

PROPOSED AMENDMENTS TO ANNEXES IV AND V TO THE PROTOCOL ON POPS

The text below has been highlighted by Canada to indicate the status of parts of the text of in annexes IV and V to the Protocol discussed by the ad hoc technical group during the 41st session of WGSR. The document aims to facilitate the discussions at the 42nd session.

The paragraph numbers correspond to those in annexes IV and V

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- amendments acceptable to the ad hoc technical group (41st session of the WGSR)
- amendments discussed, but not agreed to by the ad hoc technical group (41st session of the WGSR)
- text proposed prior to April meeting of the ad hoc technical group, but not discussed
- new text proposed for discussion at the 42nd session by participants in the ad hoc technical group at the 41st session.
- new text proposed for consideration at WGSR 42nd session.

PROPOSED AMENDMENTS TO ANNEX IV

6. Replace: Emissions of different congeners of PCDD/F are given in toxicity equivalents (TE) in comparison to 2,3,7,8 TCDD using the system proposed by the NATO Committee on the Challenges of Modern Society (NATO CCMS) in 1988.
[The toxicity of polychlorinated dibenzo-p-dioxins and dibenzofurans is expressed using the concept of toxic equivalency which measures the relative dioxin-like toxic activity of different congeners of polychlorinated dibenzo-p-dioxins and dibenzofurans and coplanar polychlorinated biphenyls in comparison to 2,3,7,8-tetrachlorodibenzo-p-dioxin. The toxic equivalent factor values to be used for the purposes of this Convention shall be consistent with accepted international standards, commencing with the World Health Organization 2003 mammalian toxic equivalent factor values for polychlorinated dibenzo-p-dioxins and dibenzofurans and coplanar polychlorinated biphenyls. Concentrations are expressed in toxic equivalents.]

7. Decrease the emission limit value for medical solid waste from [0.5] to [0.1] ng TE/m³.

- (a) Decrease the emission limit value for hazardous solid waste from 0.2 to 0.1 ng TE/m³.
- (b) Introduce new emission limit values for additional emission source categories as follows:
- (i) ["Electric Arc Furnace (for steel manufacturing): Existing facilities: 0.5 ng TE/m³; New facilities: 0.1 ng TE/m³"]; [0.4] For secondary production of copper, new facilities...
- (ii) ["Non-hazardous industrial waste (burning more than 1 ton per hour): 0.1 ng TE/m³"]

Parties may wish to consider the proposal by the European Union to introduce new emission limit values for additional emission source categories as follows:

- (a) "Furnaces for secondary production of copper, aluminium, lead or zinc: Existing facilities: [0,5] ng TE/m³, new facilities: [0.4] ng TE/m³"
- (b) "Sinter plants: Existing facilities: [0.5] ng TE/m³, new facilities: [0.4] ng/m³"

PROPOSED AMENDMENTS TO ANNEX V

10. There are several approaches to the control or prevention of POP emissions from stationary sources. These include the replacement of relevant feed materials, process modifications (including maintenance and operational control) and retrofitting existing plants. The following list provides a general indication of available measures, which may be implemented either separately or in combination:

- (a) Replacement of feed materials which are POPs or where there is a direct link between the **composition of the raw** materials and POP emissions from the source;

12. Cost-efficient **Cost-efficiency** considerations may be based on total costs per year per unit of abatement (including capital and operational costs). POP emission reduction costs should also be considered within the framework of the overall process economics, e.g. the impact of control measures and costs of production. **Cost-efficiency considerations should take into account that the measures to reduce emissions of POPs also will reduce emissions of other pollutants, like Heavy Metals or acidifying agents. The cost-efficiency of measures should be established in relation to the effects on all pollutants, and not be based on reduction of only the amount of POPs.** Given the many influencing factors, investment and operating cost figures are highly case-specific.

IV. CONTROL TECHNIQUES FOR THE REDUCTION OF PCDD/F EMISSIONS

A. Waste incineration

13. Waste incineration includes municipal waste, hazardous waste, **[(non-hazardous) industrial waste]**, medical waste and sewage sludge incineration.

15. The primary measures regarding the incinerated wastes, involving the management of feed material by reducing halogenated substances and replacing them by non-halogenated alternatives, are not appropriate for municipal or hazardous waste incineration. It is more effective to modify the incineration process and install secondary measures for flue gas cleaning. The management of feed material is a useful primary measure for waste reduction and has the possible added benefit of recycling. This may result in indirect PCDD/F reduction by decreasing the waste amounts to be incinerated.

[The environmentally sound design and operation of waste incinerators requires the use of both best available techniques and best environmental practices (which are to some extent overlapping). Primary measures for municipal or hazardous waste incineration are not sufficient. It is most effective to modify the incineration process and to install secondary measures for flue gas cleaning. Best environmental practices for waste management can be useful primary measures. These practices are focused on environmentally sound waste management for instance waste minimization; recycling; waste inspection; removal of ferrous and non-ferrous metals; proper waste handling, storage and pretreatment; minimizing storage times; and proper waste loading.]

[Primary measures involving management of feed material by reducing halogenated substances and replacing them by non-halogenated substances are not technically effective appropriate for municipal or hazardous waste incineration]

16. The modification of process techniques to optimize combustion conditions is an important and effective measure for the reduction of PCDD/F emissions (usually 850°C or higher, assessment of oxygen supply depending on the heating value and consistency of the wastes, sufficient residence time -- **[above]** 850°C for ea. **[more than]** 2 sec -- and turbulence of the gas, avoidance of cold gas regions in the incinerator, etc.). Fluidized bed incinerators keep a lower temperature than 850°C with adequate emission results. For existing incinerators this would normally involve redesigning and/or replacing a plant -- an option which may not be economically viable in all countries. The carbon content in ashes should be minimized.

17. Flue gas measures. The following measures are possibilities for lowering reasonably effectively the PCDD/F content in the flue gas. The de novo synthesis takes place at about 250 to 450°C. These measures are a prerequisite for further reductions to achieve the desired levels at the end of the pipe:

[(b) Adding inhibitors such as triethanolamine or triethylamine (can reduce oxides of nitrogen as well), but side-reactions have to be considered for safety reasons;

(c) Using dust collection systems for temperatures between 800 and 1000°C, e.g. ceramic filters and cyclones; **]***

***[Proposed to be deleted]**

18. Methods for cleaning the flue gas are:

(a) Conventional dust precipitators [*separators*] for the reduction of particle-bound PCDD/F, [*e.g. electrostatic precipitators (ESP) or fabric filters (baghouses)*];

(b) [*Oxidising organohalogens through*] Selective catalytic reduction (SCR) or ~~selective non-catalytic reduction (SNCR)~~;

[(e) H₂O₂-oxidation; and]*

* [*Proposed to be deleted*]

TABLE 1.

Management options	Emission level (%) ^{a/}	Estimated costs	Management risks
Primary measures by modification of feed materials:			
- Elimination of precursors and chlorine-containing feed materials; and - Management of waste streams.	Resulting emission level not quantified; seems not to be linearly dependent on the amount of the feed material.		Pre-sorting of feed material not [<i>sufficient</i>] effective; only parts could be collected; other chlorine-containing material, for instance kitchen salt, paper, etc., cannot be avoided. For hazardous chemical waste this is not desirable. Useful primary measure and feasible in special cases (for instance, waste oils, electrical components, etc.) with the possible added benefit of recycling of the materials.
Modification of process technology:			
- Optimized combustion conditions;			Retrofitting of the whole process needed.
- Avoidance of temperatures below 850°C and cold regions in flue gas; - Sufficient oxygen content;			

Management options	Emission level (%) ^{a/}	Estimated costs	Management risks
control of oxygen input depending on the heating value and consistency of feed material; and - Sufficient residence time and turbulence ; [more than 2 sec above 850°C, for Cl content in the feedstock above 1 % (m/m) above 1100°C]			
Flue gas measures: Avoiding particle deposition by:			
Soot cleaners, mechanical rappers, sonic or steam soot blowers.			Steam soot blowing can increase PCDD/F formation rates.
Dust removal, generally in waste incinerators:	< 10	Medium	Removal of PCDD/F adsorbed onto particles. Removal methods of particles in hot flue gas streams used only in pilot plants.
Fabric filters;	1 - 0.1	Higher	Use at temperatures < 150°C.
Ceramic filters;	Low efficiency		Use at temperatures 800-1000°C.
Cyclones; and	Low efficiency	Medium	
Electrostatic precipitation.	Medium efficiency		Use at a temperature of 450°C; promotion of the de novo synthesis of PCDD/F possible, higher NO _x emissions, reduction of heat recovery. [Formation of PCDD/F risk if used in the range 450-200 °C]
Catalytic oxidation.			Use at temperatures of 800-1000°C. Separate gas phase abatement necessary.

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Management options	Emission level (%) ^{a/}	Estimated costs	Management risks
Gas quenching.			
High-performance adsorption unit with added activated charcoal particles (electrodynamic venturi).			Residues of activated carbon (AC) or lignite coke (ALC) [from fixed bed units] may be disposed of, catalysts can be reprocessed by manufacturers in most cases, AC and ALC can be combusted under strictly controlled conditions. [Where PCDD/F control is achieved by the direct injection of AC into flue gas, it is acceptable to dispose of the fly-ash/AC mixture in a lined landfill.]
Selective catalytic reduction (SCR).		High investment and low operating costs	NOx reduction if NH3 is added; high space demand, spent catalysts and residues of activated carbon (AC) or lignite coke (ALC) may be disposed of, catalysts can be reprocessed by manufacturers in most cases, AC and ALC can be combusted under strictly controlled conditions.
Different types of wet and dry adsorption methods with mixtures of activated charcoal, open-hearth coke, lime and limestone solutions in fixed bed, moving bed and fluidized bed reactors:			Residues of activated carbon (AC) or lignite coke (ALC) [from fixed bed units] may be disposed of, catalysts can be reprocessed by manufacturers in most cases, AC and ALC can be combusted under strictly controlled conditions. [Where PCDD/F control is achieved by the direct injection of AC into flue gas, it is acceptable to dispose of the fly-ash/AC mixture in a lined landfill.]
Fixed bed reactor, adsorption with activated charcoal or open-hearth coke; and	< 2 (0.1 ng TE/m ³)	High investment, medium operating costs	Removal of residuals, high demand of space.

Management options	Emission level (%) ^{a/}	Estimated costs	Management risks
Entrained flow or circulating fluidized bed reactor with added activated coke/lime or limestone solutions and subsequent fabric filter.	< 10 (0.1 ng TE/m ³)	Low investment, medium operating costs	Removal of residuals.
[Addition of H ₂ O ₂ .	< 2 - 5 (0.1 ng TE/m ³)	Low investment, low operating costs]*	
[Destruction using catalytic filter bags]	[< 0.5 (0.1 ng TE/m ³)]	[High investment]	
[Use of carbon impregnated materials for PCDD/F adsorption in the wet scrubbers.]	[30]	[Low investment]	[Only applicable to wet scrubbers especially if there is evidence of dioxin built up. Can be used in combination with subsequent dioxin management options.]

a/ Remaining emission compared to unreduced mode.

* [Proposed to be deleted]

25. Metal production and treatment plants with PCDD/F emissions can meet a maximum emission concentration of **below** 0.1 ng TE/m³ (if waste gas volume flow > 5000 m³/h) using control measures.

Table 2: [Options for emission] Emission reduction of PCDD/F [from thermal processes] in the metallurgical industry

MANAGEMENT OPTIONS	Emission level (%) ^{a/}	Estimated costs	Management risks
Sinter plants			
<u>Primary measures:</u>			
- Optimization/encapsulation of sinter conveying belts;		Low	Not 100% achievable
- Waste gas recirculation e.g. emission optimized sintering (EOS) reducing waste gas flow by ca. 35% (reduced costs of further secondary measures by the reduced waste gas flow), cap. 1 million Nm ³ /h;	40	Low	
<u>Secondary measures:</u>			
- Electrostatic precipitation + molecular sieve;	Medium efficiency	Medium	
- Addition of limestone/activated carbon mixtures;	High efficiency (0.1 ng TE/m ³)	Medium	
- High-performance scrubbers - existing installation: AIRFINE (Voest Alpine Stahl Linz) since 1993 for 600 000 Nm ³ /h; second installation [<i>in use since 1997</i>] in the Netherlands [(<i>Corus plant IJmuiden</i>)] for 1998.	High efficiency emission reduction to 0.2-0.4 ng TE/m ³	Medium	0.1 ng TE/m ³ could be reached with higher energy demand; no existing installation
Non-ferrous production (e.g. copper)			
<u>Primary measures:</u>			
- Pre-sorting of scrap, avoidance of feed material like plastics and PVC-contaminated scrap, stripping of coatings and use of chlorine-free		Low	

MANAGEMENT OPTIONS	Emission level (%) ^{a/}	Estimated costs	Management risks
insulating materials;			
<u>Secondary measures:</u>			
- Quenching the hot waste gases;	High efficiency	Low	
- Use of oxygen or of oxygen-enriched air in firing, oxygen injection in the shaft kiln (providing complete combustion and minimization of waste gas volume);	5 - 7 (1.5-2 TE/m ³)	High [Medium]	[High costs for PCDD/F reduction; moderate if advantages of oxygen firing are used]
- Fixed bed reactor or fluidized jet stream reactor by adsorption with activated charcoal or open-hearth coal dust; [Single- and multi-stage fabric filter with injection of limestone/ activated carbon upstream of the filter]	(0.1 ng TE/m ³)	High	
- Catalytic oxidation; and	(0.1 ng TE/m ³)	High	
- Reduction of residence time in the critical region of temperature in the waste gas system.			
Iron and steel production			
<u>Primary measures:</u>			
- Cleaning of the scrap from oil prior to charging of production vessels;		Low	Cleaning solvents have to be used.
- Elimination of organic tramp materials such as oils, emulsions, greases, paint and plastics from feedstock cleaning;		Low	
- Lowering of the specific high waste gas volumes;		Medium	

MANAGEMENT OPTIONS	Emission level (%) ^{a/}	Estimated costs	Management risks
- Separate collection and treatment of emissions from loading and discharging;		Low	
<u>Secondary measures:</u>			
- Separate collection and treatment of emissions from loading and discharging; and		Low	
- Fabric filter in combination with coke injection. [< 1 [(<0.1 ng TE/m³)]]. [- Use of an optimal temperature profile during cool-down of waste gas - Use of Combustion chamber for treatment of the waste gas.]		Medium	
Secondary aluminium production			
<u>Primary measures:</u>			
- Avoidance of halogenated material (hexachloroethane);		Low	
- Avoidance of chlorine-containing lubricants (for instance chlorinated paraffins); and		Low	
- Clean-up and sorting of dirty scrap charges, e.g. by swarf decoating and drying, swim-sink separation techniques and whirling stream deposition;			
<u>Secondary measures:</u>			
- Single- and multi-stage fabric filter with added activation of limestone/ activated carbon in front [upstream] of	< 1 (0.1 ng TE/m ³)	Medium/ high	

MANAGEMENT OPTIONS	Emission level (%) ^{a/}	Estimated costs	Management risks
the filter;			
- Minimization and separate removal and purification of differently contaminated waste gas flows;		Medium/ high	
- Avoidance of particulate deposition from the waste gas and promotion of rapid passing of the critical temperature range; and		Medium/ high	
- Improved pretreatment of aluminium scrap shredders by using swim-sink separation techniques and grading through whirling stream deposition.		Medium/ high	

^{a/} Remaining emission compared to unreduced mode.

30. Generally, the following measures are suitable for reducing PCDD/F emissions:

(e) Adsorption in a fixed bed reactor or fluidized jet stream reactor with activated charcoal or open-hearth coal dust; **injection of activated carbon in combination with a fabric filter**

32. Electric arc furnaces used in secondary steel production can achieve an emission concentration value of 0.1 ng TE/m³ if the following measures are used:

(c) Use of an optimal temperature profile during cool-down of waste gas;

(d) Use of Combustion chamber for treatment of the waste gas.

A possibility to further reduce PCDD/F emissions is the injection of activated carbon upstream of the fabric filter

35. In summary, single- and multi-stage fabric filters with the addition of limestone/activated carbon/open-hearth coal ~~in front~~ **[upstream]** of the filter meet the emission concentration of 0.1 ng TE/m³, with reduction efficiencies of 99%.

40. In the combustion of fossil fuels in utility and industrial boilers (>50 MW thermal capacity), improved energy efficiency and energy conservation will result in a decline in the emissions of all pollutants because of reduced fuel requirements. This will also result in a reduction in PCDD/F

emissions. It would not be cost-effective to remove chlorine from coal or oil, but in any case the trend towards gas-fired stations will help to reduce PCDD/F emissions from this sector.

[The feasibility of fuel switching is dominated by local circumstances.]

[The use of coal or biomass rich organohalogen compounds or halogenated compounds should be avoided where possible in installations that are not equipped with emission abatement technologies.]

[The waste should only be combusted in installations equipped with proper emission abatement technologies]

[Fuel switch from waste, coal, or biomass containing organohalogen compounds to natural gas will reduce the formation of organohalogen compounds in the off-gases. This can result in a significant decrease of PCDD/F emissions from small installations that are not equipped with emission abatement technologies]

42. The application of techniques to reduce emissions of nitrogen oxides, sulphur dioxide and particulates from the flue gas can also remove PCDD/F emissions. When using these techniques, PCDD/F removal efficiencies will vary from plant to plant. Research is ongoing to develop PCDD/F removal techniques, but until such techniques are available on an industrial scale, no best available technique is identified for the specific purpose of PCDD/F removal.

[Emissions of PCDD/F from industrial powerplants and boilers should not exceed emissions of PCDD/F from waste incinerators. The emission concentrations should be below 0,1 ng TE/m³ .]*

****[CAN needs consultation on this amendment]***

43. The contribution of residential combustion appliances to total emissions of PCDD/F is less significant when approved fuels are properly used. ***[Residential combustion appliances can have a noticeable contribution to total emissions of PCDD/F. This contribution is]*** less significant when approved fuels are properly used. In addition, large regional differences in emissions can occur due to the type and quality of fuel, geographical appliance density and usage. In addition, large regional differences in emissions can occur due to the type and quality of fuel, geographical appliance density and usage.

48. The combustion of urban waste wood (demolition wood) in moving grates leads to relatively high PCDD/F emissions, compared to non-waste wood sources. A primary measure for emission reduction is to avoid the use of treated waste wood in wood-firing installations. Combustion of treated wood should be undertaken only in installations with the appropriate flue-gas cleaning to minimize PCDD/F emissions.

[Biomass fuels can have a high chloride content e.g. straw, or wood from a saline environment, which can lead to an increased formation of PCDD/F when these biomass are incinerated as fuel. Fuel switch to fuels with a low chlorine content for dedicated combustion plants firing biomass will have a large impact on PCDD/F emissions.]

If needed Installations firing biomass can be equipped with abatement techniques to reduce emissions of particulate matter, like fabric filters or electrostatic precipitators; this will reduce emission of PCDD/F significantly.

69. Optimized burning rates are accompanied by low emissions of carbon monoxide (CO), total hydrocarbons (THC) and PAHs. Setting limits (type approval regulations) on the emission of CO and THCs also affects the emission of PAHs. Low emission of CO and THCs results in low emission of PAHs. Since measuring PAH is far more expensive than measuring CO, it is more cost-effective to set a limit value for CO and THCs. ***Work is continuing on a proposal for a CEN standard [For example four CEN standards (EN 303.5; EN 13.229; EN 13.240; EN 12.809) have been published]*** for coal- and wood-fired ***[appliances]*** boilers up to 300 kW (see table 7). ***[These standards set maximum values for CO and THCs and PM.]***

70. Emissions from residential wood combustion stoves can be reduced:

(a) For ***existing*** stoves, by public information and awareness programmes regarding proper stove operation, the use of untreated wood only, fuel preparation procedures and the correct seasoning of wood for moisture content; and

[c) For new stoves, by applying abatement techniques that control the emissions of particulate matter, like electrostatic precipitators, ceramic filters, fabric filters using metal filament fabric or retrofitting of afterburner.]

[d) For existing and new stoves, by applying abatement techniques that will burn the PAHs, by re-circulating stack gases or by using catalytic converters that will oxidise the PAHs. It should be noted that for existing stoves, costs for retro-fit may be prohibitive]

71. More general measures for PAH emission reduction are those related to the development of centralized systems for households and energy conservation such as improved thermal insulation to reduce energy consumption.

[The feasibility of fuel switching is dominated by local circumstances]

[Emission of PAH's from domestic heating systems can be reduced by switching the fuels from wood or coal to natural gas.]

72. Information is summarized in table 8.

Table 8: PAH emission control for residential combustions

Management options	Emission level (%) ^{a/}	Estimated costs	Management risks

Use of dried coal and wood (dried wood is wood stored for at least 18-24 months).	High effectiveness		
Use of dried coal.	High effectiveness		
Design of heating systems for solid fuels to provide optimized complete burning conditions: - Gasification zone; - Combustion with ceramics; - Effective convection zone.	55	Medium	Negotiations have to be held with stove manufacturers to introduce an approval scheme for stoves.
Water accumulation tank.			
Technical instructions for efficient operation.	30 - 40	Low	Might be achieved also by vigorous public education, combined with practical instructions and stove type regulation.
Public information programme concerning the use of wood-burning stoves.			
[Secondary measures to reduces emissions of particulates or to burn PAHs]	[<5 %]	[Medium to high]	[Costs are relative to size of the installation and re-use of heat produced]