Redundancy Backup Testing for Variable Frequency Closed-Loop Control Systems (Type MVFCL)

[Revision Date: January 28, 2008]

WARNING: All tests must be performed on empty elevators and done in a manner that no bodily injury can occur.

1) Single Ground Tests

With the car on automatic operation and the doors closed, ground any terminal in the safety string (i.e. 2, 2Y, 3, 3A, 4, 4B, 4X, 5, 5A, 5B, 5X, 6, 6X, 14, 16). Fuse M3 will open. The car will not run.

2) Redundancy & Monitoring in Critical Circuits Tests

While the car is running, actuate each relay or contactor listed below and observe that the car will shut down and will not run again. Reset a controller shutdown by cycling the power. A "watchdog" timer that will disable all outputs if the program fails to function properly, or if a hardware failure occurs, monitors each I/O board. A redundancy system was chosen that makes use of two relays per critical circuit with the CPU monitoring critical points to detect a failure of a single contact.

After each test, the CPU will detect the event and "shutdown" to prevent the elevator from restarting. The shutdown output will turn on to indicate that the controller is in shutdown mode. To avoid "nuisance" trips, there is a built in time delay of less that 3 seconds before the controller will shut down. The relays may be held in the energized position by pushing up the manual latching lever on the top edge of the relay. Contactors may be prevented from de-energizing by removing the front cover and physically holding up the mechanism.

Critical Component	Redundant Component(s)
P Contactor	CPU, Motor Drive System
BK1 contactor	CPU, BK2 contactor
LV1 relay	CPU, LV2 relay
SB relay	CPU, SBX relay
IA1 relay	CPU, IAT relay, IAB relay
IA2 relay	CPU, IAT relay, IAB relay
DZ relay	CPU
U1 relay	CPU, U2 relay
D1 relay	CPU, D2 relay
INS relay	CPU
DF relay	CPU, DFX relay
RB relay	CPU, RBX relay
RBC relay	CPU
Car door bypass switch (Jump out 1st pole of car door bypass switch to test)	CPU, INR relay
Hoistway door bypass switch (Jump out 1st pole of hoistway door bypass switch to test)	CPU, INR relay

Monitoring of door locks

Place a front car call. Short out the front car door lock with a jumper (see schematic for terminal numbers). When the car stops at a landing, the doors will open. The doors will not close and the car will not restart. Remove the jumper to restore normal operation.

Place a rear car call, if applicable. Short out the rear car door lock with a jumper (see schematic for terminal numbers). When the car stops at a landing, the doors will open. The doors will not close and the car will not restart. Remove the jumper to restore normal operation.

Place a front car call. Short out the hall door locks with a jumper (see schematic for terminal numbers). When the car stops at a landing, the doors will open. The doors will not close and the car will not restart. Remove the jumper to restore normal operation.

3) Solid State Device Test

A watchdog timer monitors the CPU. The Watchdog is not field testable or programmable.
(Testing is done at time of manufacture.)

4) Software System Device Test

Not field testable. (Factory testing is done at time of manufacture). Safety and redundancy
checking software is not field programmable.

5) Leveling Switches Test

With the elevator at floor level, jump out the "Up Level" sensor in the selector. The car will
run up at level speed for one half of the "Dead Zone" (about 1/4 inch) and the CPU will
initiate shut down. (Simulate by jumping terminals 20-21.)

With the elevator at floor level, jump out the "Down Level" sensor in the selector. The car
will run down at level speed for one half of the "Dead Zone" (about 1/4 inch) and the CPU
will initiate a shut down. (Simulate by jumping terminals 20-22.)

With the elevator at floor level, jump out the door zone switch. (Jump terminals 20-20X in
the controller.) Send the car to another floor. The elevator will run to the floor, open the
door and the CPU will initiate a shut down.

6) Normal Terminal Stopping Devices Testing

a. Put the car on inspection operation to disable the normal stopping means.

b. Run the car to the top terminal landing until the normal limit switch is actuated.
Movement of the car in the dictated direction will cease. The car will not move in the
direction of the normal limit, but should be able to move in the opposite direction.

c. Repeat this test for the down direction.

7) Terminal Landing Speed Reducing Devices (Slowdown Limit Switches) Testing

a. When a car top positioning system is used

a) Disable the car top positioning system by disconnecting wires 31 or 31H (depending on which is provided), 32 or 32H (depending on which is provided) and 31S and 32S, if provided.

b) Disable the emergency terminal slowdown system by jumping terminal 1 to terminals 31A, 32A and, if provided, 31B and 32B. (If normally open contacts were used at the time of installation rather than the normally closed contact shown on the schematics, remove wires 31A, 32A, 31B and 32B from their respective terminal blocks.)

c) Jump the "Shutdown Defeat" input on the CPU to terminal 1. (This will prevent the CPU from shutting down the car due to a timer that monitors for a floor change every 25 seconds.)

d) Run the car to a terminal landing and observe that the car slows down at the proper distance from the landing.

e) Replace any wires 31, 31H, 32, 32H, 31S, 32S removed above. Run the car to a terminal landing to re-establish floor position.

f) Repeat steps a-d above for the opposite terminal landing.

g) Replace all wires removed in above steps, remove the shutdown defeat jumper and run the car to a terminal landing to re-establish floor position.

b. When a machine room positioning system is used

a) Disable the emergency terminal slowdown system by removing wires 31A, 32A and, if provided, 31B and 32B. (If normally open contacts were used at the time of installation rather than the normally closed contact shown on the schematics, jump terminals 31A, 32A, 31B and 32B to terminal 1.) It will not be necessary to remove any wires.)

b) Run the car to a lower landing.

c) Check the CPU and locate terminals 1FP, 2FP, 4FP, 8FP, 16FP, etc. To test the top terminal landing slowdown, it is necessary to provide false positioning information to the controller from the car top selector. Remove the wire from the largest number "FP" input that is provided (i.e. above 16FP is the largest numbered "FP" input). Run the car to an intermediate landing. The position indicator will show a position that is lower than the actual car position. Run the

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car to the top terminal landing and observe that a normal slowdown occurs. Reconnect the "FP" input wire removed above.

d) Connect a jumper from terminal 1 to the largest number "FP" input. Run the car to an intermediate landing. The position indicator will show a position that is higher than the actual car position. Run the car to the bottom terminal landing. The car will slow down normally. Remove the jumper.

e) Reconnect the emergency terminal slowdown system.

8) Emergency Terminal Slowdown System Testing

The ETSD (emergency terminal slowdown device) system's job is to ensure that the elevator cannot run into the overhead or pit at a high rate of speed. The easiest way to simulate this condition is to force the drive into high speed and not let the elevator slow down as it reaches a terminal landing. The ETSD system should then detect the overspeed condition and cause a brake stop of the elevator.

It is recommended that the test initially be done near the center of the hoistway to ensure that the ETSD system has been properly calibrated.

> *WARNING: Performing this test without properly setting up the ETSD system may allow the elevator to crash into the pit or overhead!*

To reset faults, install and then remove a jumper to the shutdown defeat input while power is on.

a. Initial test of the ETSD system in the middle of the hoistway.

a) Run the elevator to any lower landing making sure that no one is inside.

b) Turn off the doors with the "door open" cutout switch to insure that no one gets into the elevator while testing.

c) Place a call at any landing above the elevator's current location.

d) Force the "FS" relay and, if provided, the "1FR" relay to the energized position. The relays may be held in the energized position by pushing up the manual latching lever on the top edge of the relay.

> *NOTE: It will be necessary to reset the relay(s) between tests to allow the car to run normally back to a landing.*

e) As soon as the elevator reaches high speed, remove the wire to controller terminal 31A. This will simulate the switch opening at the top of the shaftway. The controller should detect an overspeed condition and shut down causing a brake stop.

> **NOTE:** *These instructions assume that normally closed ETSD shaftway switches were used. If normally open switches were used, jump terminal 1 to terminal 31A, 31B, 32A, 32B rather than removing the wire from these terminals as stated in these instructions.*

f) Reset the controller and repeat steps c-e, removing wire 31B, if provided. The controller should again detect the overspeed condition and shut down.

g) Reset the controller and repeat the test in the **down** direction, removing wire 32A. The controller should shut down the elevator.

h) Reset the controller and repeat the test in the **down** direction, removing wire 32B, if provided. The controller should shut down the elevator.

i) If the controller shuts down as expected continue to the tests described below.

> **NOTE:** *If the car does not shut down as expected, the ETSD system is not functioning properly. Find the problem and retest as described in steps a-i above.*

b. Testing the ETSD system at terminal landings.

> **NOTE:** *Do not perform this test until all the steps listed above (Initial test of the ETSD system in the middle of the hoistway) have been successfully completed.*

a) Run the elevator to the third landing, being sure that no one is in the elevator and that the doors have been taken out of service so that no one can get into the elevator.

b) Place a call at "1C".

c) Force the "FS" relay and, if provided, the "1FR" relay to the energized position. The relays may be held in the energized position by pushing up the manual latching lever on the top edge of the relay.

> **NOTE:** *It will be necessary to reset the relay(s) between tests to allow the car to run normally back to a landing.*

d) The elevator should accelerate to full speed. The controller will detect the overspeed condition and a brake stop will occur.

e) Reset the system and do the test again with the elevator running down from the second landing. Once again, the controller should stop the elevator via a brake stop.

f) Reset the system and run the car to the third landing from the top.

g) Force the "FS" relay and, if provided, the "1FR" relay to the energized position. Place a call at the top landing.

h) The elevator should accelerate to full speed. The controller will detect the overspeed condition and a brake stop will occur.

i) Reset the system and do the test again with the elevator running up from the next to the top landing. Once again, the controller should stop the elevator via a brake stop.

This completes the test of the ETSD system.

9) Phase 2 & Ground

Initiate Phase 1 fire service recall. Put the car on phase 2 fire service. Open any hall fixture and, one at a time, short to ground the wires that come through the shaftway wall. Hallway fixtures will become inoperative. See that the car is still operable on phase 2 fire service.

> **NOTE:** *Fuse M2, M5 or M7 will open depending on the type of controller being tested.*

Replace the fuse and reset the car to normal operation.

10)   Phase 1 & 2 Power off

With the car running on Phase 1 or 2 fire service, disconnect the mainline power. Restore power to the controller. If the car is floor level, it will remain at floor level and resume fire service operation. If the car is between floors, it will travel to a lower landing to reestablish absolute position and then resume fire service operation.

11)   Phase 1 & 2 With Load Weighing

Place a full load in the car to trip the load-weighing device, or jump out the load weighing device input to the CPU. Run the car on phase 1 and 2 fire service and observe normal operation.

12)   Unintended Movement Detection

Place the car at a landing on automatic operation with the doors not fully closed. Disconnect the down level sensor from the CPU by removing the wire from terminal 22. Manually release the brake so that the car will drift up away from the floor. The rope gripper will set, stopping movement of the car, and the CPU will indicate a fault condition that will not allow the car to run. To reset the fault, cycle power to the shutdown defeat input on the CPU using a jumper (install and then remove a jumper to the shutdown defeat input while power is on).

13) Ascending Car Overspeed Detection

a. Check the schematic and determine the full speed of the car.

b. Add 20% to the full speed.

c. Change the high-speed parameter in the motor drive to the new value. The exact parameter will vary depending on the drive used. Check sheet "P" in the schematic to determine which parameter to change.

d. Place a car call that will cause an up run to occur.

e. Use a tachometer on the drive sheave or governor to determine the speed at which the speed monitoring system shuts down the car. The value should be no more than 10% of the car's rated speed. The CPU will not allow the car to run again until reset.

> **NOTE:** *Momentarily touch a jumper from terminal 1 to the shutdown defeat input.*

f. Reprogram the drive for the correct high-speed value.

14) Speed in Leveling/Truck Zone

a. The CPU speed monitoring system will limit movement in the leveling zone to a maximum of 50 feet per minute.

> **NOTE:** *Code requirement is no more than 150 FPM.*

b. Reprogram the motor drive for a leveling speed of 75 feet per minute. The exact parameter will vary depending on the drive used. Check sheet "P" in the schematic to determine which parameter to change.

c. Disconnect wires from the leveling unit to the controller (terminals 21 & 22).

d. With the door not fully closed, jump terminals 20-20X to extend the door zone. Then, jump controller terminals 20-21 to simulate an up level signal.

e. The car will level at 75FPM. The speed monitoring system will detect the overspeed condition and shut down the elevator. The CPU will not allow the car to run again until reset.

> **NOTE:** *Momentarily touch a jumper from terminal 1 to the shutdown defeat input.*

f. Reprogram the drive for the correct leveling speed.

15) Inner Landing Zone Limits

a. Place the car between landings with a hall door or car door open. Attempt to run the car on automatic or inspection operation. The car will not move until the door is closed and locked.

b. With the car floor level, disconnect wires from the leveling unit to the controller (terminals 21 & 22).

c. With the door not fully closed, jump controller terminals 20-21 to simulate an up level signal.

d. The car will level until it runs off of the door zone limit and then stop. The monitoring system will detect the condition and shut down the elevator. Check the position of the elevator sill with respect to the landing sill. There should be no more than 3 inches between them. The CPU will not allow the car to run again until reset.

> *NOTE: Momentarily touch a jumper from terminal 1 to the shutdown defeat input.*

e. Repeat the test in the down direction by jumping controller terminals 20-22.

16) Brake Contactors

The main motor drive contactor must cause the driving machine brake circuit to open. To test this, run the car on automatic or inspection and remove the wire to the "P" contact coil. Note that the BK1 & BK2 contactors both drop out causing the brake to set. The CPU will fault and not allow the car to run again until reset.

17) Emergency Power

If the elevator is required to run on emergency power, place a full load on the car, and while the emergency power system is operating, run the car to another floor. The elevator should respond normally.

18)   Additional Tests

Top of Car inspection operation with open door circuits

Turn the "Car Door Bypass" switch, or the "Hoistway Doors Bypass" switch, or both of these switches to the "Bypass" position. Test the non-response of car and hall calls, fire service recall, and leveling operation for all three conditions.

Place the "Top of Car Inspection" switch in the "inspection" position and the "Car Door Bypass" switch in the "bypass" position. Verify that the car can move on Inspection operation with the car door open, but all hall doors closed.

Place the "Top of Car Inspection" switch in the "inspection" position and the "Hoistway Doors Bypass" switch in the "bypass" position. Verify that the car can move on Inspection operation with a hall door open, but the car door closed.

Place the "Top of Car Inspection" switch in the "inspection" position, and both the "Car Door Bypass" switch and the "Hoistway Doors Bypass" switch in the "bypass" position. Verify that the car can move on Inspection operation with the car door and a hall door opened.

19)   Additional Monitoring

Note that relay contacts INR, INS, IAT, IAB and the second pole of the controller inspection enable button (wired between terminals 2Y & 3A) are monitored for failure through the emergency stop switch input (terminal 4). These devices open the circuit between terminals 2Y and 3A while the car is on Inspection operation and an Inspection Run button or Access key switch is not actuated. The microprocessor input connected to terminal 4 must be off before the car will be allowed to run on Inspection or access operation.   If the circuit fails to operate properly, the CPU will detect the fault and not allow the car to restart. There is a 3-second delay before a fault is declared. Place a jumper on terminals 2Y & 3A. Place the car on Inspection operation. The CPU will detect the fault and shutdown, not allowing the car to run until the jumper is removed.

This completes the testing procedure.