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Recovery Boiler Functional Checks
AF&PA Example Document Rev 4

February 21, 2017

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Example of Recovery Boiler
Functional Trip Checks

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AF&PA example functional testing document introduction

The intent of this example document is to comply with BLRBAC 3.13 Functional Testing described below BLRBAC 3.13.
Functional testing of Recovery Boiler Safety Systems (RBSS) is intended to provide the recovery boiler owners and operators with confidence that the system will operate as designed.
Functional testing should be conducted within the scope and frequency outlined in the following recommended good practices: Emergency Shutdown Procedures, Safe Firing of Auxiliary Fuels, Safe Firing of Black Liquor and Thermal Oxidation of Waste Streams.
Functional test plans should be developed for each boiler based on the starting permissive and tripping interlock block diagrams from the recommended good practices referenced above. Functional testing should be done any time a modification or work has been performed on a RBSS that might reasonably affects its integrity. All testing should be documented and dated with detailed records maintained on file.
Functional testing should verify that the safety systems field devices, wiring, hardware and logic are in sound conditions (i.e. no jumpers, bridges or forces in place, no plugged sensing lines, no broken actuators nor stuck valves or dampers, no damaged instruments nor burnt or corroded wiring, no inadvertent undocumented and/or improper software changes, etc.)
A "complete" trip/interlock test incorporates a signal test from the sensing line (or initiating device for manual trips) through all associated circuitry and logic, and includes actuation of the final elements (valves, pumps, dampers, etc.) being interlocked. It should create or simulate, as safely as possible, the actual conditions being monitored at the sensing lines.
Note: Provided that a complete test through a common output (e.g. MFT) is performed, a test of the remaining individual trip conditions, to just that common output, is acceptable. While boiler start up, following a shutdown, provides the most feasible time for these tests, it is perfectly acceptable to conduct such tests throughout the year, when possible. This would be applicable for auxiliary fuel and waste stream systems and possibly others depending on operating arrangements of the unit. Any unscheduled trips occurring during boiler start-up or operation may be applied toward meeting the intent of testing for that particular trip or permissive, provided the event is properly documented and the first out system is provided verifies the source of the trip.

A formal written testing and checking program should be set up. It should cover all equipment and all interlocks. The testing and checking should be frequent enough so that inoperative equipment or malfunctions will not go undetected for any period of time. The testing and checking should be at regular intervals and for no piece of equipment or interlock should this exceed the major outage interval. Much of the equipment and many of the interlocks may require testing and checking daily, weekly, biweekly, or monthly. The testing and checking program which is set up should be followed.

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Functional test documentation should include the function description being tested, the test method, the trip point or setting, test results including as found and as left and date tested.

Notes
-Mills to pre-determine maximum acceptable tolerance from trip point settings.
-Field verifications should occur for each trip
-ESP tests to be conducted as well as per mill Standard Operating Procedures.
-All auxiliary fuel systems should be included (for example oil systems and gas systems)
-The following is an example and not limited to the trips and permissives listed. Each facility should customize to their system.
-Calibrations should also be conducted on major outages to ensure accuracy of instrumentation.

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	Function Description	Functional Test Method	Trip Point Target	Notes	Field Verification
	Boiler Drum Level Tests (requires burner in boiler)				
1.	Drum Level – Low Level device 1- _____ Level Device 2- _____ Level Device 3- _____	1. Reset boiler purge 2. Minimum gas fire in boiler 3. Lower drum level 4. Verify all level devices signals MFT	Trip at - _____in.	+/- Mill to determine tolerance	Trip Point device 1 – Trip Point device 2- Trip Point device 3- Boiler MFT- Gas SSV's closed – Low Alarm set- Low Low Alarm set- Date completed - Initials-
2.	Drum Level – High Level device 1-_____ Level device 2-_____ Level device 3-_____	1. Reset boiler purge 2. Minimum gas fire in boiler 3. Boiler should be off line for test 4. Raise drum level 5. Verify all level devices signal a MFT	Trip at +_____in	+/- Mill to determine tolerance	Trip Point device 1 – Trip Point device 2- Trip Point device 3- Boiler MFT- Gas SSV closed – Check Alarms- Date completed - Initials-
	Combustion Air (does not require burner in boiler)				
3.	Low Air Flow Trip (Below Liquor Guns) FSL _____	1. Reset boiler purge. Establish Air flow above 30% 2. Open AUX fuel supply header 3. Reduce air flow below 30%	Trip point based on 30% of MCR air flow below liquor guns		Trip point- _____ pph Verify MFT- Date completed - Initials-
4.	Loss Primary FD Fan motor	1. Reset boiler purge 2. Shutdown Primary FD fan 3. Test loss of backup trip device such as differential pressure switch or zero speed switch if present.			MFT- Loss of purge credit Date completed - Initials-

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	Function Description	Functional Test Method	Trip Point Target	Notes	Field Verification
5.	Loss Secondary FD Fan	1. Reset boiler purge 2. Shutdown Secondary FD fan 3. Test loss of backup trip device if present			MFT- Loss of purge credit Date completed - Initials-
	Combustion Air (does not require burner in boiler)				
6.	Loss of last Burner	1. Minimum fire in boiler with one Burner in boiler 2. Disable flame detector to prove burner trip			Verify burner header and main gas header SSVs closed Verify AUX fuel trip Verify MFT Date completed – Initials-
	Auxiliary Fuel Header Pressure Trips (does not require burner in boiler)				
7.	Burner Igniter Gas Pressure Trip – High PSHH _____	1. Reset boiler purge 2. Open Igniter Header SSV's **3.** I/E trigger high pressure switch externally (calibration verified during outage) or switch is pressurized to trip point	Set to trip at ___ psig increasing		Trip point- __ psig Igniter SSV close- Verify MFT- Verify Igniter Header SSV close- Date completed - Initials-
8.	Burner Igniter Gas Pressure Trip – Low PSLL _____	1. Reset boiler purge 2. Open Igniter Header SSV 3. I/E trigger low pressure switch externally (calibration verified during Outage) or switch or header is de-pressurized to trip point	Set to trip at __ psig decreasing		Trip point- __ psig Verify MFT Operator verify Igniter Header SSV Date completed - Initials-
9.	Burner Gas Pressure Trip – High PSHH _____	1. Reset boiler purge 2. Open Burner SSV 3. I/E trigger high pressure switch or simulate high gas pressure on switch/transmitter	Set to trip at ___ psig increasing		Trip point – ___ psig Verify MFT Verify SSV close Date completed - Initials-

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	Function Description	**Functional Test Method**	**Trip Point Target**	**Notes**	**Field Verification**
10.	Burner Gas Pressure Trip – Low PSLL _____	1. Reset boiler purge 2. Open Burner SSV 3. I/E trigger low pressure switch or simulate low gas pressure on switch or transmitter	Set to trip at ____ psig decreasing		Trip point – ____ psig MFT- Verify SSV close- Date completed - Initials-
11.	Low dissolving tank level	Reset boiler purge Open Burner SSV With purge credit established lower dissolving tank level	Permissive level_____in		Verify loss of purge credit as level is dropped Level____ in Initials-
12.	Sootblower Water Wash Spool _____-ZI	1. Install sootblower water wash spool piece 2. 3. Try to establish purge			Verify unable to purge Date completed -
13.	Manual auxiliary fuel master fuel trip (E-stop push button)	Reset boiler purge Engage the manual MFT push button If multiple E-stop stations are available each station must be tested			MFT Verify SSVs close- Date completed - Initials-
	Furnace and Flue Gas (does not require burner in boiler) _**Do not Raise or Lower Actual Furnace Pressure to Normal Trip Points to Accomplish Test. Use External Pressure Source to Drive Pressure Sensors or Adjust Trip Points to Simulate Furnace Pressure Trips at Safer Test Levels.**_				
14.	High Furnace Pressure Trip PSHH _____	1. Start ID Fan 2. Start FD Fans 3. Adjust FD fans to achieve minimum air flow with zero draft (to prevent damage from low pressure condition when FD fans trip) 4. Put ID Fan in manual 5. I/E to raise external pressure source to high trip point	Set to trip at +__ in H2O Increasing		Trip point-_____ + inches Verify MFT input and FD fans trip Date completed -

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	Function Description	**Functional Test Method**	**Trip Point Target**	**Notes**	**Field Verification**
15.	Low Furnace Pressure Trip PSLL _____	1. Start ID Fan 2. Start FD Fans 3. Adjust FD fans to achieve minimum air flow with zero draft (to prevent damage from high pressure condition) 4. Put ID Fan in manual 5. I/E to lower external pressure source to lower pressure to trip point on transmitter or switch.	Set to trip at – ____ in H2O decreasing		Trip point- Verify MFT input and all fans trip Date completed -
16.	FD Fans interlock	1. With ID fan running 2. Force Furnace High pressure switch 3. Will FD fans start 4. Document results	Verify that FD fans will not start		Primary FD fan- Secondary FD fan- Date completed -
17.	ID Fan Drive Shutdown	1. Reset boiler purge 2. Trip ID fan drives 3. Verify MFT and FD fan drive trips 4. Document results	ID fan run indicated by- Zero speed switches Diff press- Motor starter-		MFT- FD fan trips- Verify trip signal from secondary proof of running- Date completed -
18.	FD Fan Start Permissive	1. With ID fans down verify FD Fans will not start			FD fans will not start- Date completed –
19.	Loss of FD fan above liquor gun (Shut off aux fuels associated above liquor guns)	1. Establish aux fuel purge 2. Shutdown FD fan above liquor gun 3. Verify loss of purge for burners above liquor gun			Loss of purge for burners above liquor guns
Auxiliary Fuel individual igniter/burner Failure to Close Trip & Alarm					

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20.	Starter-up Burner Igniter Failed To Close Alarm _____ CLSD	1. 2 burners in service 2. Pull one burner closed limit switch fuse 3. Shutoff burner 4. Verify Failed to close Alarm and upstream SSV closes			Failed to close Alarm Upstream SSV closed Date completed -
21.	Start-up Burner Failed to close Alarm _____ CLSD	1. 2 burners in service 2. Pull one burner closed limit switch fuse 3. Shutoff burner 4. Verify Failed to close Alarm and upstream SSV closes			Failed to close Alarm Upstream SSV closed Date completed -
22.	Load Burner Igniter failed to close Alarm _____CLSD	1. 2 burners in service 2. Pull one burner closed limit switch fuse 3. Shutoff burner 4. Verify Failed to close Alarm and upstream SSV closes			Failed to close Alarm Upstream SSV closed Date completed -
23.	Load Burner Failed to close Alarm _____CLSD	1. 2 burners in service 2. Pull one burner closed limit switch fuse 3. Shutoff burner 4. Verify Failed to close Alarm and upstream SSV closes			Failed to close Alarm Upstream SSV closed Date completed -
24.	CNCG Burner Igniter Failed to close Alarm _____ CLSD	1. 2 burners in service 2. Pull one burner closed limit switch fuse 3. Shutoff burner 4. Verify Failed to close Alarm and upstream SSV closes			Failed to close Alarm Upstream SSV closed Date completed –

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	Function Description	**Functional Test Method**	**Trip Point Target**	**Notes**	**Field Verification**
25.	CNCG Burner Failed to Close Alarm _____ CLSD	1. 2 burners in service 2. Pull one burner closed limit switch fuse 3. Shutoff burner 4. Verify Failed to close Alarm and upstream SSV closes			Failed to close Alarm Upstream SSV closed Date completed –
	**Auxiliary Fuel – Individual Igniter/Burner Proof of Flame (Requires igniter/burner in the boiler during test. This test can be performed while boiler is in operation Other burners should be started prior to testing to maintain boiler purge credit) Similar criteria need to be tested for all burner fuels**				
26.	No. **X** Start-up Burner and Igniter (Class 1 Ignitors)	1. Light Igniter 2. Light Burner 3. Trip ignitor to verify burner trips 4. Verify individual SSVs close 5. Test low air flow trip 6. Test igniter not inserted 7. Test Burner not inserted 8. Test loss of proof of igniter heat input (N/A) 9. Test local burner stop button			Trips Burner SSVs close- Date completed -
27.	No. **X** Start-up Burner and Igniter (Class 3 Ignitors)	1. Light Igniter 2. Light Burner 3. Disable burner flame scanner to verify burner trips 4. Verify individual SSVs close 5. Test low air flow trip 6. Test igniter not inserted 7. Test Burner not inserted 8. Test loss of proof of igniter heat input (N/A) 9. Test local burner stop button			Trips Burner SSVs close- Date completed -

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	Function Description	Functional Test Method	Trip Point Target	Notes	Field Verification
28.	No. 3 Burner and Igniter	Same as above			Trips Burner SSV's close Date completed -
29.	No. 4 Burner and Igniter	Same as above			Trips Burner SSV's close Date completed –
30.	CNCG Burner and Igniter	Same as above			Trips SSV's close **Date completed -**
	Black Liquor System				

31.	Manual black liquor trip	1. Circulate Liquor around Boiler
		  a) Solids above divert value
		  b) Divert system reset
		  c) Switch in operate position
		2. Activate Manual Black Liquor trip
					Verify that the liquor header block valve closes and the liquor header divert valve opens –
					
					Verify Nozzle pump drives shut down –

32.	Liquor System Water Wash Spool Water Source _____-ZI	1. Spool piece in place 2. Try to establish liquor header purge			Verify unable to purge Date completed -
33.	Liquor gun door switches	1. Circulating liquor without black liquor purge credit established 2. Activate first liquor gun door limit switch 3. Activate remaining liquor gun door switches to common logic point			Verify liquor diverts-

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	Function Description	**Functional Test Method**	**Trip Point Target**	**Notes**	**Field Verification**

34.	Black Liquor Solids Below low set point %.	1. Circulate liquor around the boiler
		  a) All liquor guns removed.
		  b) Solids above low set point %
		  c) Divert system reset.
		  d) Switch to operate position.
		2. Lower solids to < trip point %. By adding water to system.
			____% solids		Block valve Closes-
					Divert valve Opens-
					Nozzle pumps shutdown-
					Liq. divert % solids-
					Date completed –

35.	Sufficient heat input to furnace to burn liquor	1. Circulate liquor around boiler
		  a) Solids above trip point %.
		  b) Divert system reset
		  c) Minimum number of startup burners
		  d) Simulate liquor gun in (door open, no gun in)
		  e) Switch to operate.
		2. Reduce heat input so Steam Flow drops below minimum by shutting down burners to drop heat input below minimum.
			___ steam flow		Trip point-
					Liq. block valve closes-
					Divert valve opens-
					Nozzle pumps shutdown-
					
					Date completed –

36.	Loss of all black liquor nozzle pumps. (If burning Blk. Liq. with no Aux burners in service then would get MFT)	1. Circulate liquor around the boiler
		  a) All liquor guns removed
		  b) Solids above trip point setting
		  c) Divert system reset
		  d) Min # of startup burners
		  e) Switch to operate position
		2. Stop all nozzle pumps.
					Liq. Block valve closes-
					Divert valve opens-
					Nozzle pumps shutdown-
					
					Date completed -

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	Function Description	**Functional Test Method**	**Trip Point Target**	**Notes**	**Field Verification**
37.	One or more guns in furnace and header in wash position	1. Circulate liquor around the boiler 2. Simulate liquor gun in (door open, no gun in) 3. Solids above trip value 4. Divert System reset 5. Wash Switch in operator position 6. Change wash switch to wash position			Block valve closes Divert valve opens Verify Liquor trip-Completed -
38.	Minimum Liquor flow purge requirement	1. Circulate Liquor around boiler. 2. Solids above trip value 3. Divert system reset 4. With all purge requirements satisfied Switch to Operate position to start liquor purge timer. 5. Reduce liquor flow below minimum requirement.	Min. Liq. Flow ____		Trip point-____ Loss of black liquor purge credit-
39.	Smelt spout cooling water flow satisfied	1. Initiate purge timer countdown 2. Shut-off cooling water flow or bypass switch. 3. Verify loss of purge permissive		Verify for each spout or flow meter	Purge credit loss
40.	Liquor purge pressure	1. Establish liquor purge credit 2. Lower liquor header pressure while maintaining minimum flow 3. Verify loss of liquor purge permissive	Loss of permissive at ____ psi		Permissive satisfied at _____
41.	Liquor purge temperature	1. Verify liquor temperature satisfied during purge	Permissive at ___ F		Permissive satisfied at _____
42.	BMS de-energized (on relay based systems)	1. Establish purge credit 2. Power down BMS system			Purge credit lost
43.	Loss of FD fan above liquor gun (Shut off aux fuels associated above liquor guns)	1. Establish aux fuel purge 2. Shutdown FD fan above liquor gun 3. Verify loss of purge for burners above liquor gun			Loss of purge for burners above liquor guns

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