

US EPA ARCHIVE DOCUMENT

APPENDIX A

RISK BURN CONDITIONS AND PERMIT LIMITS FOR EXAMPLE FACILITIES

- A.1 Risk Burn Conditions and Permit Limits for a Liquid Injection Incinerator (13 pages)**
- A.2 Risk Burn Conditions and Permit Limits for a Rotary Kiln Incinerator Burning
Containerized Wastes (16 pages)**

APPENDIX A.1

RISK BURN CONDITIONS AND PERMIT LIMITS FOR A LIQUID INJECTION INCINERATOR

Note: This illustrative example does not represent the only approach to structuring a trial burn/risk burn/MACT performance test. Other regulatory and permitting options exist. Test plans and final permit conditions should always be developed on a site-specific basis after close interaction between the regulator and facility.

Appendix A.1 describes the risk burn and resulting permit limits for an example liquid injection incineration facility (Facility Z). Facility Z burns organic liquid and aqueous wastes in a liquid injection combustion chamber, followed by a heat recovery boiler and an air pollution control system consisting of a fabric filter and venturi scrubber. Facility Z typically operates the combustion chamber within a $1,750 \pm 50$ EF temperature window, with exit gas temperatures from the heat recovery boiler in the range of 350 to 550 EF. Gas exit temperatures from the heat recovery boiler generally increase and decrease with combustion temperature. A review of historical operating data indicates that Facility Z consistently maintains steady-state operations, with very low carbon monoxide and few waste feed cutoffs.

Facility Z needs to complete performance testing and a risk burn for a Resource Conservation and Recovery Act (RCRA) permit renewal. In addition, Facility Z anticipates complying with the hazardous waste combustor Maximum Achievable Control Technology (MACT) standards in the future, and has already added an activated carbon injection system to control dioxins. By carefully structuring the test plan, Facility Z can satisfy the current RCRA permitting needs, as well as generate data that may be submitted at a later date as “data in lieu of the initial performance test” for MACT.

Facility Z begins writing the test plan with the following test conditions (summarized in Table A.1-1):

Destruction and Removal Efficiency Test Condition

A destruction and removal efficiency (DRE) demonstration will be conducted at a minimum combustion temperature of 1,600 EF. This combustion temperature corresponds to a fabric filter inlet temperature of

350EF. Other control parameters to be demonstrated during the DRE test include: 1) maximum combustion gas velocity, as an indicator of minimum gas residence time; 2) maximum waste feed rate to each feed location; and 3) worst-case operating conditions for air pollution control parameters (to the extent possible). Continuous carbon monoxide and total hydrocarbon monitoring is also planned for this test. Operating parameters to ensure good operation of the waste firing system will be based on manufacturer's specifications.

System Removal Efficiency Test Conditions

In anticipation of future MACT compliance, Facility Z adds test conditions to demonstrate system removal efficiencies (SREs) for semivolatile and low-volatile metals (arsenic, beryllium, cadmium, chromium, and lead). Stack determinations for particulate matter (PM) and hydrogen chloride (HCl) and chlorine (Cl₂) are also planned for the SRE tests.

The SRE demonstrations will be conducted at a maximum combustion temperature of 1,850 EF in order to achieve a maximum inlet fabric filter temperature of 550 EF. Maximum semivolatile and low-volatile metal feed rates will be achieved by spiking one metal from each of the two volatility groups. Since all of the feed mechanisms at Facility Z are for liquid feeds, there is no distinction between total metal feed rates and pumpable metal feed rates. Other control parameters to be demonstrated during the SRE test conditions include: 1) maximum combustion gas velocity; 2) maximum chlorine feed rate; 3) maximum ash feed rate; and 4) worst-case operating conditions for air pollution control parameters.

Two SRE test conditions are necessary to resolve conflicting parameters. Demonstration of the maximum combustion gas velocity control parameter conflicts with demonstration of minimum pressure differential for the venturi scrubber. The two SRE test conditions are designated as SRE 1 and SRE 2 in Table A.1-1. During the SRE 1 test condition, maximum combustion gas velocity will be demonstrated. During the SRE 2 test condition, minimum pressure differential for the venturi scrubber will be demonstrated, and all other control parameters will be maintained as close as possible to the SRE 1 conditions. Demonstration of the maximum combustion gas velocity control parameter also conflicts with demonstration of minimum pressure differential for the fabric filter. However, Facility Z observes that the MACT rule allows minimum and

maximum fabric filter pressure differential to be established based on manufacturer's specifications, and the permit writer agrees with this approach.

For mercury, Facility Z wishes to avoid spiking and will not demonstrate a maximum mercury feed rate during the SRE test. Facility Z plans to conservatively assume that 100% of the mercury fed to the unit is emitted (even though some mercury control will be achieved from the carbon injection system).

Risk Burn Determinations and Addition of a Normal Test Condition

To complete a site-specific risk assessment, Facility Z recognizes that stack emissions determinations are needed for: dioxins/furans (D/Fs); organics other than D/Fs; the eighteen toxic metals listed in Section 2.3; particle-size distribution; and HCl/Cl₂. Facility Z incorporates these determinations into the test plan as follows:

D/Fs

The primary operating parameters related to D/F formation for Facility Z are boiler exit temperature and fabric filter inlet temperature (both operating parameters are represented by the same measurement location for the Facility Z system configuration), as well as control parameters for the carbon injection system. D/Fs are expected to be maximized at the maximum fabric filter inlet temperature of 550 EF, and will therefore be measured in conjunction with the SRE tests.

D/F testing will also be performed during the DRE test because of the permit writer's concern that the high combustion temperatures demonstrated during the SRE test might not adequately represent D/F precursors which could be formed during lower temperature combustion situations. In general, the formation of D/F precursors due to poor combustion should not be a significant concern for this system (because of the historical data indicating steady-state operation). Also, the 350EF fabric filter inlet temperature planned for the DRE test is outside of the critical D/F temperature range (400 - 750 EF). However, the facility agrees that D/F sampling during DRE conditions will better represent the complete operating envelope, and will put Facility Z in a better position to potentially use the data for

future MACT compliance (control parameters for minimum combustion temperatures, maximum waste feed rates, and maximum gas flow rates are required to be demonstrated during D/F testing pursuant to MACT). Therefore, Facility Z adds a D/F determination to the DRE test.

Non-D/F Organics

The feed and operating conditions that influence organic products of incomplete combustion (PICs) are already represented during the DRE test. Therefore, the facility plans to measure PICs and total organics in conjunction with the DRE performance demonstration. In addition, Facility Z arranges for the sampling contractor to operate a temporary total hydrocarbon continuous emissions monitor during the DRE/PIC testing.

Metals

The SRE tests already involve stack determinations for the five toxic metals identified in the MACT rule. However, Facility Z is concerned that the metals spiking during the SRE tests may result in emissions that exceed risk target values. Therefore, Facility Z proposes a separate test condition for the purpose of generating metals emissions data for the risk assessment. A normal test is proposed (as summarized in Table A.1-1) since Facility Z is capable of defining and maintaining normal operating conditions for metals.

The normal test for metals will be conducted at normal metal feed rates, at a combustion temperature of approximately 1,750 EF and a fabric filter inlet temperature of 450 EF. Emissions testing will be performed for eighteen metals.

Particle-Size Distribution

For Facility Z, the fabric filter will be the primary determinant of particle-size distribution. Therefore, significant variation in particle-size distribution between the different test conditions is not expected. A particle-size determination is added to the normal test, since this test does not include

ash spiking.

HCl and Cl₂

Determinations for HCl and Cl₂ are already included in the SRE tests, and this data can also be used for the risk assessment.

TABLE A.1-1
FACILITY Z TEST CONDITIONS

	TEST CONDITIONS AND EMISSIONS DETERMINATIONS			
	DRE	SRE 1	SRE 2	NORMAL
	POHCs, PICs, D/Fs, TOE, Total Hydrocarbons, Carbon Monoxide	Metals, D/Fs, PM, HCl/Cl ₂ , Carbon Monoxide		Metals, Particle Size
Combustion temperature	1,600 EF	1,850 EF		1,750 EF
Fabric filter inlet temperature	350 EF	550 EF		450 EF
Organic liquid feed rate	Maximum	Maximum		Normal
Aqueous liquid feed rate	Maximum	Minimum		Normal
Combustion gas velocity	Maximum *	Maximum *		Normal
Ash feed rate	Above average	Maximum		Normal
Chlorine feed rate	Maximum	Maximum		Normal
Spiked metal feed rates	N/A	Maximum		Normal
Other metal feed rates	N/A	Normal		Normal
Fabric filter differential pressure	Within manufacturer's specifications	Within manufacturer's specifications		Normal
Venturi differential pressure	Minimum * (or as close as possible)	Minimum *		Normal
Venturi liquid-to-gas ratio	Minimum	Minimum		Normal
Venturi scrubber liquid exit pH	Minimum	Minimum		Normal
Scrubber blowdown rate	Minimum	Minimum		Normal
Carbon feed rate	Minimum	Minimum		Normal

Notes:

* = conflicting parameters

D/Fs = Dioxins/furans

DRE = Destruction and removal efficiency

N/A = Not applicable

PICs = Products of incomplete combustion

PM = Particulate matter

POHCs = Principal organic hazardous constituents

SRE = System removal efficiency

TOE = Total organic emissions

Site-Specific Risk Assessment

Facility Z performs the tests according to the approved test plan. As expected, D/F emissions are highest during the SRE test conditions. Emissions data are consolidated from all of the test conditions for evaluation in a single multi-pathway human health and ecological site-specific risk assessment as follows:

- ☐ D/F emissions from the SRE test conditions are evaluated, together with . . .
- ☐ Organic PIC emissions from the DRE test condition, and . . .
- ☐ Metals emissions (18 metals) from the normal test condition, and . . .
- ☐ HCl and Cl₂ emissions from the SRE test conditions.

Total chronic risks from these consolidated emissions are determined to be below target levels.

An acute risk evaluation is also performed to assess inhalation risks associated with maximum potential one-hour emissions. Maximum one-hour emissions for the acute evaluation are estimated for D/Fs, other organics, and HCl/Cl₂ based on the test data listed above, with an upward adjustment to reflect upsets. However, for metals, the test data are not representative of maximum potential one-hour emissions. For the metals represented by the spiked metals (arsenic, beryllium, cadmium, chromium, and lead), the facility uses an approved extrapolation procedure to estimate maximum one-hour emission rates based on maximum anticipated one-hour feed rates and the SREs demonstrated during the testing. The extrapolated emissions estimates are then adjusted further to reflect upsets. For the remaining metals, the facility estimates maximum emissions based on maximum anticipated one-hour feed rates and an assumption of zero SRE. Further upward adjustment for these metals is not necessary, since the “zero SRE” assumption already represents the most conservative estimate. Acute risks associated with these maximum emissions estimates are determined to be below target levels.

Finally, Facility Z performs a “post-MACT scenario” chronic risk evaluation. This evaluation is based on emissions estimates for D/Fs, mercury, semivolatile metals, low-volatile metals, and HCl/Cl₂, where the emissions are determined assuming that Facility Z emits at the allowable MACT standard for these

pollutants. These emission estimates are combined with the organic PIC emissions measured during the DRE test, as well as the metals emissions for the non-MACT metals measured during the normal test. Total chronic risks from these consolidated emissions are determined to be below target levels, with the exception of mercury.

Final Permitted Emission Rates

As summarized in Table A.1-2, maximum emission rate limits are established in the RCRA permit for D/Fs, metals, and HCl/Cl₂ based on the levels needed to achieve target risk levels. The limits are established for the purpose of periodic verification testing to ensure that emissions remain below those evaluated in the risk assessment. If emissions increases occur above the permitted levels, then the permit calls for the risk assessment to be repeated. Since none of the non-D/F organics were found to be risk drivers, emission limits for individual non-D/F organic compounds are not established in the permit.

The “post-MACT scenario” risk evaluation showed that the MACT standards for D/Fs, arsenic, beryllium, cadmium, chromium, lead, and HCl/Cl₂ will be sufficiently protective. Therefore, the RCRA permit includes “sunset” provisions on the emission limits for these pollutants in the RCRA permit. In this instance, the sunset provisions are structured so that the RCRA emission limits will no longer apply once the facility has documented compliance with MACT, and once the regulatory agency has completed a finding of compliance. For mercury, the MACT standard will not be sufficiently protective if one assumes that the source continuously emits at the standard. Therefore, the risk-based emission limits for mercury will remain in the RCRA permit. Emission limits for the non-MACT metals (aluminum, antimony, barium, cobalt, copper, manganese, nickel, selenium, silver, thallium, vanadium, and zinc) will also remain in the RCRA permit.

Final Permit Limits for Control Parameters

Table A.1-2 provides the final permit limits on relevant control parameters for Facility Z. Total hydrocarbon levels were negligible during the DRE test condition. Therefore, the permit writer determines that there is no need to specify continued total hydrocarbon monitoring as a condition of the RCRA permit.

For arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel, acceptable risks were projected for at

least one of the risk scenarios evaluated. However, since the projected risks came close to approaching target risk levels, the permit writer determines that closer monitoring and control for these metals is warranted. Therefore, quarterly average metals feed rate limits are established in the RCRA permit to ensure that these metals are not fed at higher rates than those demonstrated. With the exception of mercury, the metals feed rate limits are established in the RCRA permit based on feed rates demonstrated during the testing. For mercury, a risk-based feed rate limit is conservatively calculated from the risk-based emissions limit by assuming zero SRE (i.e., 100% of the mercury fed to the unit is emitted).

For the non-mercury metals, quarterly average feed rate limits are established based on two different test scenarios. For arsenic, beryllium, cadmium, chromium and lead, the quarterly average feed rate limits are established based on the SRE test (since the higher feed rates demonstrated during the SRE test were demonstrated to achieve compliance with the MACT standards, and since the MACT standards were shown to be sufficiently protective in the risk assessment). The RCRA permit is written with sunset provisions for the feed rate limits on these five metals. For nickel, quarterly average feed rate limits are established based on the normal test. The risk-based feed rate limits for nickel will remain in the RCRA permit after MACT. Since risks from the remaining eleven metals were very far from target levels, and since target risk levels could not possibly be exceeded based on the wastes burned at Facility Z, the permit writer decides to simply document the risk assessment feed and emissions assumptions for the remaining metals in the administrative record instead of imposing specific feed rate limits in the permit.

Short-term metal feed rate limits are not necessary for the RCRA permit, because acute risks were determined to be negligible (considering the range of inputs for metals at Facility Z). Although the SRE tests were performed for the purpose of establishing short-term metal feed rate limits for arsenic, beryllium, cadmium, chromium, and lead, these limits will apply in the future pursuant to MACT and are not a RCRA concern.

The RCRA permit is written with sunset provisions for all control parameters except for the quarterly average feed rate limits for mercury and nickel.

TABLE A.1-2
FINAL RCRA PERMIT LIMITS FOR FACILITY Z

Parameter	Value	Basis		Sunset
		Test	Established As:	
Summary of Performance Standards and Emission Limits				
DRE	99.99% for POHCs	N/A	Regulatory Limit	Yes
Maximum PM Emissions	0.08 gr/dscf	N/A	Regulatory Limit	Yes
HCl	Larger of 99% removal or 4 lbs/hr	N/A	Regulatory Limit	Yes
Maximum HCl and Cl ₂ emissions	Inhalation risk-based limits	N/A	Target levels from risk assessment	Yes
Maximum D/F emissions	Multi-pathway risk-based limit	N/A	Target level from risk assessment	Yes
Maximum emissions (arsenic, beryllium, cadmium, chromium, lead)	Multi-pathway risk-based limits	N/A	Target levels from risk assessment	Yes
Maximum emissions (aluminum, antimony, barium, cobalt, copper, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc)	Multi-pathway risk-based limits	N/A	Target levels from risk assessment	No
Group A Control Parameters - Interlocked with AWFCO				
Minimum combustion temperature	1,600 EF, HRA	DRE	Avg. of the test run averages	Yes
Maximum combustion gas velocity	cfm, HRA	SRE 1/ DRE	Avg. of the test run averages ¹	Yes
Maximum organic liquid feed rate	lbs/hr, HRA	DRE	Avg. of the test run averages ¹	Yes
Maximum aqueous feed rate	lbs/hr, HRA	DRE	Avg. of the test run averages ¹	Yes
Maximum fabric filter inlet temperature	550 EF, HRA	SRE	Avg. of the test run averages	Yes

TABLE A.1-2
FINAL RCRA PERMIT LIMITS FOR FACILITY Z (continued)

Parameter	Value	Basis		Sunset
		Test	Established As:	
Minimum and maximum fabric filter pressure differential	inches water column, HRA	N/A	Manufacturer's specifications	Yes
Minimum venturi scrubber differential pressure	inches water column, HRA	SRE 2	Avg. of the test run averages	Yes
Minimum venturi liquid-to-gas ratio	gal/cfm, HRA	SRE	Avg. of the test run averages	Yes
Minimum venturi scrubber liquid exit pH	pH, HRA	SRE	Avg. of the test run averages	Yes
Minimum carbon injection feed rate	lbs/hr, HRA	DRE/ SRE	Avg. of the test run averages	Yes
Maximum stack carbon monoxide concentration	100 ppm at 7% oxygen, dry basis, HRA	N/A	Limit based on established guidance	Yes
Maximum combustion chamber pressure	inches water column, vacuum, instantaneous limit	N/A	As necessary to maintain negative pressure	Yes
Group B Control Parameters				
Restrictions on "more difficult-to-burn POHCs"	Allowable Appendix VIII constituents	DRE	More difficult-to-burn constituents than those which achieved 99.99% DRE are prohibited	Yes
Maximum chlorine feed rate	lbs/hr, HRA ²	SRE	Avg. of the test run averages	Yes
Maximum ash feed rate	lbs/hr, HRA ³	SRE	Avg. of the test run averages ³	Yes
Maximum feed rates (arsenic, beryllium, cadmium, chromium, and lead)	lbs/hr, quarterly average ²	SRE	Avg. of the test run averages	Yes

TABLE A.1-2
FINAL RCRA PERMIT LIMITS FOR FACILITY Z (continued)

Parameter	Value	Basis		Sunset
		Test	Established As:	
Maximum nickel feed rate	lbs/hr, quarterly average	Normal	Avg. of the test run averages	No
Maximum mercury feed rate	lbs/hr, quarterly average ⁴	N/A	Feed rate calculated from the risk-based emission limit assuming zero SRE ⁴	No
Minimum scrubber blowdown	gpm, HRA	SRE	Avg. of the test run averages	Yes
Carbon adsorption properties	Manufacturer's brand	N/A	Same as test	Yes
Group C Control Parameters				
Maximum heat input	million Btu/hr	N/A	Design basis	Yes
Burner/atomizer: - Maximum viscosity - Maximum turndown - Maximum solids - Minimum atomizing pressure differential	- centipoise - gpm range - percent solids - psig (interlocked with AWFCO)	N/A	Manufacturer's recommendations	Yes
Minimum venturi scrubber nozzle pressure	psig (interlocked with AWFCO)	N/A	Manufacturer's recommendations	Yes
Minimum carbon carrier fluid nozzle pressure drop	psig (interlocked with AWFCO)	N/A	Manufacturer's recommendations	Yes

Notes:

AWFCO	=	Automatic waste feed cutoff system	HRA	=	Hourly rolling average
Avg.	=	Average	lbs/hr	=	Pounds per hour
Btu/hr	=	British thermal units per hour	N/A	=	Not applicable
cfm	=	Cubic feet per minute	PM	=	Particulate matter
D/F	=	Dioxin/furan	ppm	=	Parts per million
DRE	=	Destruction and removal efficiency	psig	=	Pounds per square inch, gauge
gal/cfm	=	Gallons per cubic feet per minute	POHC	=	Principle organic hazardous constituent
gpm	=	Gallons per minute			
gr/dscf	=	Grains per dry standard cubic foot	SRE	=	System removal efficiency

TABLE A.1-2
FINAL RCRA PERMIT LIMITS FOR FACILITY Z (continued)

- | | |
|---|---|
| 1 | Under MACT, the limit will be based on the average of the maximum hourly rolling averages for each run. |
| 2 | Under MACT, the averaging period will be 12 hours. |
| 3 | Under MACT, the averaging period will be 12 hours and the limit will be based on the average of the maximum hourly rolling averages for each run. |
| 4 | Under MACT, the averaging period will be 12 hours and the limit will be based on the maximum theoretical emission concentration assuming that all mercury from all feed streams is emitted. |

APPENDIX A.2

RISK BURN CONDITIONS AND PERMIT LIMITS FOR A ROTARY KILN INCINERATOR BURNING CONTAINERIZED WASTES

Note: This illustrative example does not represent the only approach to structuring a trial burn/risk burn/MACT performance test. Other regulatory and permitting options exist. Test plans and final permit conditions should always be developed on a site-specific basis after close interaction between the regulator and facility.

Appendix A.2 describes the risk burn and resulting permit limits for an example rotary kiln incineration facility (Facility Y). Facility Y burns a variety of waste streams including organic liquids, aqueous wastes, organic sludges, bulk solids, and containerized wastes in a rotary kiln combustion chamber. The rotary kiln is followed by a secondary combustion chamber, where organic liquids and aqueous wastes are fired. The downstream air pollution control system consists of a spray dryer and fabric filter. Facility Y is a commercial facility, and the waste streams received at the facility can be highly variable. A review of historical operating data indicates that Facility Y routinely experiences transient operations, with carbon monoxide spikes that often correlate with charges of containerized wastes to the unit.

Facility Y needs to complete performance testing and a risk burn for a Resource Conservation and Recovery Act (RCRA) permit renewal. In addition, Facility Y anticipates complying with the hazardous waste combustor Maximum Achievable Control Technology (MACT) standards in the future. By carefully structuring the test plan, Facility Y can satisfy the current RCRA permitting needs, as well as generate data that may be submitted at a later date as “data in lieu of the initial performance test” for MACT (this facility does not need to physically modify the combustion system to comply with MACT).

Facility Y begins writing the test plan with the following test conditions (summarized in Table A.2-1):

Destruction and Removal Efficiency Test Conditions

Destruction and removal efficiency (DRE) demonstrations will be conducted at minimum primary combustion chamber (PCC) and secondary combustion chamber (SCC) combustion temperatures of

1,400 EF and 1,800 EF, respectively. Other control parameters to be demonstrated during the DRE tests include: 1) maximum combustion gas velocity, as an indicator of minimum gas residence time; 2) maximum waste feed rate to each feed location; and 3) worst-case operating conditions for air pollution control parameters (to the extent possible). Continuous carbon monoxide and total hydrocarbon monitoring is also planned for the DRE tests. Operating parameters to ensure good operation of the waste firing system will be based on manufacturer's specifications.

For the DRE determination, it is not possible to demonstrate maximum waste feed rates for all feed streams simultaneously. Therefore, four (4) DRE test conditions are necessary. The four DRE test conditions are designated as DRE 1, DRE 2, DRE 3, and DRE 4 in Table A.2-1. During each of the test conditions, maximum feed rates for different individual waste streams will be demonstrated, while maintaining a relatively constant maximum total thermal input to the PCC and total system (the unit is designed for 40 million (MM) Btu/hr thermal input to the PCC and 80 MM Btu/hr for the total system). Minimum combustion temperatures and maximum combustion gas velocity will also be maintained throughout the four test conditions. The maximum individual waste feed rate to be demonstrated during each condition follows:

- Ⓒ DRE 1 - Maximum organic liquid feed rate to the PCC
 - Maximum bulk solids feed rate to the PCC
 - Maximum container feed rate (mass basis) to the PCC
 - Maximum organic liquid feed rate to the SCC
- Ⓒ DRE 2 - Maximum container feed rate (thermal input basis) to the PCC
- Ⓒ DRE 3 - Maximum aqueous feed rate to the PCC
 - Maximum organic sludge feed rate to the PCC
- Ⓒ DRE 4 - Maximum aqueous feed rate to the SCC

The demonstration for containerized feeds encompasses two test conditions (DRE 1 and DRE 2). The containerized wastes at Facility Y are fed in 55-gallon drums weighing 100 to 200 pounds each, and can be highly variable. Containerized feeds can range from soil remediation waste (with high moisture and no heating content) to high-heating-value, highly volatile organics sorbed onto a solid matrix.

In the DRE 1 test condition, Facility Y will demonstrate maximum containerized feed rate, as well as

maximum total solids feed rate (for both the containerized and bulk feeds combined). Both feeds will consist of contaminated, moist soils with no heating value (this type of material is representative of the bulk solids which are normally burned, and is representative of materials which are sometimes burned in containers). These conditions represent a challenging DRE test because of the heavy loading of solid material forming a heat sink in the rotary kiln. The maximum containerized feed rate for the DRE 1 condition will be 9,000 lbs/hr, and the maximum container size will be 200 lb/hr, resulting in a feeding frequency of 45 drums per hour.

A separate test condition, DRE 2, is necessary to represent containerized feeds consisting of high-heating-value, highly volatile organics. For DRE 2, drums with a total heat content of 2 MM Btu each will be prepared by adding a glass jar of highly volatile, high-heating-value liquid organics to a wood chip/plastic pellet mixture. The drums will weigh 125 pounds each, and will be fed at the maximum rate allowed by the thermal design capacity of the kiln (40 MM Btu/hr). This results in a feeding frequency of 20 drums per hour. The DRE 2 test will be performed at a higher PCC temperature than the other DRE tests, because the higher kiln temperature ensures a maximum volatilization rate. The higher PCC temperature, in combination with the minimum SCC temperature, still represents a worst-case condition for organic destruction for containerized feeds. In addition, combustion gas velocity for the DRE 2 condition will be slightly lower than the other DRE conditions, since excess air to the PCC will be minimized in an attempt to minimize excess oxygen at the location where the containers are fed.

Several batch/containerized feed parameters will not be demonstrated during the testing. Maximum batch size (200 pounds) will be demonstrated during the DRE 1 condition, and maximum batch charge heat content (which is the more important indicator of a situation that could overwhelm the combustion system) will be demonstrated in the DRE 2 condition. However, maximum container feeding frequency will not be demonstrated in either test, because Facility Y cannot simultaneously demonstrate maximum size (or maximum batch charge heat content) and maximum feeding frequency. Larger batches fed less frequently are considered to be worse than smaller batches fed more frequently, within the total targeted feed rate limits for the containerized feeds of 9,000 lbs/hr and 40 MM Btu/hr for the DRE 1 and DRE 2 tests, respectively. In addition, demonstration of maximum kiln rotation speed is not necessary, since the method of introducing volatile liquids in glass jars will ensure a maximum rate of volatilization and puff intensity.

During the DRE 1 and DRE 4 test conditions, maximum total ash feed rate and maximum atomized ash feed rate will be demonstrated. Therefore, stack sampling for particulate matter will be performed during these test conditions.

System Removal Efficiency Test Condition

In anticipation of future MACT compliance, Facility Y adds a test condition to demonstrate system removal efficiencies (SREs) for semivolatile and low-volatile metals (arsenic, beryllium, cadmium, chromium, and lead). Stack determinations for hydrogen chloride (HCl) and chlorine (Cl₂) are also planned for the SRE test, since chlorine will be maximized during this test and worst-case operating conditions for the spray dryer will be demonstrated.

Maximum semivolatile and low-volatile metal feed rates will be achieved by spiking one metal from each of the two volatility groups to the SCC organic liquid feed. Facility Y will base their total metal feed rate limits only on metals in the SCC feed stream, so that separate feed rate limits on total and pumpable feed streams will not be needed (metals fed as liquids to the SCC constitute a worst-case test).

The SRE demonstration will be conducted at a maximum SCC combustion temperature of 2,200 EF to achieve a maximum inlet fabric filter inlet temperature of 400 EF. Other control parameters to be demonstrated during the SRE test condition include: 1) maximum combustion gas velocity; 2) maximum chlorine feed rate; and 4) worst-case operating conditions for air pollution control parameters (to the extent possible).

The permit writer and Facility Y discuss whether two SRE test conditions should be performed to resolve conflicting parameters. Demonstration of the maximum combustion gas velocity control parameter conflicts with demonstration of minimum pressure differential for the fabric filter. (In fact, this conflict exists for all of the DRE test conditions as well, including the DRE 1 and DRE 4 conditions where compliance with the particulate matter standard will be demonstrated.) Facility Y wishes to avoid duplicating multiple test conditions, since the test program is already quite extensive, and observes that the MACT rule allows limits for minimum (and maximum) fabric filter pressure differential to be established based on manufacturer's specifications. The permit writer agrees with this approach in lieu of expanding the test program further.

For mercury, Facility Y wishes to avoid spiking and will not demonstrate a maximum mercury feed rate during the SRE test. Facility Y plans to conservatively assume that 100% of the mercury fed to the unit is emitted.

Risk Burn Determinations

To complete a site-specific risk assessment, Facility Y recognizes that stack emissions determinations are needed for: dioxins/furans (D/Fs); organics other than D/Fs; the eighteen toxic metals listed in Section 2.3; particle-size distribution; and HCl/Cl₂. Facility Y incorporates these determinations into the test plan as follows:

D/Fs

The primary operating parameters related to D/F formation for Facility Y are fabric filter inlet temperature and combustion parameters, including: 1) minimum PCC and SCC combustion temperatures; 2) maximum combustion gas velocity; 3) maximum waste feed rate for each location; 4) limitations on waste feed composition and batch/containerized feeds; and 5) maximum flue gas carbon monoxide and/or total hydrocarbon concentrations.

D/Fs can be expected to be maximized at the maximum fabric filter inlet temperature of 400 EF, which will be demonstrated during the SRE test. However, the SRE test is not designed to be a challenging test with respect to combustion of organics. Facility Y operates under challenging combustion scenarios which could promote D/F precursor formation, and which should be preferentially targeted for D/F testing, including: 1) transient conditions; 2) operation with containerized feeds; and 3) high carbon monoxide (greater than 100 ppm) situations. These conditions are already represented by the DRE test scenarios. Therefore, Facility Y decides to adjust the spray dryer operation to demonstrate the maximum fabric filter inlet temperature of 400 EF during the DRE tests. D/F stack emissions determinations are added to those tests.

Adjusting the DRE test conditions to demonstrate a maximum fabric filter inlet temperature causes another potential conflicting parameter situation with respect to operation of the spray dryer. To

achieve the maximum 400 EF fabric filter inlet temperature at the lower SCC combustion temperatures planned for the DRE tests, the lime slurry feed rate will have to be lowered from the feed rate planned for the SRE test (which is supposed to represent the minimum). The permit writer and facility agree that this is acceptable, as long as the permit limit for minimum spray dryer slurry feed rate is based on the higher rate demonstrated during the SRE test.

Non-D/F Organics

The feed and operating conditions that influence organic products of incomplete combustion (PICs) are already represented during the DRE test conditions. Therefore, the facility adds PIC and total organic stack emissions determinations to the DRE test conditions. In addition, Facility Y arranges for the sampling contractor to provide a temporary total hydrocarbon continuous emissions monitor during the DRE/PIC testing.

Metals

The SRE test already involves stack determinations for the five toxic metals identified in the MACT rule, and Facility Y has performed a preliminary risk assessment which indicates that the MACT emission standards for semivolatile and low-volatile metals should be sufficiently protective. Therefore, Facility Y simply expands the planned analytical determinations for the SRE test to encompass eighteen metals. The non-MACT metals will be fed at normal feed rates, since Facility Y is capable of defining and maintaining normal conditions for these metals.

Particle-Size Distribution

At Facility Y, the fabric filter will be the primary determinant of particle-size distribution. Therefore, significant variation in particle-size distribution between the different test conditions is not expected. Facility Y suggests that the particle-size distribution determination be performed during the SRE test condition. However, the permit writer is concerned that a particle-size determination during the SRE test could be biased due to the absence of solid feeds, as well as the high temperatures and metals spiking. Therefore, the parties agree that the particle-size determination will

be performed at the conclusion of the risk burn after the facility returns to normal operation.

HCl and Cl₂

Determinations for HCl and Cl₂ are already included in the SRE test, and this data can also be used for the risk assessment.

TABLE A.2-1
FACILITY Y TEST CONDITIONS

	TEST CONDITIONS AND EMISSIONS DETERMINATIONS				
	POHCs, PICs, D/Fs, TOE, Total Hydrocarbons, Carbon Monoxide				Metals, HCl/Cl ₂ , Carbon Monoxide
	PM (DRE 1 and 4 only)				
	DRE 1	DRE 2	DRE 3	DRE 4	SRE
PCC combustion temperature	1,400 EF	1,800 EF	1,400 EF	1,400 EF	1,800 EF
SCC combustion temperature	1,800 EF	1,800 EF	1,800 EF	1,800 EF	2,200 EF *
Fabric filter inlet temperature	400 EF	400 EF	400 EF	400 EF	400 EF *
PCC organic liquid feed rate	Maximum	Minimal	Minimal	High	Maximum
PCC aqueous liquid feed rate	Minimal	Minimal	Maximum	Minimal	N/A
PCC organic sludge feed rate	Normal	Minimal	Maximum	Normal	N/A
PCC bulk solids feed rate	Maximum	Minimal	Minimal	Minimal	N/A
PCC container feed rate	Maximum (mass input)	Maximum (thermal input)	Minimal	Minimal	N/A
- total lb/hr	9,000	2,500			
- lbs/drum	200	125			
- drums/hr	45	20			
- MM Btu/drum	0	2			
- MM Btu/hr	0	40			
SCC organic liquid feed rate	Maximum	High	High	High	Maximum
SCC aqueous liquid feed rate	Minimal	Minimal	Minimal	Maximum	N/A
Thermal input, MM Btu/hr					
- PCC	42	45	45	42	N/A
- SCC	41	33	35	40	
- Total	83	78	80	82	
Combustion gas velocity	Maximum**	High **	Maximum**	Maximum**	Maximum**
Ash feed rate	Maximum total ash	N/A	N/A	Maximum atomized ash	N/A
Chlorine feed rate	Above average	Above average	Above average	Above average	Maximum

TABLE A.2-1
FACILITY Y TEST CONDITIONS (continued)

	TEST CONDITIONS AND EMISSIONS DETERMINATIONS				
	POHCs, PICs, D/Fs, TOE, Total Hydrocarbons, Carbon Monoxide PM (DRE 1 and 4 only)				Metals, HCl/Cl ₂ , Carbon Monoxide
	DRE 1	DRE 2	DRE 3	DRE 4	SRE
Spiked metal feed rates	N/A	N/A	N/A	N/A	Maximum
Other metal feed rates	N/A	N/A	N/A	N/A	Normal
Lime slurry feed rate	Minimum	Minimum	Minimum	Minimum	As low as possible *
Lime slurry properties (minimum percent lime and lime absorbent properties)	Minimum	Minimum	Minimum	Minimum	Minimum
Fabric filter differential pressure	Within manufacturer specifications **	Within manufacturer specifications **	Within manufacturer specifications **	Within manufacturer specifications **	Within manufacturer specifications **

Notes:

- * = conflicting parameters related to spray dryer operation
 ** = conflicting parameters related to fabric filter operation

D/Fs	=	Dioxins/furans	PICs	=	Products of incomplete combustion
DRE	=	Destruction and removal efficiency	PM	=	Particulate matter
hr	=	Hour	POHCs	=	Principal organic hazardous constituents
lb	=	Pounds	SCC	=	Secondary combustion chamber
MM Btu	=	Million British thermal units	SRE	=	System removal efficiency
N/A	=	Not applicable	TOE	=	Total organic emissions
PCC	=	Primary combustion chamber			

Site-Specific Risk Assessment

Facility Y performs the tests according to the approved test plan. Emissions data are consolidated from the test conditions for evaluation in four (4) separate multi-pathway human health and ecological site-specific risk assessment scenarios corresponding to each of the DRE 1, DRE 2, DRE 3 and DRE 4 test conditions as follows:

- C D/F emissions and organic PIC emissions from each DRE test condition are evaluated, together with . . .
- C Metals emissions (18 metals) from the SRE test condition, and . . .
- C HCl and Cl₂ emissions from the SRE test condition.

Total chronic risks for all four risk scenarios are determined to be below target levels.

An acute risk evaluation is also performed to assess inhalation risks associated with maximum potential one-hour emissions. Maximum one-hour emissions for the acute evaluation are estimated for D/Fs, other organics, and HCl/Cl₂ based on the test data listed above, with an upward adjustment to reflect upsets. However, for metals, the test data are not representative of maximum potential one-hour emissions. For the metals represented by the spiked metals (arsenic, beryllium, cadmium, chromium, and lead), the facility uses an approved extrapolation procedure to estimate maximum one-hour emission rates based on maximum anticipated one-hour feed rates and the SREs demonstrated during the testing. The extrapolated emissions estimates are then adjusted further to reflect upsets. For the remaining metals, the facility estimates maximum emissions based on maximum anticipated one-hour feed rates and an assumption of zero SRE. Further upward adjustment for these metals is not necessary, since the “zero SRE” assumption already represents the most conservative estimate. Acute risks associated with these maximum emissions estimates are determined to be below target levels.

Finally, Facility Y performs a “post-MACT scenario” chronic risk evaluation. This evaluation is based on emissions estimates for D/Fs, mercury, semivolatile metals, low-volatile metals, and HCl/Cl₂, where emissions are determined assuming that Facility Y emits at the allowable MACT standard for these pollutants. These emission estimates are combined with the organic PIC emissions measured during the DRE

tests, as well as the metals emissions for the non-MACT metals measured during the SRE test. Total chronic risks from these consolidated emissions are determined to be below target levels.

Final Permitted Emission Rates

As summarized in Table A.2-2, maximum emission rate limits are established in the RCRA permit for D/Fs, metals, and HCl/Cl₂ based on the levels needed to achieve target risk levels. The limits are established for the purpose of periodic verification testing to ensure that emissions remain below those evaluated in the risk assessment. If emissions increases occur above the permitted levels, then the permit calls for the risk assessment to be repeated. Since none of the non-D/F organics were found to be risk drivers, emission limits for individual non-D/F organic compounds are not established in the permit.

The “post-MACT scenario” risk evaluation showed that the MACT standards for D/Fs, metals, and HCl/Cl₂ will be sufficiently protective. Therefore, the RCRA permit includes “sunset” provisions on the emission limits for these pollutants in the RCRA permit. In this instance, the sunset provisions are structured so that the RCRA emission limits will no longer apply once the facility has documented compliance with MACT, and once the regulatory agency has completed a finding of compliance. Emission limits for the non-MACT metals (aluminum, antimony, barium, cobalt, copper, manganese, nickel, selenium, silver, thallium, vanadium, and zinc) will remain in the RCRA permit.

Final Permit Limits for Control Parameters

Table A.2-2 provides the final permit limits on relevant control parameters for Facility Y. During the DRE test conditions, carbon monoxide levels were greater than 100 ppm and total hydrocarbon levels were less than 10 ppm on an hourly rolling average basis. The permit writer establishes the RCRA permit limit for carbon monoxide as the average of the test run averages (i.e., a value greater than 100 ppm). Since carbon monoxide and total hydrocarbon spikes appeared to track pretty closely, the permit writer determines that there is no need to specify continued total hydrocarbon monitoring as a RCRA permit condition prior to MACT. However, after MACT, the facility will comply with a total hydrocarbon limit of 10 ppm instead of with the limit on carbon monoxide.

With the exception of mercury, quarterly average metals feed rate limits are established in the RCRA permit based on the feed rates demonstrated during the SRE test. For mercury, a risk-based feed rate limit is conservatively calculated from the risk-based emission limit by assuming zero SRE (i.e., 100% of the mercury fed to the unit is emitted).

Short-term metal feed rate limits are not necessary for the RCRA permit, because acute risks were determined to be negligible (considering the range of inputs for metals at Facility Y). Although the SRE tests were performed for the purpose of establishing short-term metal feed rate limits for arsenic, beryllium, cadmium, chromium, and lead, these limits will apply in the future pursuant to MACT and are not a RCRA concern.

The RCRA permit is written with sunset provisions for all control parameters except for the quarterly average feed rate limits on the non-MACT metals, and except for limits on containerized feeds which are not required to be established under the MACT rule. Although MACT will limit total mass feed rate for containers (as well as total hydrocarbons), the historical operating data for Facility Y suggests that preventive controls are needed to preclude overcharging of highly volatile, high-Btu containers. Therefore, the limits on “maximum Btu/drum” and “maximum total containerized thermal input” established based on the DRE 2 test will be retained in the RCRA permit. The RCRA permit may be modified to delete these provisions if similar limitations are placed in the Title V permit for this facility in the future.

TABLE A.2-2

FINAL RCRA PERMIT LIMITS FOR FACILITY Y

Parameter	Value	Basis		Sunset
		Test	Established As:	
Summary of Performance Standards and Emission Limits				
DRE	99.99% for POHCs	N/A	Regulatory Limit	Yes
Maximum PM Emissions	0.08 gr/dscf	N/A	Regulatory Limit	Yes
HCl	Larger of 99% removal or 4 lbs/hr	N/A	Regulatory Limit	Yes
Maximum HCl and Cl ₂ emissions	Inhalation risk-based limits	N/A	Target levels from risk assessment	Yes
Maximum D/F emissions	Multi-pathway risk-based limit	N/A	Target level from risk assessment	Yes
Maximum emissions (arsenic, beryllium, cadmium, chromium, lead and mercury)	Multi-pathway risk-based limits	N/A	Target levels from risk assessment	Yes
Maximum emissions (aluminum, antimony, barium, cobalt, copper, manganese, nickel, selenium, silver, thallium, vanadium, zinc)	Multi-pathway risk-based limits	N/A	Target levels from risk assessment	No
Group A Control Parameters - Interlocked with AWFCO				
Minimum PCC combustion temperature	1,400 EF, HRA	DRE	Avg. of the test run averages	Yes
Minimum SCC combustion temperature	1,800 EF, HRA	DRE	Avg. of the test run averages	Yes
Maximum combustion gas velocity	cfm, HRA	DRE/SRE	Avg. of the test run averages ¹	Yes
Maximum PCC organic liquid feed rate	lbs/hr, HRA	DRE 1	Avg. of the test run averages ¹	Yes
Maximum PCC aqueous feed rate	lbs/hr, HRA	DRE 3	Avg. of the test run averages ¹	Yes

TABLE A.2-2
FINAL RCRA PERMIT LIMITS FOR FACILITY Y (continued)

Parameter	Value	Basis		Sunset
		Test	Established As:	
Maximum PCC organic sludge feed rate	lbs/hr, HRA	DRE 3	Avg. of the test run averages ¹	Yes
Maximum PCC bulk solids feed rate	lbs/hr, HRA	DRE 1	Avg. of the test run averages ¹	Yes
Maximum PCC container feed rate	9,000 lbs/hr, HRA	DRE 1	Avg. of the test run averages ¹	Yes
Maximum PCC container heat content	2 MM Btu/drum	DRE 2	As demonstrated during DRE 2	No/Yes ²
Maximum total containerized thermal input	40 MM Btu/hr	DRE 2	As demonstrated during DRE 2	No/Yes ²
Maximum SCC organic liquid feed rate	lbs/hr, HRA	DRE 1	Avg. of the test run averages ¹	Yes
Maximum SCC aqueous liquid feed rate	lbs/hr, HRA	DRE 4	Avg. of the test run averages ¹	Yes
Maximum fabric filter inlet temperature	400 EF, HRA	DRE/ SRE	Avg. of the test run averages	Yes
Minimum and maximum fabric filter pressure differential	inches water column, HRA	N/A	Manufacturer's specifications	Yes
Minimum spray dryer slurry feed rate	gpm, HRA	SRE	Avg. of the test run averages	Yes
Maximum stack carbon monoxide concentration	Site-specific limit greater than 100 ppm at 7% oxygen, dry basis, HRA	DRE	Avg. of the test run averages ³	Yes
Maximum combustion chamber pressure	inches water column, vacuum, instantaneous limit	N/A	As necessary to maintain negative pressure	Yes

TABLE A.2-2
FINAL RCRA PERMIT LIMITS FOR FACILITY Y (continued)

Parameter	Value	Basis		Sunset
		Test	Established As:	
Group B Control Parameters				
Limits on most difficult-to-burn POHCs	Allowable Appendix VIII constituents	DRE	Based on POHCs which achieved 99.99% DRE	Yes
Maximum chlorine feed rate	lbs/hr, HRA ⁴	SRE	Avg. of the test run averages	Yes
Maximum ash feed rate - total - atomized	lbs/hr, HRA ⁵	DRE 1 DRE 4	Avg. of the test run averages ⁵	Yes
Maximum feed rates (arsenic, beryllium, cadmium, chromium, and lead)	lbs/hr, quarterly average ⁴	SRE	Avg. of the test run averages	Yes
Maximum mercury feed rate	lbs/hr, quarterly average ⁶	N/A	Feed rate calculated from the risk-based emission limit assuming zero SRE ⁶	Yes
Maximum feed rates (aluminum, antimony, barium, cobalt, copper, manganese, nickel, selenium, silver, thallium, vanadium, and zinc)	lbs/hr, quarterly average	SRE	Avg. of the test run averages	No
Lime slurry properties (minimum percent lime and lime absorbent properties)	percent	SRE	Avg. of the test run averages	Yes
Group C Control Parameters				
Maximum total heat input	80 MM Btu/hr	N/A	Design basis	Yes

TABLE A.2-2
FINAL RCRA PERMIT LIMITS FOR FACILITY Y (continued)

Parameter	Value	Basis		Sunset
		Test	Established As:	
Burner/atomizer: - Maximum viscosity - Maximum turndown - Maximum solids - Minimum atomizing pressure differential	- centipoise - gpm range - percent solids - psig (interlocked with AWFCO)	N/A	Manufacturer's recommendations	Yes
Minimum spray dryer nozzle pressure	psig, HRA (interlocked with AWFCO)	N/A	Manufacturer's recommendations	Yes

Notes:

AWFCO	=	Automatic waste feed cutoff system	MM Btu	=	Million British thermal units
Avg.	=	Average	N/A	=	Not applicable
Btu/hr	=	British thermal units per hour	PCC	=	Primary combustion chamber
cfm	=	Cubic feet per minute	PM	=	Particulate matter
D/F	=	Dioxin/furan	ppm	=	Parts per million
DRE	=	Destruction and removal efficiency	psig	=	Pounds per square inch, gauge
gal/cfm	=	Gallons per cubic feet per minute	POHC	=	Principle organic hazardous constituent
gpm	=	Gallons per minute			
gr/dscf	=	Grains per dry standard cubic foot	SCC	=	Secondary combustion chamber
HRA	=	Hourly rolling average	SRE	=	System removal efficiency
lbs/hr	=	Pounds per hour			

- Under MACT, the limit will be based on the average of the maximum hourly rolling averages for each run.
- For some systems, these parameters may be critical to passing the DRE performance standard under MACT and would therefore be incorporated into the Title V permit. If these limitations are placed in the Title V permit, then the provisions may be sunset or deleted from the RCRA permit.
- Under MACT, total hydrocarbon monitoring to demonstrate compliance with a 10 ppmv limit will be performed instead of carbon monoxide monitoring.
- Under MACT, the averaging period will be 12 hours.
- Under MACT, the averaging period will be 12 hours and the limit will be based on the average of the maximum hourly rolling averages for each run.
- Under MACT, the averaging period will be 12 hours and the limit will be based on the maximum theoretical emission concentration assuming that all mercury from all feed streams is emitted.