td>
<td>in</td>
<td>00.00</td>
</tr>
</tbody>
</table>

**SPEED ANALYSIS:**

<table>
<thead>
<tr>
<th>POINT 1</th>
<th>= 01.12 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>POINT 2</td>
<td>= 05.12 in</td>
</tr>
</tbody>
</table>

**U1 NOMINAL VOLTAGE:** 0 VOLTS  
**U1 MINIMUM VOLTAGE:** 0 VOLTS  
**INITIATOR CURRENT:** 19.3 AMPS

**SHOT LENGTH:** 1 SECOND  
**INSERTION RESISTOR:** NO  
**TRIGGER:** INTERNAL

---

VANGUARD INSTRUMENT CORP., INC.  
1800 S. HELLHAN AVE, ONTARIO, CA 91761  
TEL (909) 923-9930  
FAX (909) 923-9991  
RSR 3.047  
OPERATION: 0056  
SERIAL NUMBER: 70204  
CLOSED THRESHOLD: 017  
OPENED THRESHOLD: 200  
SAMPLE: 044  
VOLTAGE: 064  
RESISTIVE CONTACT FILTER: 001 SAMPLES
# Breaker Timing Results - 60 Hz

**Shot Number:** 0004  
**Date:** 12/02/11  
**Time:** 12:12:01

**Company:** WSF  
**Station:** Puyallup Ferry  
**Circuit:** 4 Prop Xfmr  
**Mfr:** Siemens  
**Model:** 3AF1052 4  
**S/N:** CAN 0765  
**Operator:** LB

## Contact Time

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Bounce</th>
<th>Wipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>044.70</td>
<td>02.46</td>
</tr>
<tr>
<td>2</td>
<td>044.40</td>
<td>02.66</td>
</tr>
<tr>
<td>3</td>
<td>045.00</td>
<td>02.70</td>
</tr>
</tbody>
</table>

**Delta Time (ms):** 000.60

## Travel Analysis T1

<table>
<thead>
<tr>
<th>Stroke</th>
<th>00.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>00.00</td>
</tr>
<tr>
<td>Over-Travel</td>
<td>00.00</td>
</tr>
<tr>
<td>Bounce Back</td>
<td>00.00</td>
</tr>
</tbody>
</table>

## Speed Analysis:

- **Point 1:** 01.12 in
- **Point 2:** 05.12 in

## V1 Nominal Voltage = 0 Volts
## V1 Minimum Voltage = 0 Volts
## Initiator Current = 19.5 Amps

**Shot Length:** 1 Second  
**Insertion Resistor:** No  
**Trigger:** Internal
# Breaker Timing Results - 60 Hz

**Shot Number:** 0005  
**Date:** 12/02/11  
**Time:** 14:51:04

**Company:** WGF  
**Station:** PUYALLUP FERRY  
**Circuit:** GEN 3  
**Mfr:** SIEMENS  
**Model:** 3AF1052 4  
**S/N:** GAN 0766  
**Operator:** LB

## Test: Open

<table>
<thead>
<tr>
<th>CH</th>
<th>Time</th>
<th>Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>036.10</td>
<td>02.29</td>
</tr>
<tr>
<td>2</td>
<td>037.10</td>
<td>02.29</td>
</tr>
<tr>
<td>3</td>
<td>037.60</td>
<td>02.29</td>
</tr>
</tbody>
</table>

**Delta Time (ms):** 001.00

### Travel Analysis T1
- Stroke: 00.00
- Speed: 0 ft/s
- Over-Travel: 00.00
- Bounce Back: 00.00

**Speed Analysis:**
- Point 1 = 01.12 in
- Point 2 = 05.12 in

**U1 Nominal Voltage:** 0 Volts  
**U1 Minimum Voltage:** 0 Volts  
**Initiator Current:** 19.5 Amps

**Shot Length:** 1 Second  
**Insertion Resistor:** No  
**Trigger:** Internal

---

**Temperature:**
- **Current:** 39.7°C
- **Humidity:** 46%
### BREAKER TIMING RESULTS - 60 Hz

**SHOT NUMBER:** 0006  
**DATE:** 12/02/11  
**TIME:** 16:13:23

**COMPANY:** WSF  
**STATION:** PUYALLUP FERRY  
**CIRCUIT:** 2 PROP XFRM  
**MFR:** SIEMENS  
**MODEL:** 3AF1052 4  
**S/N:** CAN 0748  
**OPERATOR:** LB

**TEST:** OPEN

<table>
<thead>
<tr>
<th>CH</th>
<th>TIME</th>
<th>CYCLE</th>
<th>BOUNCE</th>
<th>WIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(ms)</td>
<td>(ms)</td>
<td>(in)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>044.30</td>
<td>02.66</td>
<td>000.10</td>
<td>00.00</td>
</tr>
<tr>
<td>2</td>
<td>044.40</td>
<td>02.66</td>
<td>000.20</td>
<td>00.00</td>
</tr>
<tr>
<td>3</td>
<td>044.60</td>
<td>02.69</td>
<td>000.20</td>
<td>00.00</td>
</tr>
</tbody>
</table>

**DELTA TIME (ms):** 000.30

**TRAVEL ANALYSIS T1**

<table>
<thead>
<tr>
<th>STROKE</th>
<th>in</th>
<th>00.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPEED</td>
<td>ft/s</td>
<td>00.00</td>
</tr>
<tr>
<td>OVER-TRADE</td>
<td>in</td>
<td>00.00</td>
</tr>
<tr>
<td>BOUNCE BACK</td>
<td>in</td>
<td>00.00</td>
</tr>
</tbody>
</table>

**SPEED ANALYSIS:**

<table>
<thead>
<tr>
<th>POINT 1</th>
<th>= 01.12 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>POINT 2</td>
<td>= 05.12 in</td>
</tr>
</tbody>
</table>

**V1 NOMINAL VOLTAGE = 0 VOLTS**  
**V1 MINIMUM VOLTAGE = 0 VOLTS**  
**INITIATOR CURRENT = 18.5 AMPS**

<table>
<thead>
<tr>
<th>SHOT LENGTH:</th>
<th>1 SECOND</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSERTION RESISTOR:</td>
<td>NO</td>
</tr>
<tr>
<td>TRIGGER:</td>
<td>INTERNAL</td>
</tr>
</tbody>
</table>

**ANGELWARD INSTRUMENT CO., NPH (C) 1988-2009**  
**P.O. BOX 30, MELBOURNE, FL 32903-7020**  
**TEL: (305) 322-9901 FAX (305) 322-9931**  
**REV: 2 047**  
**S+PDU 0280**  
**S+PDU NUMBER: 70204**  
**CLOSED THRESHOLD = 0.17 OPENED THRESHOLD = 200**  
**SAMPLE - M4 VOLTAGE = 64**  
**RESISTIVE CONTACT FILTER = 001 SAMPLES**
### Breaker Timing Results - 60 Hz

**Shot Number:** 2  
**Date:** 08/15/14  
**Time:** 12:36:03

**Company:** WSF Tacoma  
**Station:** NO 2 End  
**Circuit:** NO 3 Gen  
**Mfr:** Siemens  
**Model:** 3AE 1052 4  
**S/N:** CAN 0535  
**Operator:** LB

**Test:** Open

<table>
<thead>
<tr>
<th>CH</th>
<th>Time Cycle (ms)</th>
<th>Contact Time Bounce (ms)</th>
<th>Contact Time Wick (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>55.95</td>
<td>3.34</td>
<td>0.05</td>
</tr>
<tr>
<td>2</td>
<td>55.80</td>
<td>3.35</td>
<td>0.10</td>
</tr>
<tr>
<td>3</td>
<td>55.50</td>
<td>3.33</td>
<td>0.05</td>
</tr>
</tbody>
</table>

**Delta Time (ms):** 0.45

**Travel Analysis:**  
**Stroke:** 0.00 in  
**Speed:** 0.00 ft/s  
**Over-Travel:** 0.00 in  
**Bounce Back:** 0.00 in

**Speed Analysis:**  
**Point 1:** 0.75 in  
**Point 2:** 3.00 in

**U1 Nominal Voltage:** 0 Volts  
**U1 Minimum Voltage:** 0 Volts  
**Initiator Current:** 16.6 Amps

**Shot Length:** 1 Second  
**Insertion Resistor:** No  
**Trigger:** Internal
BREATHER TIMING RESULTS - 60 Hz

SHOT NUMBER: 2
DATE: 08/15/14  TIME: 13:07:16

COMPANY: WSF TACOMA
STATION: NO 2 END
CIRCUIT: NO & GEN
MFR: SIEMENS
MODEL: 3AE 1052 4
S/N: CAN 0005
OPERATOR: LB

TEST: OPEN

<table>
<thead>
<tr>
<th>CONTACT TIME</th>
<th>TIME CYCLE</th>
<th>BOUNCE</th>
<th>WIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH</td>
<td>(ms)</td>
<td>(ms)</td>
<td>(in)</td>
</tr>
<tr>
<td>1</td>
<td>58.95</td>
<td>3.52</td>
<td>0.05</td>
</tr>
<tr>
<td>2</td>
<td>58.70</td>
<td>3.52</td>
<td>0.05</td>
</tr>
<tr>
<td>3</td>
<td>58.70</td>
<td>3.52</td>
<td>0.05</td>
</tr>
</tbody>
</table>

DELTA TIME (ms): 0.25

TRAVEL ANALYSIS: T1 STROKE in 0.00
SPEED ft/s 0.00
OVER-TRAVEL in 0.00
BOUNCE BACK in 0.00

SPEED ANALYSIS:
POINT 1 = 20%
POINT 2 = 3.00 in

V1 NOMINAL VOLTAGE = 0 VOLTS
V1 MINIMUM VOLTAGE = 0 VOLTS
INITIATOR CURRENT = 12.0 AMPS

SHOT LENGTH:
INSERTION RESISTOR: NO TRIGGER: INTERNAL

UANGUARD INSTRUMENTS CO., INC. REV 1.27 (C) 2006-2011
ONTARIO, CA. 91761, USA
ON (909) 923-9390 FAX (909) 923-9391
WWW.VANGUARD-INSTRUMENTS.COM
SERIAL NUMBER: 71167
OPERATION: 345
CLOSED THRESHOLD = 272  OPEN THRESHOLD = 2400
SAMPLE = 600  VOLTAGE = 1
RESISTIVE CONTACT FILTER = 1 SAMPLES