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1	1	Design Authority	<i>[Signature]</i>	2-4-98	74-20	1	1	Elec. Cog.	<i>[Signature]</i>	2/4/98	
1	1	Design Agent	<i>[Signature]</i>	2-4-98	74-20	1	1	HVAC Cog	<i>[Signature]</i>	2/5/98	
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1	1	Cog. Mgr.	<i>[Signature]</i>	2/11/98	74-20						
1	1	QA	<i>[Signature]</i>	2/04/98	74-15						
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Acceptance Test Report MICON Software Exhaust Fan Control

R. D. Keck

Babcock & Wilcox Hanford Company, Richland, WA 99352
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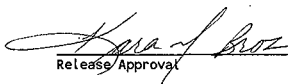
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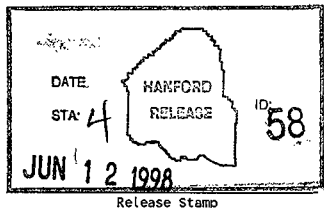
Abstract: This report details the results of acceptance testing for the MICON software upgrades needed to control two emergency exhaust fans in the event of a power outage.

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Release Approval Date



Approved for Public Release

Acceptance Test Procedure
 MICON Software
 Exhaust Fan Control

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Acceptance Test Procedure
MICON Software
Exhaust Fan Control

1. GENERAL

1.1 Scope

This test procedure specifies instructions for acceptance testing of software for exhaust fan control under Project ESPC (Energy Savings Performance Contract). The software controls the operation of two emergency exhaust fans when there is a power failure.

1.2 References

Drawings

400474-101 Rev. A - "RVSS Wiring Diagram 91TE W/CPT NEMA 12 w/Isolation"

Engineering Change Notices (ECN)

ESPC-643006

Prior to final test approval, enter below ECNs written against this ATP.

1.3 Responsibilities

1.3.1 General

Each company or organization participating in this ATP will designate personnel to assume the responsibilities and duties as defined herein for their respective roles. The designees shall become familiar with this ATP and the systems involved to the extent that they can perform their assigned duties.

1.3.2 Test Director (PFP Electrical Power and Control Cognizant Engineer or MICON Cognizant Engineer)

Coordinates and directs acceptance testing.

Initials each test section as it is completed.

Initiates ECNs to document required changes to the ATP.

Reviews recorded data, discrepancies, and exceptions.

Obtains information or changes necessary to clear or resolve objections during the performance of the test.

Signs Test Approval page when test has been performed.

Obtains required signatures on the ATP Master prior to reproduction and distribution.

1.3.3 WITNESSES (Provided by Participating Organizations. One witness shall be a QC inspector.)

Witness the tests.

Review results of testing.

Assist the Test Director when requested.

1.4 Software Requirements

Part of Project ESPC modifies the MICON software to add logic to control two emergency exhaust fans. The MICON software will assure:

- 1) One and only one fan will operate at all times (EF-1 or EF-2).
- 2) If the operating fan shuts off or fails, the other fan will start and the operating fan will be stopped. Also, if high-high plenum pressure is detected for more than 30 seconds, the backup fan will be started (if available) and the running fan will be stopped.
- 3) The operator can switch fans only if a fan is running, both fans are in AUTO control, the fans are powered by normal power, the non-running fan is operable, and any alarm condition for the non-running fan has been RESET by the operator. To switch fans, the operator must start the non-running fan. The run signals for both fans will be on simultaneously for 15 seconds, after which the run signal for the operating fan will be turned off.
- 4) If there is a power failure and the emergency generators are started up, there is a 25 second delay to allow time for the generators to start and begin supplying power to the fan. If the operating fan cannot begin re-starting within 25 seconds, the backup fan will be started.
- 5) Under all other power failure conditions, 6 seconds is allowed for the operating fan to begin re-starting.
- 6) If the ATS-2 is placed in Emergency Bypass, the MICON will act as if there were an ATS-2 power failure.
- 7) To avoid having both fans trying to start simultaneously, the run signals for both fans will be on only when one fan is up to speed and fans are being switched by the operator (see #3 above). In all other cases, therefore, the run signal for the failing fan must be turned off before the run signal for the backup fan is turned on.
- 8) When an operating fan is re-started due to a power failure, a faster startup curve will be used if the starter can be engaged within 45 seconds after the power failure.

- 9) If there is a loss of ATS-2 normal power, all three generators will be started regardless of load conditions.
- 10) If the ATS-2 fails to transfer to emergency power within 30 seconds, an ATS-2 FAIL alarm will be generated (change from 2 minutes previously).
- 11) If there is a power failure and two or less generators are running, loads will be shed to assure that adequate power is available to re-start and run the fan. If there is only one generator running, CLC is load shed immediately whenever a fan is being re-started and then CLC is restored after the fan is up to speed, independent of the total load on the generator. Other load shedding is based on the following cut-offs:

	<u>1 Gen</u>	<u>2 Gen</u>	
Instant Shed	500 KVA	1000 KVA	(3 sec delay)
Delayed Shed	400 KVA	800 KVA	(30 sec delay)
Un-Shed	300 KVA	600 KVA	(10 sec delay)

234-5Z and ATS-3/4 are shed first. If further shedding is needed, 2736-ZB is shed. For example, if one generator is running and the total load is 550 KVA, then 234-5Z and ATS-3/4 are shed after 3 seconds. If the total load is still above 500 KVA after 10 seconds, then 2736-ZB is shed. If the total load drops to under 300 KVA after 10 seconds, loads are restored in the reverse order they were shed. To avoid cycling, however, the same load cannot be restored twice within ten minutes. Loads are restored only if the total load is below the unshed value.

- 12) The following conditions will trigger an alarm and DCS event to be printed on the MICON printer:

- ATS-2 placed in Normal Power Bypass
- ATS-2 placed in Emergency Power Bypass
- Fan abnormal condition due to:
 - Starter fault contact or fan interlock active
 - Fan switch in OFF position
 - Fan switch in HAND position
 - Starter fails to engage within a time limit
 - Motor not up to speed within a time limit
- High-high plenum pressure for more than 30 seconds
- High plenum pressure for more than 30 seconds
- Loads being shed
- Loads being restored

- 13) The indicator lights will reflect fan status as follows:

Status of Fan	Red Light	Green Light
RUNNING	ON	OFF
STOPPED	OFF	ON
STARTING	ON	ON
WAITING	OFF	OFF
FAILED	*	FLASHING
HAND	*	FLASHING

* Red light may be ON or OFF depending on status of starter engaged

1.5 Test Conditions and Equipment Required

Supplied by Test Operator unless otherwise noted.

There will be one analog and one digital test box to simulate inputs to the MICON controller cards in order to test and verify the MICON logic.

1.6 Change Control

Technical changes to this test procedure shall be authorized by an ECN. Technical changes shall be signed by the Cognizant Engineer and the QA Engineer or his representative. Record these changes on the exception sheet in Section 3 and section 1.2. Administrative changes, including order of turning on/off inputs or verifications, may be authorized by the Electrical Power and Control or MICON Cognizant Engineer and shall be recorded in black ink on the instruction page. Errors/exceptions in the ATP itself shall NOT be processed as test exceptions. Also, individual test sections may be done in any order at the Test Director's discretion.

1.7 Occupational Safety and Health

In order to accomplish the work in this ATP, it is necessary to have the equipment or circuit energized. Complete testing requires installation and removal of a 24 VDC test box.

1.8 Exceptions

Exceptions to the required test results shall be sequentially numbered and recorded on the exception forms.

Number each exception sequentially as it occurs and record it on the exception form.

Enter disposition to resolve each exception when such determination is made.

NOTE: Errors/exceptions in the ATP itself shall NOT be processed as test exceptions (see Section 1.6 CHANGE CONTROL). Also, individual test sections may be done in any order at the Test Director's discretion and this practice shall not be considered a test exception.

2. ACCEPTANCE TEST

~~2.0~~ 2.1 Test Conditions

2.1.1 Test Terminology

Turn ON - Move switch on test box from OFF (Open) position to ON (Closed) Position.

Turn OFF - Move switch on test box from ON (Closed) position to OFF (Open) Position.

Verify ON - Verify the output LED on the specified point is ON.

Verify OFF - Verify the output LED on the specified point is OFF.

Verify alarm - Verify alarm on DCS monitor.

Verify DCS Event Printed - Verify event printed on DCS line printer.

Set analog - Adjust knob on analog test box until desired value is obtained (values can be approximate at the Test Director's discretion)

2.1.2 Analog Test Box Connections

Connect the Analog Test Box to the following inputs with all inputs set to their normal values.

Input #	Description	Slot No.	Point No.
1	NP-VF1-3 Voltage	IV	1
2	Gen 1 KW	IV	2
3	Gen 1 KVAR	IV	3
4	Gen 3 KW	IV	4
5	EGS Bus Phase A Volts	IV	5
6	EGS Bus Phase B Volts	IV	6
7	EGS Bus Phase C Volts	IV	7
8	CB-2 Phase A Current	IV	8
9	CB-2 Phase B Current	IV	9
10	CB-2 Phase C Current	IV	10
11	CB-4 Phase A Current	IV	11
12	CB-4 Phase B Current	IV	12
13	CB-4 Phase C Current	IV	13
14	Not Used		
15	Not Used		
16	NP-VF1-3 Frequency	III	1
17	Gen 2 KW	III	2
18	Gen 2 KVAR	III	3
19	Gen 3 KVAR	III	4
20	CB-1 Phase A Current	III	5
21	CB-1 Phase B Current	III	6
22	CB-1 Phase C Current	III	7
23	CB-3 Phase A Current	III	8
24	CB-3 Phase B Current	III	9
25	CB-3 Phase C Current	III	10
26	Exhaust Plenum Pressure	III	11
27	Exhaust Plenum Pressure (redundant)	IV	15

~~2.2~~ 2.2 Re-test of CB-1, CB-2, and CB-4

~~2.2.1~~ 2.2.1 Digital Test Box Connections

Connect Test Box to the following inputs with all inputs OFF

Input #	Description	Slot No.	Point No.
1	Gen 1 On Line	IV	2
2	ATS-2 Engine Start Call	IV	3
3	234-5Z SWGR F8X309 Closed	IV	11
4	234-5Z SWGR F8X309 Open	IV	12
5	ATS-2 Norm Position	IV	15
6	ATS-2 Emer Position	IV	16
7	CB-1 Closed	IV	18
8	Gen 2 On Line	V	2
9	ATS-3 Engine Start Call	V	3
10	ATS-4 Norm Position	V	8
11	ATS-4 Emer Position	V	9
12	CB-2 Closed	V	15
13	ATS-3 Emer Position	V	16
14	ATS-3 Norm Position	V	17
15	CB-3 Closed	V	18
16	Gen 3 On Line	VI	2
17	ATS-4 Engine Start Call	VI	3
18	EGS Bus Over/Under Volt 2721-Z	VI	8
19	EGS Bus Over/Under Freq 2721-Z	VI	9
20	O/U Volt/Freq Reset	VI	15
21	234-5Z Start Call	VI	17
22	CB-4 Closed	VI	18
23	ATS-2 Engine Start Call (Redundant)	VI	19
24	NP-VF-1-3 Closed	V	19
25	Gen 1 Running	IV	5
26	Gen 1 Mode in Auto	IV	6
27	ATS-2 Emergency Power Bypass	III	21
28	Gen 2 Mode in Auto	V	6
29	Gen 3 Mode in Auto	VI	6
30	Gen 2 Running	V	5

2.2.2 CB-1 Breaker Controls

NOTE: Numbers in parentheses refer to digital test box inputs;
 Numbers in brackets refer to analog test inputs

Action	2721-Z CBI
Breaker Open	
Turn ON	CB-1 Closed (7)
	EGS Bus Over/Under Volt 2721-Z (18)
	EGS Bus Over/Under Freq 2721-Z (19)
Set analog input (NP-VF-1 out of limits)	Panel NP-VF-1 Bus Frequency to 0% [16]
Wait 10 seconds	
Set analog inputs (NP-VF-1 in limits)	Panel NP-VF-1 Bus Voltage to 100% (480 vac) [1]
	Panel NP-VF-1 Bus Frequency to 50% (60 Hz) [16]
Wait 30 seconds	
Verify 5 second pulse	CB-1 Open (Slot I Point 10)
Verify DCS event printed	TR_CB1 Open 2721-Z CB-1 Breaker
Turn OFF	CB-1 Closed (7)
After 5 second delay, Verify no pulse	CB-1 Open (Slot I Point 10)
Set analog input (NP-VF-1 out of limits)	Panel NP-VF-1 Bus Voltage to 0% [1]
Turn ON	CB-1 Closed (7)
Turn OFF (2721-Z out of limits)	EGS Bus Over/Under Volt 2721-Z (18)
Verify 5 second pulse	CB-1 Open (Slot I Point 10)
Verify DCS event printed	BS_OU_V Gen 2721 Bus Hi/Lo Volts
Turn ON (2721-Z in limits)	EGS Bus Over/Under Volt 2721-Z (18)
Verify no pulse (after 5 sec)	CB-1 Open (Slot I Point 10)
Turn OFF (2721-Z out of limits)	EGS Bus Over/Under Freq 2721-Z (19)

Action	2721-Z CBI
Verify 5 second pulse	CB-1 Open (Slot I Point 10)
Verify DCS event printed	BS_OU_F Gen 2721 Bus Hi/Lo Freq
Breaker Close	
Turn OFF	CB-1 Closed (7)
If needed, reset ZB PERM from the console.	
Set analogs (NP-VF-1 in limits)	Panel NP-VF-1 Bus Voltage to 100% (480 vac) [1]
	Panel NP-VF-1 Bus Frequency to 50% (60 Hz) [16]
Turn ON (2721-Z in limits)	EGS Bus Over/Under Freq 2721-Z (19)
Verify no pulse (after 5 sec)	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Set analog (NP-VF-1 out of limits)	Panel NP-VF-1 Bus Voltage to 0% [1]
Verify 5 second pulse	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Verify DCS event printed	CL_CBI Close 2721 CB-1 Breaker
Turn ON	NP-VF-1-3 Closed (24)
Verify no pulse after 5 seconds	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Turn OFF	NP-VF-1-3 Closed (24)
Verify 5 second pulse	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Set analog (NP-VF-1 still out of limits)	Panel NP-VF-1 Bus Voltage to 100% (480 vac) [1]
	Panel NP-VF-1 Bus Frequency to 0% [16]

Action	2721-Z CBI
Verify 5 second pulse	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Turn OFF (2721-Z out of limits)	EGS Bus Over/Under Volt 2721-Z (18)
Verify no pulse after 5 seconds	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Turn ON (2721-Z in limits)	EGS Bus Over/Under Volt 2721-Z (18)
Verify 5 second pulse	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Turn OFF (2721-Z out of limits)	EGS Bus Over/Under Freq 2721-Z (19)
Verify no pulse after 5 seconds	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Turn ON (2721-Z in limits)	EGS Bus Over/Under Freq 2721-Z (19)
Verify 5 second pulse	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Turn ON	CB-1 Closed (7)
Verify no pulse after 5 seconds	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Turn OFF	CB-1 Closed (7)

Action	2721-Z CBI
Verify no pulse after 5 seconds	CB-1 Close (Slot I Point 9) CB-1 Synchronizer Bypass (Slot III Point 16)
Verify DCS event printed	ZB_PERM No Control ZB MCC Pwr Breakers
Verify alarm ON	ZB PERM
Reset ZB breaker controls from display	
Verify 5 second pulse	CB-1 Close (Slot I Point 9)
	CB-1 Synchronizer Bypass (Slot III Point 16)
Test Successful	<i>SSP</i>

SSP 2.2.3 CB-2 and CB-4 Breaker Controls

Action	2721-Z	
	CB2	CB4
Breaker Open		
Turn ON	CB2 Closed (12)	CB4 Closed (22)
	Gen 1 On Line (1)	Gen 1 On Line (1)
Turn OFF	ATS-3 Engine Start Call (9)	234-5Z Engine Start Call (21)
	ATS-4 Engine Start Call (17)	n/a
	ATS-3 Normal Position (14)	F8X309 Open (4)
	ATS-4 Normal Position (10)	n/a
Turn OFF	Gen 1 On Line (1)	Gen 1 On Line (1)
Verify ON	CB2 Open (Slot III Point 11)	CB4 Open (Slot I Point 12)
Verify DCS event printed	TR CB2 Open 2721 CB-2 Breaker	TR CB4 Open 2721 CB-4 Breaker

Action	2721-Z	
	CB2	CB4
Turn OFF	CB2 Closed (12)	CB4 Closed (22)
Verify OFF after 5 seconds	CB2 Open (Slot III Point 11)	CB4 Open (Slot I Point 12)
Turn ON	CB2 Closed (12)	CB4 Closed (22)
	Gen 2 On Line (8)	Gen 2 On Line (8)
Turn ON	ATS-3 Normal Position (14)	F8X309 Open (4)
	ATS-4 Normal Position (10)	n/a
Verify ON	CB2 Open (Slot III Point 11)	CB4 Open (Slot I Point 12)
Turn OFF	CB2 Closed (12)	CB4 Closed (22)
Verify OFF after 5 seconds	CB2 Open (Slot III Point 11)	CB4 Open (Slot I Point 12)
Turn ON	CB2 Closed (12)	CB4 Closed (22)
Verify ON	CB2 Open (Slot III Point 11)	CB4 Open (Slot I Point 12)
Turn ON	ATS-3 Engine Start Call (9)	234-5Z Engine Start Call (21)
Verify OFF after 5 seconds	CB2 Open (Slot III Point 11)	CB4 Open (Slot I Point 12)
Turn OFF	ATS-3 Engine Start Call (9)	234-5Z Engine Start Call (21)
Verify ON	CB2 Open (Slot III Point 11)	CB4 Open (Slot I Point 12)
Turn ON	ATS-4 Engine Start Call (17)	n/a
Verify OFF after 5 seconds	CB2 Open (Slot III Point 11)	n/a
Turn OFF	ATS-4 Engine Start Call (17)	n/a
Verify ON	CB2 Open (Slot III Point 11)	n/a

Action	2721-Z	
	CB2	CB4
Turn OFF	Gen 2 On Line (8)	Gen 2 On Line (8)
Breaker Close		
Turn OFF	CB2 Closed (12)	CB4 Closed (22)
Turn ON	Gen 1 On Line (1)	Gen 3 On Line (16)
Turn ON	ATS-3 Engine Start Call (9)	234-5Z Engine Start Call (21)
Verify ON for 5 seconds	CB2 Close (Slot III Point 10)	CB4 Close (Slot I Point 11)
Verify DCS event printed	CL CB2 Close 2721 CB-2 Breaker	CL CB4 Close 2721 CB-4 Breaker
Turn OFF	ATS-3 Engine Start Call (9)	234-5Z Engine Start Call (21)
Turn ON	ATS-4 Engine Start Call (17)	n/a
Verify ON for 5 seconds	CB2 Close (Slot III Point 10)	n/a
Turn OFF	ATS-4 Engine Start Call (17)	n/a
Turn OFF	Gen 1 On Line (1)	Gen 3 On Line (16)
Turn ON	ATS-4 Engine Start Call (17)	234-5Z Engine Start Call (21)
Verify OFF	CB2 Close (Slot III Point 10)	CB2 Close (Slot I Point 11)
Test Successful	<i>ADD</i>	<i>ADD</i>

2.3 Re-test of ATS-2 Start Call (Partial)

Action	ATS-2	ATS-2 Bypass
Turn ON	Gen 1 Mode in Auto (26) Gen 2 Mode in Auto (28) Gen 3 Mode in Auto (29) ATS-2 Engine Start Call (2)	Gen 1 Mode in Auto (26) Gen 2 Mode in Auto (28) Gen 3 Mode in Auto (29) ATS-2 Emer Pwr Bypass (27)
Verify ON	Gen 1 Start (Slot I Point 4) Gen 2 Start (Slot II Point 4) Gen 3 Start (Slot III Point 4)	Gen 1 Start (Slot I Point 4) Gen 2 Start (Slot II Point 4) Gen 3 Start (Slot III Point 4)
Verify alarm and DCS event printed	ATS-2 Normal Power Fail	ATS-2 Emergency Power Bypass
Turn ON	Gen 1 Running (25)	Gen 2 Running (30)
Verify a 0.2 second pulse repeating every 12 sec	Gen 1 Sync Aux (Slot I Point 7)	Gen 2 Sync Aux (Slot II Point 7)
Turn ON	Gen 1 On Line (1)	Gen 2 On Line (8)
Verify ON for 5 seconds	CB-3 Close (Slot II Point 11)	CB-3 Close (Slot II Point 11)
Verify pulse stops	Gen 1 Sync Aux (Slot I Point 7)	Gen 2 Sync Aux (Slot II Point 7)
Verify ON	Generator On Line (Slot I Point 17)	Generator On Line (Slot I Point 17)
Wait 30 sec		
Verify alarm and DCS event printed	"ATS-2 failed to transfer"	"ATS-2 failed to transfer"
Test Successful	<i>SD</i>	<i>SD</i>

2.4 Exhaust Fan Control

2.4.1 Digital Test Box Connections

Jumperwire the following from "+" to "COM"

Gen 1 Mode in Auto	IV	6
Gen 2 Mode in Auto	V	6
Gen 3 Mode in Auto	VI	6
Generator Bus O/U Voltage	VI	8

Connect the Digital Test Box to the following inputs with all inputs OFF.

Input #	Description	Slot No.	Point No.
1	Fan 1 starter engaged	I	20
2	Fan 1 in HAND position	I	21
3	Fan 1 in AUTO position	I	22
4	Fan 1 starter fault OK	I	23
5	Fan 1 up to speed	I	25
6	Fan 2 starter engaged	II	20
7	Fan 2 in HAND position	II	21
8	Fan 2 in AUTO position	II	22
9	Fan 2 starter fault OK	II	23
10	Fan 2 up to speed	II	25
11	Fan 2 up to speed (redundant)	I	26
12	Fan 1 up to speed (redundant)	II	26
13	Fan 2 starter engaged (redundant)	I	27
14	Fan 1 starter engaged (redundant)	II	27
15	CLC load isolation position	III	18
16	ATS-2 Engine Start Call	IV	3
17	ATS-2 Engine Start Call (redundant)	VI	19
18	ATS-2 Emergency Power Bypass	III	21
19	Fan 1 or 2 start command (321A)	I-VI	7
20	Fan 1 or 2 reset command (321A) (for points 19 and 20, the same card will be used for either input)	I-VI	1
21	CB-1 Closed	IV	18
22	Generator Bus O/U Frequency	VI	9
23	ATS-2 in NORMAL position	IV	15
24	Gen 1 On Line	IV	2
25	Gen 2 On Line	V	2
26	Gen 3 On Line	VI	2
27	ATS-3 Engine Start Call	V	3
28	ATS-4 Engine Start Call	VI	3
29	234-5Z Start Call	VI	17

see 2.4.2 Table of Output Points

The following is a list of MICON discrete output points to be verified during the exhaust fan ATP

Description	Slot No.	Point No.
Fan 1 or 2 green light (321A)*	I-VI	8
Fan 1 or 2 red light (321A)*	I-VI	9
Fan 1 run signal	I	19
Fan 1 alternate curve selection	I	24
Fan 2 run signal	II	19
Fan 2 alternate curve selection	II	24
CLC load isolation	III	19
CB-1 Open	I	10
CB-2 Open	III	11
CB-4 Open	I	12
CB-1 Close	I	9
CB-2 Close	III	10
CB-4 Close	I	11

* The same card will be used for either output. The program will be changed to match the test performed.

APP 2.4.3 Selection of Proper Startup Curve

Action	Fan 1 test	Fan 2 test
Turn ON	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 in AUTO (3) Fan 1 up to speed (5/12)	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 in AUTO (8) Fan 2 up to speed (10/11)
Turn OFF	Fan 1 in AUTO (3) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 in AUTO (8) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Wait 30 sec		
Turn ON	Fan 1 starter engaged (1/14) Fan 1 in AUTO (3)	Fan 2 starter engaged (6/13) Fan 2 in AUTO (8)
Verify ON	Fan 1 run signal (Slot I Point 19) Fan 1 curve selection (Slot I Point 24)	Fan 2 run signal (Slot II Point 19) Fan 2 curve selection (Slot II Point 24)
Turn ON	Fan 1 up to speed (5/12)	Fan 2 up to speed (10/11)
Wait 30 sec		
Verify ON	Fan 1 curve selection (Slot I Point 24)	Fan 2 curve selection (Slot II Point 24)
Turn OFF	Fan 1 in AUTO (3) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 in AUTO (8) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Wait 60 sec		
Turn ON	Fan 1 starter engaged (1/14) Fan 1 in AUTO (3)	Fan 2 starter engaged (6/13) Fan 2 in AUTO (8)
Verify ON	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Verify OFF	Fan 1 curve selection (Slot I Point 24)	Fan 2 curve selection (Slot II Point 24)
Test Successful	<i>APP</i>	<i>APP</i>

2.4.4 Fan Interlock Logic - Local Switch in HAND

NOTE: Numbers in parentheses refer to the test box input number.
A second number is a secondary input.

Action	Fan 1 test	Fan 2 test
Turn ON	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12) Fan 1 in HAND position (2) Fan 2 starter fault OK (9) Fan 2 in AUTO (8)	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11) Fan 2 in HAND position (7) Fan 1 starter fault OK (4) Fan 1 in AUTO (3)
Verify alarm and DCS event printed	"EF-1 in HAND"	"EF-2 in HAND"
Verify ON	Fan 1 run signal (Slot I Point 19) Fan 1 red light (Slot I-VI Point 9)	Fan 2 run signal (Slot II Point 19) Fan 2 red light (Slot I-VI Point 9)
Verify ON and OFF (flashing)	Fan 1 green light (Slot I-VI Point 8)	Fan 2 green light (Slot I-VI Point 8)
Verify MICON display	Fan 1 is in HAND and RUNNING	Fan 2 is in HAND and RUNNING
Turn ON from Graphic	Fan 2 start command	Fan 1 start command
Verify no outputs change		
Turn OFF	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Wait 6 sec		
Verify alarm and DCS event printed	"EF-1 failed in HAND"	"EF-2 failed in HAND"
Verify OFF	Fan 1 red light (Slot I-VI Point 9)	Fan 2 red light (Slot I-VI Point 9)
Test successful	<i>[Signature]</i>	<i>[Signature]</i>

2.4.5 Fan Switch on Manual Disconnect of Running Fan

Action	Fan 1 test	Fan 2 test
Turn ON	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12) Fan 1 in HAND position (2) Fan 2 starter fault OK (9) Fan 2 in AUTO (8)	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11) Fan 2 in HAND position (7) Fan 1 starter fault OK (4) Fan 1 in AUTO (3)
Turn OFF	Fan 1 in HAND position (2) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 in HAND position (7) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Wait 6 sec		
Verify alarm and DCS event printed	"EF-1 local switch in OFF"	"EF-2 local switch in OFF"
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Test Successful	<i>ADD</i>	<i>ADD</i>

2.4.6 Fan Switch by Operator


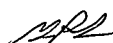
Action	Fan 1 test	Fan 2 test
Turn ON	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12) Fan 1 in AUTO (3) Fan 2 starter fault OK (9) Fan 2 in AUTO (8) ATS-2 in NORMAL (23)	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11) Fan 2 in AUTO (8) Fan 1 starter fault OK (4) Fan 1 in AUTO (3) ATS-2 in NORMAL (23)
Turn ON	Fan 2 from Graphics Display	Fan 1 from Graphics Display
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Turn ON	Fan 2 starter engaged (6/13)	Fan 1 starter engaged (1/14)
Wait 15 sec		
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Turn OFF	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)

Action	Fan 1 test	Fan 2 test
Turn ON	Fan 2 up to speed (10/11)	Fan 1 up to speed (5/12)
Turn OFF	ATS-2 in NORMAL (23)	ATS-2 in NORMAL (23)
Turn ON	Fan 1 start command (19)	Fan 2 start command (19)
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Turn OFF	Fan 1 start command (19)	Fan 2 start command (19)
Turn ON	ATS-2 in NORMAL (23) ATS-2 Start Call (16) Fan 1 start command (19)	ATS-2 in NORMAL (23) ATS-2 Start Call (2nd) (17) Fan 2 start command (19)
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Test Successful	<i>[Signature]</i>	<i>[Signature]</i>

~~2.4.7~~ 2.4.7 Fan Switch on Failure of Running Fan

Action	Fan 1 test	Fan 2 test
Turn ON	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12) Fan 1 in AUTO (3) Fan 2 starter fault OK (9) Fan 2 in AUTO (8)	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11) Fan 2 in AUTO (8) Fan 1 starter fault OK (4) Fan 1 in AUTO (3)
Turn OFF	Fan 1 in AUTO (3)	Fan 2 in AUTO (8)
Verify alarm and DCS event printed	"EF-1 local switch in OFF"	"EF-2 local switch in OFF"
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Turn ON	Fan 2 starter engaged (6/13)	Fan 1 starter engaged (1/14)
Turn OFF	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Turn ON	Fan 1 in AUTO (3)	Fan 2 in AUTO (8)
Wait 30 sec		
Turn ON	Fan 2 up to speed (10/11)	Fan 1 up to speed (5/12)
Wait 5 sec		
Turn OFF	Fan 2 starter fault OK (9)	Fan 1 starter fault OK (4)
Verify alarm and DCS event printed	"EF-2 start fault"	"EF-1 start fault"
Verify OFF	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Verify ON	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Turn ON	Fan 1 starter engaged (1/14)	Fan 2 starter engaged (6/13)
Turn OFF	Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)
Wait 5 sec		
Turn ON	Fan 1 up to speed (5/12)	Fan 2 up to speed (10/11)
Turn ON	Fan 2 starter fault OK (9)	Fan 1 starter fault OK (4)
Wait 30 sec		

Action	Fan 1 test	Fan 2 test
Turn OFF	Fan 1 starter engaged (1/14)	Fan 2 starter engaged (6/13)
Wait 6 sec		
Verify alarm and DCS event printed	"EF-1 motor failed"	"EF-2 motor failed"
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Turn ON	Fan 2 starter engaged (6/13)	Fan 1 starter engaged (1/14)
Turn OFF	Fan 1 up to speed (5/12)	Fan 2 up to speed (10/11)
Wait 30 sec		
Turn ON	Fan 2 up to speed (10/11)	Fan 1 up to speed (5/12)
Wait 5 sec		
Turn ON then OFF	Fan 1 reset (20)	Fan 2 reset (20)
Turn ON	ATS-2 Start Call (16)	ATS-2 EMER Bypass (18)
Verify alarm and DCS event printed	"ATS-2 Normal Power Fail"	"ATS-2 Emer Power Bypassed"
Turn OFF	Fan 2 starter engaged (6/13)	Fan 1 starter engaged (1/14)
Wait 25 sec		
Verify alarm and DCS event printed	"EF-2 motor failed"	"EF-1 motor failed"
Verify OFF	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Verify ON	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Turn ON	Fan 1 starter engaged (1/14)	Fan 2 starter engaged (6/13)
Turn OFF	Fan 2 up to speed (10/11) ATS-2 Start Call (16)	Fan 1 up to speed (5/12) ATS-2 EMER Bypass (18)
Wait 45 sec		
Verify alarm and DCS event printed	"EF-1 motor failed"	"EF-2 motor failed"

Action	Fan 1 test	Fan 2 test
Verify ON	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Verify OFF	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Test Successful		

2.4.8 Fan Switch on Ineffectiveness of Running Fan

Action	Fan 1 test	Fan 2 test
Turn ON	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12) Fan 1 in AUTO (3) Fan 2 starter fault OK (9) Fan 2 in AUTO (8)	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11) Fan 2 in AUTO (8) Fan 1 starter fault OK (4) Fan 1 in AUTO (3)
Set analog (high plenum pressure)	Set exhaust plenum vacuum to about 2" Hg (20% of full scale) [26]	Set exhaust plenum vacuum to about 2" Hg (20% of full scale) (redundant) [27]
Wait 30 sec		
Verify DCS event printed	"Exhaust plenum high pressure"	"Exhaust plenum high pressure"
Set analog (high-high pressure)	Set exhaust plenum vacuum to zero [26]	Set exhaust plenum vacuum to zero (redundant) [27]
Wait 30 sec		
Verify alarm and DCS event printed	"Exhaust plenum high-high pressure - fan failed"	"Exhaust plenum high-high pressure - fan failed"
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Turn ON	Fan 2 starter engaged (6/13)	Fan 1 starter engaged (1/14)
Turn OFF	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Wait 15 sec		
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Turn ON	Fan 2 up to speed (10/11)	Fan 1 up to speed (5/12)

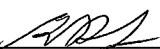

Action	Fan 1 test	Fan 2 test
Set analog (normal pressure)	Set exhaust plenum vacuum to 8" Hg (80%) [26]	Set exhaust plenum vacuum to 8" Hg (80%) (redundant) [27]
Wait 30 sec		
Reset Alarm	EF-1 High Pressure	EF-2 High Pressure
Turn OFF	Fan 1 in AUTO (3)	Fan 2 in AUTO (8)
Set analog (high-high pressure)	Set exhaust plenum vacuum to zero [26]	Set exhaust plenum vacuum to zero [26]
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Test Successful	<i>SS</i>	<i>SS</i>

2.4.9 Running Fan Keeps Running on Failure of Backup Fan

Action	Fan 1 test	Fan 2 test
Turn ON	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12) Fan 1 in AUTO (3) Fan 2 starter fault OK (9) Fan 2 in AUTO (8)	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11) Fan 2 in AUTO (8) Fan 1 starter fault OK (4) Fan 1 in AUTO (3)
Set analog (high-high pressure)	Set exhaust plenum vacuum to zero [26]	Set exhaust plenum vacuum to zero (redundant) [27]
Wait 30 sec		
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Turn OFF	Fan 2 starter fault OK (9)	Fan 1 starter fault OK (4)
Verify OFF	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Verify ON	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Wait 20 sec		
Verify ON	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)

Action	Fan 1 test	Fan 2 test
Set analog (normal pressure)	Set exhaust plenum vacuum to 8" Hg (80%) [26]	Set exhaust plenum vacuum to 8" Hg (80%) (redundant) [27]
Reset pressure alarms from MICON display		
Turn ON	Fan 2 starter fault OK (9)	Fan 1 starter fault OK (4)
Turn OFF	Fan 1 starter fault OK (4)	Fan 2 starter fault OK (9)
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Turn ON	Fan 2 starter engaged (6/13)	Fan 1 starter engaged (1/14)
Turn OFF	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Turn OFF	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13)	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14)
Turn ON	Fan 1 starter fault OK (4)	Fan 2 starter fault OK (9)
Wait 30 Sec		
Verify OFF	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Verify ON	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Test Successful	<i>[Signature]</i>	<i>[Signature]</i>

2.4.10 Fan Switch by Operator with Failure of Switched Fan.

Action	Fan 1 test	Fan 2 test
Turn ON	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12) Fan 1 in AUTO (3) Fan 2 starter fault OK (9) Fan 2 in AUTO (8) ATS-2 in NORMAL (23)	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11) Fan 2 in AUTO (8) Fan 1 starter fault OK (4) Fan 1 in AUTO (3) ATS-2 in NORMAL (23)
Turn ON	Fan 2 start command (19)	Fan 1 start command (19)
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Turn OFF	Fan 2 starter fault OK (9)	Fan 1 starter fault OK (4)
Verify alarm and DCS event printed	"Fan 2 start fault"	"Fan 1 start fault"
Verify ON and OFF (flashing)	Fan 2 green light (Slot I-VI Point 8)	Fan 1 green light (Slot I-VI Point 8)
Verify OFF	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Verify ON	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Wait 20 sec		
Verify ON	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Turn ON	Fan 2 starter fault OK (9)	Fan 1 starter fault OK (4)
Turn OFF	Fan 2 start command (19) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 1 start command (19) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Wait 6 sec		
Verify alarm and DCS event printed	"EF-1 motor failed"	"EF-2 motor failed"
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Test Successful		

2.4.11 Fan Re-Start upon Power Failure

Action	Fan 1 test	Fan 2 test
Turn ON	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12) Fan 1 in AUTO (3) Fan 2 starter fault OK (9) Fan 2 in AUTO (8)	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11) Fan 2 in AUTO (8) Fan 1 starter fault OK (4) Fan 1 in AUTO (3)
Turn ON	ATS-2 start call (16)	ATS-2 start call (2nd) (17)
Turn OFF	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Verify ON	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Wait 10 sec		
Verify OFF	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Turn ON	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Verify ON	Fan 1 curve selection (Slot I Point 24)	Fan 2 curve selection (Slot II Point 24)
Wait 30 sec		
Turn OFF	ATS-2 start call (16) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	ATS-2 start call (2nd) (17) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Wait 3 sec		
Turn ON	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Verify OFF	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Wait 30 sec		
Turn OFF	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)	Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Wait 10 sec		
Verify OFF	Fan 1 run signal (Slot I Point 19)	Fan 2 run signal (Slot II Point 19)
Verify ON	Fan 2 run signal (Slot II Point 19)	Fan 1 run signal (Slot I Point 19)
Test Successful	<i>ASL</i>	<i>ASL</i>

2.5 Load Shed Tests

2.5.1 Digital Test Box Connections

The digital test box connections for the load shed tests will be the same as in Section 2.4.1 except for the following three points:

Input #	Description	Slot No.	Point No.
2	CB-2 Closed	V	15
7	CB-4 Closed	VI	18
18	F8X309 Closed	IV	11
30	Gen 1 Running	IV	5



2.5.2 Load Shed Test w/ 2 Generators Running

Action	Load Shed - 2 Generators
Turn ON (NOTE: Fan 2 is OFF)	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12) Fan 1 in AUTO (3) CB-1 Closed (21) CB-2 Closed (2) CB-4 Closed (7) ATS-2 Start Call (16) F8X309 Closed (18) Generator Bus O/U Frequency (22) Gen 1 On Line (24) Gen 2 On Line (25) ATS-3 Engine Start Call (27) ATS-4 Engine Start Call (28) 234-5Z Start Call (29)
Set analog input	NP-VF1-3 Voltage to zero [1]
Instant Shed - all loads	
Set analog inputs (1120 KVA load)	Gen 1 KW to 100% [2] Gen 1 KVAR to 100% [3] Gen 2 KW to 100% [17] Gen 2 KVAR to 100% [18] Gen 3 KW to zero [4] Gen 3 KVAR to zero [19]
Wait 3 sec	
Verify ON for 5 seconds	CB-2 Open (Slot III Point 11) CB-4 Open (Slot I Point 12)

Action	Load Shed - 2 Generators
Turn OFF	CB-2 Closed (2) CB-4 Closed (7)
Verify no pulse	F8X309 Open (Slot I Point 6)
Wait 10 sec	
Verify ON for 5 seconds	CB-1 Open (Slot I Point 10)
Turn OFF	CB-1 Closed (21)
Verify alarms and DCS events printed	"Load Shed 400 Bus - 234Z" "Load Shed ATS-3" "Load Shed ATS-4" "Load Shed 2736-ZB"
If needed, Reset ZB PERM	
Verify ON	Fan 1 run signal (Slot I Point 19)
Turn OFF then ON	Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)
Wait 10 sec	
Verify no pulse	CB-1 Close (Slot I Point 9) CB-2 Close (Slot III Point 10) CB-4 Close (Slot I Point 11)
Verify ON	Fan 1 curve selection (Slot I Point 24)
Restore all loads	
Set analog inputs (560 KVA load)	Gen 2 KW to zero [17] Gen 2 KVAR to zero [18]
Wait 10 sec	
Verify ON for 5 seconds	CB-1 Close (Slot I Point 9)
Turn ON	CB-1 Closed (21)
Wait 10 sec	
Verify ON for 5 seconds	CB-2 Close (Slot III Point 10) CB-4 Close (Slot I Point 11)
Turn ON	CB-2 Closed (2) CB-4 Closed (7)
Verify alarms and DCS events printed	"PWR Return 2736-ZB" "PWR Return 400 Bus - 234-5Z" "PWR Return ATS-3" "PWR Return ATS-4"
Wait 10 minutes	

Action	Load Shed - 2 Generators
Delayed Shed - all loads	
Set analog inputs (900 KVA load)	Gen 2 KW to 60% [17] Gen 2 KVAR to 60% [18]
Wait 30 sec	
Verify ON for 5 seconds	CB-2 Open (Slot III Point 11) CB-4 Open (Slot I Point 12)
Turn OFF	CB-2 Closed (2) CB-4 Closed (7)
Wait 10 sec	
Verify ON for 5 seconds	CB-1 Open (Slot I Point 10)
Turn OFF	CB-1 Closed (21)
If needed, Reset ZB PERM	
Delayed shed - no cycling	
Set analog inputs (560 KVA load)	Gen 2 KW to zero [17] Gen 2 KVAR to zero [18]
Wait 10 sec	
Verify ON for 5 seconds	CB-1 Close (Slot I Point 9)
Turn ON	CB-1 Closed (21)
Set analog inputs (840 KVA load)	Gen 2 KW to 50% [17] Gen 2 KVAR to 50% [18]
Wait 30 sec	
Verify ON for 5 seconds	CB-1 Open (Slot I Point 10)
Turn OFF	CB-1 Closed (21)
If needed, Reset ZB PERM	
Set analog inputs (560 KVA load)	Gen 2 KW to zero [17] Gen 2 KVAR to zero [18]
Wait 10 sec	
Verify no pulse	CB-1 Close (Slot I Point 9)
Wait 10 minutes	
Verify ON for 5 seconds	CB-1 Close (Slot I Point 9)
Turn ON	CB-1 Closed (21)
Wait 10 sec	
Verify ON for 5 seconds	CB-2 Close (Slot III Point 10) CB-4 Close (Slot I Point 11)

Action	Load Shed - 2 Generators
Turn ON	CB-2 Closed (2) CB-4 Closed (7)
No shed	
Set analog inputs (700 KVA load)	Gen 2 KW to 25% [17] Gen 2 KVAR to 25% [18]
Wait 30 sec	
Verify no pulse	CB-1 Open (Slot I Point 10) CB-2 Open (Slot III Point 11) CB-4 Open (Slot I Point 12)
Fan failure during emergency power	
Set analog inputs (560 KVA load)	Gen 2 KW to zero [17] Gen 2 KVAR to zero [18]
Turn ON	Fan 2 starter fault OK (9) Fan 2 in AUTO (8)
Turn OFF	Fan 1 starter fault OK (4) Fan 1 starter engaged (1/14) Fan 1 up to speed (5/12)
Verify OFF	Fan 1 run signal (Slot I Point 19)
Verify ON	Fan 2 run signal (Slot II Point 19)
Turn ON	Fan 2 starter engaged (6/13)
Wait 30 sec	
Verify no pulse	CB-2 Open (Slot III Point 11) CB-4 Open (Slot I Point 12)
Turn ON	Fan 2 up to speed (10/11)
Wait 10 minutes	
Simulate ZB-only load	
Turn OFF	ATS-3 Engine Start Call (27) ATS-4 Engine Start Call (28) 234-5Z Start Call (29) CB-2 Closed (2) CB-4 Closed (7) FBX309 Closed (18)
Set analog inputs (900 KVA load)	Gen 2 KW to 60% [17] Gen 2 KVAR to 60% [18]
Wait 30 sec	
Verify ON for 5 seconds	CB-1 Open (Slot I Point 10)

Action	Load Shed - 2 Generators
Turn OFF	CB-1 Closed (21)
If needed, Reset ZB PERM	
Set analog inputs (560 KVA load)	Gen 2 KW to zero [17] Gen 2 KVAR to zero [18]
Wait 10 sec	
Verify ON for 5 seconds	CB-1 Close (Slot I Point 9)
Turn ON	CB-1 Closed (21)
Wait 10 minutes	
Simulate ATS-3/4 and 5Z only	
Set analog input	NP-VF1-3 Voltage to 100% [1]
Turn ON	ATS-3 Engine Start Call (27) ATS-4 Engine Start Call (28) 234-5Z Start Call (29) CB-2 Closed (2) CB-4 Closed (7)
Turn OFF	CB-1 Closed (21)
If needed, Reset ZB PERM	
Set analog inputs (900 KVA load with no ZB load)	Gen 2 KW to 60% [17] Gen 2 KVAR to 60% [18]
Wait 30 sec	
Verify ON for 5 seconds	CB-2 Open (Slot III Point 11) CB-4 Open (Slot I Point 12)
Turn OFF	CB-2 Closed (2) CB-4 Closed (7)
Set analog inputs (560 KVA load)	Gen 2 KW to zero [17] Gen 2 KVAR to zero [18]
Wait 10 sec	
Verify ON for 5 seconds	CB-2 Close (Slot III Point 10) CB-4 Close (Slot I Point 11)
Test successful 	

NOTE: Wait 10 minutes before proceeding to the next test.

2.5.3 Load Shed Test w/ 1 Generator Running

Action	Load Shed - 1 Generator
Turn ON (NOTE: Fan 1 is OFF)	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11) Fan 2 in AUTO (8) CB-1 Closed (21) CB-2 Closed (2) CB-4 Closed (7) ATS-2 Start Call (redundant) (17) FBX309 Closed (18) Generator Bus O/U Frequency (22) Gen 3 On Line (26) ATS-3 Engine Start Call (27) ATS-4 Engine Start Call (28) 234-5Z Start Call (29)
Set analog	NP-VF1-3 Voltage to zero [1]
Instant shed - all loads	
Set analog inputs (280 KVA load)	Gen 1 KW to zero [2] Gen 1 KVAR to zero [3] Gen 2 KW to zero [17] Gen 2 KVAR to zero [18] Gen 3 KW to 50% [4] Gen 3 KVAR to 50% [19]
Turn OFF	Fan 2 up to speed (10/11)
Verify ON	CLC load isolation (Slot III Point 19)
Verify alarm and DCS event printed	"Load Shed CLC"
Set analog inputs (560 KVA load)	Gen 3 KW to 100% [4] Gen 3 KVAR to 100% [19]
Wait 3 sec	
Verify ON for 5 seconds	CB-2 Open (Slot III Point 11) CB-4 Open (Slot I Point 12)
Turn OFF	CB-2 Closed (2) CB-4 Closed (7)
Wait 10 sec	
Verify ON for 5 seconds	CB-1 Open (Slot I Point 10)
Turn OFF	CB-1 Closed (21)
Verify alarms and DCS events printed	"Load Shed 400 Bus - 234-5Z" "Load Shed ATS-3" "Load Shed ATS-4" "Load Shed 2736-ZB"

Action	Load Shed - 1 Generator
If needed, Reset ZB PERM	
Verify ON	Fan 2 run signal (Slot II Point 19)
Turn ON	Fan 2 up to speed (10/11)
Verify OFF	CLC load isolation (Slot III Point 19)
Verify alarm and DCS event printed	"PWR Return CLC"
Wait 10 sec	
Verify no pulse	CB-1 Close (Slot I Point 9) CB-2 Close (Slot III Point 10) CB-4 Close (Slot I Point 11)
Reset EF-2 Motor Failed Alarm	
Restore all loads	
Set analog inputs (280 KVA load)	Gen 3 KW to 50% [4] Gen 3 KVAR to 50% [19]
Wait 10 sec	
Verify ON for 5 seconds	CB-1 Close (Slot I Point 9)
Turn ON	CB-1 Closed (21)
Wait 10 sec	
Verify ON for 5 seconds	CB-2 Close (Slot III Point 10) CB-4 Close (Slot I Point 11)
Turn ON	CB-2 Closed (2) CB-4 Closed (7)
Verify alarms and DCS events printed	"PWR Return 2736-ZB" "PWR Return 400 Bus - 234-5Z" "PWR Return ATS-3" "PWR Return ATS-4"
Wait 10 minutes	
Delayed shed - all loads	
Set analog inputs (450 KVA load)	Gen 3 KW to 80% [4] Gen 3 KVAR to 80% [19]
Turn OFF	Fan 2 up to speed (10/11)
Verify ON	CLC load isolation (Slot III Point 19)
Wait 30 sec	

Action	Load Shed - 1 Generator
Verify ON for 5 seconds	CB-2 Open (Slot III Point 11) CB-4 Open (Slot I Point 12)
Turn OFF	CB-2 Closed (2) CB-4 Closed (7)
Wait 10 sec	
Verify ON for 5 seconds	CB-1 Open (Slot I Point 10)
Turn OFF	CB-1 Closed (21)
Turn ON	Fan 2 up to speed (10/11)
Verify OFF	CLC load isolation (Slot III Point 19)
If needed, Reset ZB_PERM & EF-2 Motor Failed	
Delayed shed - no cycling	
Set analog inputs (280 KVA load)	Gen 3 KW to 50% [4] Gen 3 KVAR to 50% [19]
Wait 10 sec	
Verify ON for 5 seconds	CB-1 Close (Slot I Point 9)
Turn ON	CB-1 Closed (21)
Set analog inputs (420 KVA load)	Gen 3 KW to 75% [4] Gen 3 KVAR to 75% [19]
Wait 30 sec	
Verify ON for 5 seconds	CB-1 Open (Slot I Point 10)
Turn OFF	CB-1 Closed (21)
If needed, Reset ZB PERM	
Set analog inputs (280 KVA load)	Gen 3 KW to 50% [4] Gen 3 KVAR to 50% [19]
Wait 10 sec	
Verify no pulse	CB-1 Close (Slot I Point 9)
Wait 10 minutes	
Verify ON for 5 seconds	CB-1 Close (Slot I Point 9)
Turn ON	CB-1 Closed (21)
Wait 10 sec	
Verify ON for 5 seconds	CB-2 Close (Slot III Point 10) CB-4 Close (Slot I Point 11)

Action	Load Shed - 1 Generator
Turn ON	CB-2 Closed (2) CB-4 Closed (7)
Simulate ZB-only load	
Turn OFF	ATS-3 Engine Start Call (27) ATS-4 Engine Start Call (28) 234-5Z Start Call (29) CB-2 Closed (2) CB-4 Closed (7)
Set analog inputs (450 KVA load)	Gen 3 KW to 80% [4] Gen 3 KVAR to 80% [19]
Wait 30 sec	
Verify ON for 5 seconds	CB-1 Open (Slot I Point 10)
Turn OFF	CB-1 Closed (21)
If needed, Reset ZB PERM	
Set analog inputs (280 KVA load)	Gen 3 KW to 50% [4] Gen 3 KVAR to 50% [19]
Wait 10 sec	
Verify ON for 5 seconds	CB-1 Close (Slot I Point 9)
Turn ON	CB-1 Closed (21)
Wait 10 minutes	
Simulate ATS-3/4 and 5Z only	
Turn ON	ATS-3 Engine Start Call (27) ATS-4 Engine Start Call (28) 234-5Z Start Call (29) CB-2 Closed (2) CB-4 Closed (7)
Set analog input	NP-VF1-3 Voltage to 100% [1]
Turn OFF	CB-1 Closed (21)
If needed, Reset ZB PERM	
Set analog inputs (450 KVA load with no ZB load)	Gen 3 KW to 80% [4] Gen 3 KVAR to 80% [19]
Wait 30 sec	
Verify ON for 5 seconds	CB-2 Open (Slot III Point 11) CB-4 Open (Slot I Point 12)
Turn OFF	CB-2 Closed (2) CB-4 Closed (7)

Action	Load Shed - 1 Generator
Set analog inputs (280 KVA load)	Gen 3 KW to 50% [4] Gen 3 KVAR to 50% [19]
Wait 10 sec	
Verify ON for 5 seconds	CB-2 Close (Slot III Point 10) CB-4 Close (Slot I Point 11)
Turn ON	CB-2 Closed (2) CB-4 Closed (7)
Fan failure during emergency power	
Set analog input	NP-VF1-3 Voltage to zero [1]
Turn ON	CB-1 Closed (21) Fan 1 starter fault OK (4) Fan 1 in AUTO (3)
Turn OFF	Fan 2 starter fault OK (9) Fan 2 starter engaged (6/13) Fan 2 up to speed (10/11)
Verify ON	Fan 1 run signal (Slot I Point 19)
Turn ON	Fan 1 starter engaged (1/14)
Verify ON	CLC load isolation (Slot III Point 19)
Verify OFF	Fan 2 run signal (Slot II Point 19)
Wait 15 sec	
Turn ON	Fan 1 up to speed (5/12)
Verify OFF	CLC load isolation (Slot III Point 19)
Wait 30 sec	
Verify no pulse	CB-2 Open (Slot III Point 11) CB-4 Open (Slot I Point 12)
Turn ON	Fan 2 starter fault OK (9)
Fan switch by operator not allowed with one generator running	
Turn ON from Graphic Display	Fan 2 start command
Verify OFF	Fan 2 run signal (Slot I Point 19)
All 3 generators start on failure of running generator	

Action	Load Shed - 1 Generator
Turn OFF	Gen 3 Online (26)
Turn ON	Gen 1 On Line (24) Gen 1 Running (30)
Set analog input	Gen 3 KW to 0% [4] Gen 3 KVAR to 0% [19]
Turn OFF	Gen 1 On Line (24) Generator Bus O/U Frequency (22)
Verify ON	Gen 1 Start (Slot I Point 4) Gen 2 Start (Slot II Point 4) Gen 3 Start (Slot III Point 4)
Test Successful	<i>SPD</i>

3. EXCEPTIONS TO ACCEPTANCE TEST

ITEM	STEP	PAGE	DESCRIPTION	DISPOSITION
1	2.5.2	32	Cb-2 & CB-4 took 10 min. to open instead of 10 sec.	Corrected program & retested.
2	2.2.3	16	CB-2 close output would not actuate because the closed input was on.	Retested with closed input off.

4. TEST PARTIES

All personnel involved in the performance of this test including the person-in-charge (PIC), data taker/recorder, verifier and witnesses shall fill out the data below:

PRINT NAME	SIGN NAME	INITIAL	POSITION	DATE
STEVENER, BW	<i>BW Stevener</i>	<i>BWS</i>	QC Inspector	1-26-98
Silvan, GR	<i>GR Silvan</i>	<i>GRS</i>	Test Director	1-26-98
ROMBOUGH, CT	<i>CT Rombough</i>	<i>CRM</i>	Witness	1-26-98
PARULEKAR AD	<i>A.P. Parulekar</i>	<i>APP</i>	Quality Engineer	1-28-98

5. TEST APPROVAL

Without exceptions _____

With exceptions resolved X

With exceptions outstanding _____

RD Heck 2/4/98

PFP Electrical Cognizant Engineer Date

SS 1-28-98

MICON Cognizant Engineer Date

Burton 1-28-98

QC Inspector Date

DISTRIBUTION SHEET

To Information Resource Management	From PFP Facilities Systems Engineering	Page 1 of 1
		Date 2/4/98

Project Title/Work Order ESPC, 291-Z	EDT No. 621576
ECN No. N/A	

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	Only
Central Files	A3-88	X			
R.D. Keck	T4-20	X			
G.L. Rippy	T5-50	X			
G.R. Silvan	T4-20	X			
FDNW Const. Doc. Control	S2-53	X			
Project Files	R1-29	X			