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Options for revising annex IX to the Gothenburg Protocol

Draft revised annex IX on measures for the control of emissions of ammonia from agricultural sources

Note by the co-Chairs of the Task Force on Reactive Nitrogen

Summary

At its forty-seventh session in September 2010, the Working Group on Strategies and Review welcomed the work by the Task Force on Reactive Nitrogen on options for revising annex IX to the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol), the Guidance document on control techniques for preventing and abating emissions of ammonia (Guidance Document) (ECE/EB.AIR/WG.5/2007/13) and the Framework Code for Good Agricultural Practice for Reducing Ammonia (EB.AIR/WG.5/2001/7). It requested the Task Force to further update the Guidance Document and the cost estimates for ammonia abatement, as well as to explore combinations of the options for revising annex IX for consideration by the Working Group at its forty-eighth session in April 2011 (ECE/EB.AIR/WG.5/102, para. 21 (c) and (d)).

The annex to this document presents updated options for revising annex IX (as contained in document ECE/EB.AIR/WG.5/2010/14) and a number of technical amendments (that are explained in the report of the Task Force (ECE/EB.AIR/WG.5/2011/6)). The structure of the draft revised annex has been streamlined to facilitate its reading. The proposals for revising the annex are presented as bracketed text with proposed new text indicated in bold. In addition, a “clean”, non-bracketed text of the draft revised annex is included as an appendix to the present document for the convenience of the Working Group.

An updated version of the Guidance Document will be made available to the Working Group as an informal document.

Introduction

1. This document updates the options for revising annex IX to the Gothenburg Protocol presented by the Task Force on Reactive Nitrogen to the Working Group on Strategies and Review at its forty-seventh session in September 2010 (see ECE/EB.AIR/WG.5/2010/14 for bracketed text, and informal document No. 2 of September 2010 for “clean text”).¹ The presentation of the options has been streamlined with a view to improving the readability, while maintaining the broad range of the possible ambition levels for controlling ammonia emissions (A, high; B, medium; and C, low)².

2. Further to the explanations on the updates and amendments provided in the report of the fifth meeting of the Task Force (ECE/EB.AIR.WG.5/2011/6), the co-Chairs of the Task Force have drafted the below points 3 (a) to (o) to describe the updated options and their rationale, and to stimulate discussion by the Working Group on the combination of the proposed options.

3. The Working Group is invited to note that:

(a) With a view to streamlining the draft revised annex IX, a new paragraph 4 was introduced to provide for time-scales for the application of all the measures set out in the annex. The paragraph also includes a provision for countries with economies in transition;

(b) The style of the draft revised annex IX has been harmonized with that of the other Gothenburg Protocol annexes. For example, the provision on reporting proposed in ECE/EB.AIR/WG.5/2010/14, para. 20, has been removed from the annex, as it is assumed that this will be included in the body of the Protocol text;

(c) Depending on the outcome of the integrated assessment modelling, and considering the new estimates of ammonia abatement costs (see ECE/EB.AIR/WG.5/2011/6, paras. 11–22), it is anticipated that Parties may need additional measures beyond those described as option B in order to reach the eventual emission ceilings for ammonia. The options in annex IX can be considered as the basic steps needed for meeting future ammonia emission ceilings, and for ensuring equitability of approach among Parties;

(d) The thresholds in the previous version of the draft revised annex IX (ECE/EB.AIR/WG.5/2010/14) were mainly based on farm size, and, in the case of manure application, also on equipment size. There are, however, a large number of very small farms in the United Nations Economic Commission for Europe (UNECE) region that only contribute a small proportion to the total ammonia emission. Therefore, in order to avoid requiring measures from the smallest farms, the present version of draft annex IX proposes the inclusion of two kinds of farm-size thresholds. First, a comprehensive limit would apply to exclude the very smallest farms, currently set at five livestock units. (For conversion factors for livestock units, see para. 2 of draft revised annex IX annexed hereto) Second, depending on the ambition level of the options, additional thresholds would be used to capture the main fraction of the ammonia emissions, representing a smaller fraction of the number of farms. In order to ensure a common standard between different livestock sectors, these options would include thresholds with a target to cover 70 per cent of the livestock numbers for each of the three categories of cattle, pigs and poultry. Based on statistics from

¹ The document also updates information provided by the Task Force to the forty-sixth session of the Working Group, in April 2010. See document ECE/EB.AIR/WG.5/2010/4, which describes the rationale to amend annex IX and explains the ambition levels for the abatement options.

² The three different options, A, B and C are presented in bold and curly brackets.

the European Union (EU) (see ECE/EB.AIR/WG.5/2010/4, annex I), 72 per cent of cattle are on farms of more than 50 livestock units, which represents only 13 per cent of cattle farm holdings. For pigs, approximately 70 per cent of animals are on farms with more than 200 livestock units (this applies to both fattener pigs and sows). For poultry, approximately 70 per cent of animals are on farms with more than 40,000 birds;

(e) For the poultry threshold, the target to include 70 per cent of the animals is consistent with the current provisions of the Gothenburg Protocol and the EU Integrated Pollution Prevention Control (IPPC) Directive. However, for pigs, the current Gothenburg Protocol and IPPC thresholds only cover approximately 20 per cent of animals. For that reason, options limited to farms larger than the IPPC threshold for pigs (2,000 fattener pigs or 750 sows) would be denoted as reflecting a low level of ambition;

(f) The targets for animal feeding strategies are currently expressed as a percentage reduction based on baseline values to be established by parties during a first five year period. An alternative way to express the range of ambition would be to focus solely on target values of feed protein content;

(g) The options for ammonia emission reduction requirements related to animal housing have been reformulated and presented in a table format (see table 1 in draft revised annex IX below) for improved readability;

(h) For existing animal houses (referred to in para. 11 and table 1 of draft revised annex IX below), the proposed requirements can be met with negligible net costs because the minimum reduction target is set at only 20 per cent. This target can be met through frequent manure removal for pigs, and by avoiding water spillages for housed poultry. Consequently, the target would not require alteration to the existing building structure. Any potential (small) additional labour costs would be more than offset by the fertilizer value of the reduced emissions. This provision is also covered by the EU IPPC, and therefore implies no additional costs for those Parties that are EU member States. A higher ambition reduction percentage is not being proposed for existing animal houses because this could entail significant costs for Parties outside the EU;

(i) For new animal housing for cattle, exemptions to the firm requirement have been allowed because of the limited technical capability using current approaches for naturally ventilated cattle housing;

(j) For new animal housing, firm requirements in the options focus on pig and poultry housing. In general terms, the lower ambition level emission reduction targets (options C) can be achieved without net costs (see subparagraph (f), above), while the higher ambition level targets (options B and A) are achievable at 0–2 euros per kg ammonia-nitrogen (NH₃-N) abated (option B) or at 0.5–6 euros per kg NH₃-N abated (option A). It should be noted that, from 2013 onwards, animal welfare regulations for pigs in the EU would make it more difficult to achieve a 60 per cent reduction unless a different reference was specified. (At present, this has not yet been agreed);

(k) For all the options relating to new or largely rebuilt animal housing, a threshold of five livestock units has been retained (as opposed to ECE/EB.AIR/WG.5/2010/14, paragraph 13 (a)). This provides an exemption for the smallest farms, while recognizing that most new or largely rebuilt animal housing will concern larger farms. It has been proposed not to give other farm-size thresholds to options B and C because of the small estimated implementation costs of the requirements. By contrast, for poultry housing, due to the larger costs implied, the higher target option A might be restricted to farms larger than a threshold of 40,000 bird places;

(l) For existing manures stores on livestock farms, several options (A, B, C) for setting the farm-size threshold were included. The Task Force experts noted that a 40 per

cent reduction for existing stores could be achieved cheaply by using several types of floating cover (see ECE/EB.AIR/WG.5/2010/4, paragraphs 46–48). The requirements have been relaxed for “very large lagoons” because of the technical limitations of using floating covers over larger areas. It should be noted that a threshold to define “very large lagoons” has not yet been agreed;

(m) Currently, the measures, as formulated by the Task Force, do not cover manure transferred to arable farms and stored before land application. Consequently, additional consideration by the Task Force and the Working Group would be needed in order to determine whether this issue is sufficiently important to justify further amendment of the options for manure storage;

(n) For application of manure to land, the three options presented for table 2 have been simplified by incorporating exemptions into the table notes. (To compare with the previous presentation of the tables, see ECE/EB.AIR/WG.5/2010/14, section F, pages 6 to 8). It is worth noting that the costs of a high efficiency abatement technique (e.g., for emission reduction by 60 per cent, option A) are often smaller than of a low efficiency abatement technique (that achieve 30 per cent reduction, options B, C), when expressed as euros per kg NH₃-N abated;

(o) For all of the options proposed, the percentage reduction targets can be achieved by approaches described in the draft revised Ammonia Guidance Document (see informal document No. 4 of September 2010). Each of the abatement methods/techniques listed as category 1, category 2 and category 3 methods in the Guidance Document, as well as other methods, may be used to meet the requirements set out in annex IX. Where Parties use category 1 methods, which are considered as having been already verified, no additional verification by the Party is needed. By contrast, where a Party chooses to use methods that are not listed as category 1 in the Guidance Document, verification of the method needs to be reported by that Party. This requirement has been included in paragraph 5 of the present version of draft revised annex IX below).

4. Based on feedback from the Working Group at its forty-eighth session, the Task Force will continue its work in refining the options for revising annex IX to the Gothenburg Protocol, and in finalizing the Guidance Document, including the cost estimates.

Annex

Draft revised Annex IX: Measures for the control of emissions of ammonia from agricultural sources^a

1. [The Parties that are subject to obligations in article 3, paragraph 8 (a), shall take the measures set out in this annex. - ~~delete~~] **[This annex describes the minimum measures for the control of ammonia emissions. These minimum measures can be reached by using, as a guidance, the techniques for preventing and reducing ammonia emissions, according to the specifications listed in Guidance Document V adopted by the Executive Body at its seventeenth session (decision 1999/1) and any amendments thereto (hereafter referred to as the Guidance Document).]**
2. **[Data on animals are converted into livestock units (LU) using the following coefficients: Cattle: under 1 year old: 0.4; 1 year or over but under 2 years: 0.7; 2 years old and over: Male animals: 1.0; Dairy cows: 1.0; Other cows and heifers: 0.8. Sheep and goats (all ages): 0.1. Pigs: Piglets having a live weight of under 20 kg per 100 head: 2.7; Breeding sows weighing 50 kilograms and over: 0.5; and Other pigs 0.3.]**
3. [Each Party shall take due account - ~~delete~~] **[When taking the minimum measures for the control of ammonia emissions, due account shall be taken]** of the need to reduce losses from the whole nitrogen cycle. **[Efforts shall be made to develop strategies for increasing nitrogen-use efficiency in crop and animal production. A high nitrogen-use efficiency is indicative for low nitrogen losses, low risk of pollution swapping and a high economic return on farm expenditure on nitrogen.]**
4. **[The time-scales for the application of the minimum measures for the control of ammonia emissions set out in this annex are:**
 - (a) **{Two years after the date of entry into force of the present Protocol for that Party (options A, B); 31 December 2017 (option C)}; or**
 - (b) **For a Party that is a country with an economy in transition, {five years after the date of entry into force of the present Protocol for that Party (options A, B); 31 December 2019 (option C)} 1/.**
5. **[Where measures are used to meet the requirements of this annex, other than those listed as Category 1 in the Guidance Document, these shall be reported including justification of the verification procedures used to estimate the abatement efficiencies specified, according to the principles set out in the Guidance Document.]**

A. Advisory code of good agricultural practice

6. [Within one year from the date of entry into force of the present Protocol for it, a Party shall establish, publish and disseminate an - ~~delete~~] **[An] advisory code of good agricultural practice to control ammonia emissions [shall be established, published and disseminated, based on the Framework Code for Good Agricultural Practices for Reducing Emissions of Ammonia, adopted by the Executive Body at its thirty-third session (EB.AIR/WG.5/2001/7) and any amendment thereto.]** The **[advisory]** code shall

^a The order and numbering of sections and paragraphs have been revised but not indicated as bracketed text.

take into account the specific conditions within the territory of the Party and shall include provisions on the following items:

- (a) Nitrogen management, taking into account the full nitrogen cycle;
- (b) Livestock feeding strategies;
- (c) Low-emission manure spreading [techniques - ~~delete~~] [**approaches**];
- (d) Low-emission manure storage systems;
- (e) [**Low-emission manure processing and composting systems;**]
- (f) Low-emission animal housing systems;
- (g) Possibilities for limiting ammonia emissions from the use of mineral fertilizers.

7. [The advisory code shall be reviewed and updated at least every five years and, whenever the framework code is revised; it shall take into account the most recent insights and developments related to ammonia emissions abatement.] [Parties should give a title to the code with a view to avoiding confusion with other codes of guidance. - ~~delete~~] [The code should be unambiguously titled and as far as feasible linked to other codes of good agricultural practices describing good management of the overall nitrogen cycle.]

B. Nitrogen management, taking into account the full nitrogen cycle

8. [All available on-farm nitrogen sources and external nitrogen inputs should be used effectively. For that purpose, nitrogen input-output (i.e., farm-gate) balances shall be established on demonstration farms^b representative of various farming systems and typical farming conditions. Farm-type-specific baseline values of these farm-level input-output balances shall be established as an average of the first five-year period after the date specified in paragraph 5 of this annex. During the second and subsequent five-year periods a relative improvement of {30 per cent (option A); 20 per cent (option B); 10 per cent (option C)} of the nitrogen-use efficiency and a reduction of the nitrogen surplus of {30 per cent (option A); 20 per cent (option B); 10 per cent (option C)} should be achieved relative to the previous five-year average for these demonstration farms. The improvement shall continue under a continuous programme until levels of high efficiency and low nitrogen surplus are achieved according to farm type, as specified in the Guidance Document.]

9. [Based on the experience gained with the methods applied on demonstration farms, nitrogen input-output balances shall be implemented on all farms {(option A) with more than five livestock units; (option B) with more than 50 livestock units for cattle farms, 200 livestock units for pigs or 40,000 places for poultry; (option C) with more than 50 livestock units for cattle farms, 20,00 fattener pigs, 750 sows or 40,000 poultry} within 10 years of entry into force of the revised protocol. These input-output balances shall be used to ensure a relative improvement of {30 per cent (option A); 20 per cent (option B); 10 per cent (option C)} of the nitrogen-use efficiency and a reduction of the nitrogen surplus of {30 per cent (option A); 20 per cent (option B); 10 per cent (option C)} over a five-year period relative to the previous five-year average

^b The Task Force notes that it is a matter for further discussion with the Working Group on Strategies and Review to agree the manner in which such “demonstration farms”, “pilot farms” or “demonstration on farm” would be established.

on these farms. For the first five-year period, the farm-type-specific baseline values collected on demonstration farms may be used as the reference. The improvement shall continue under a continuous programme until a level of high efficiency is achieved, as specified in the Guidance Document.]

10. [National nitrogen budgets shall be established as far as is technically feasible, based on available statistics {annually (option A); every three years (option B); every five years (option C)}, in order to follow the changes in overall losses of reactive nitrogen, including emissions of ammonia and nitrous oxide to air and the leaching of nitrogen to groundwater and surface water.]

C. Livestock feeding strategies

11. [Low-protein animal feeding strategies shall be used on all farms where animals are housed with more than {five livestock units (option A); 50 livestock units for cattle farms or 200 livestock units for pigs or 40,000 places for poultry (option B); 50 livestock units for cattle farms or 2,000 fattener pigs or 750 sows or 40,000 poultry (option C)}. Baseline animal feeding strategies at farm level shall be established as an average of the first five-year period as described in the Guidance Document. During the second and subsequent five-year periods, the Parties shall ensure that these feeding strategies result in a reduction of {15 per cent (option A); 10 per cent (option B); 5 per cent (option C)} relative to the previous five-year period, with the aim of reducing both ammonia volatilization potential and the nitrogen excretion until the values specified in the Guidance Document have been achieved.]

D. Animal housing

12. [Within one year from the date of entry into force of the present Protocol for it, a Party shall use, for new animal housing on large pig and poultry farms of 2,000 fattening pigs or 750 sows or 40,000 poultry, housing systems which have been shown to reduce emissions by 20 per cent or more compared to the reference (as listed in the Guidance Document) V adopted by the Executive Body at its seventeenth session (decision 1999/1) and any amendments thereto), or other systems or techniques with a demonstrably equivalent efficiency. 2/ Applicability may be limited for animal welfare reasons, for instance in straw-based systems for pigs and aviary and free-range systems for poultry. - ~~delete~~] **[For animal housing, systems shall be used (as listed in the Guidance Document) that have been shown to reduce emissions as specified in table 1 below.]**

**[Table 1
Ammonia emission reduction requirements for animal housing**

<i>Category</i>	<i>Minimum emission reduction compared with the reference^a</i>	<i>Exemptions/conditions</i>
Existing pig and poultry housing on farms with >2,000 fattening pigs or >750 sows or >40,000 poultry	20%	{Note: This target can generally be met with negligible additional net costs}
New or largely rebuilt cattle housing^b	25%	As far as a Party considers it feasible and acceptable for animal welfare reasons. When it is considered not feasible, this shall be documented
New or largely rebuilt pig housing^b	{60% (option A); 35 % (option B); 25 % (option C)}	A relaxation of the {35% (option A); 25% (option B)} reduction requirement applies for locations where the average air temperature of the warmest month exceeds 20°C (based on a five-year mean) {Note: The net cost of option C is negligible. For warm countries there is negligible net cost to option B}
New and largely rebuilt broiler housing^b	20%	Includes chicken, turkeys, geese and other table birds {Note: The net cost of meeting this target is negligible for all countries}
New and largely rebuilt poultry housing^b	{60% (option A); 50% (caged layer hens) and 60% (non-caged layer hens) (option B); 30% (caged layer hens) and 60% (non-caged layer hens) (option C)}	{Note: As there are larger costs for option A, this target might be restricted to new farms with >40,000 birds}
New and largely rebuilt animal housing on farms for animals other than those already listed in this table^b	Use of low-emission housing systems	As far as they are considered technically and economically feasible. When it is considered not feasible, this should be reported

^a The reference specified is that listed in the Guidance Document.

^b Livestock farms with five livestock units or less would be exempt from these requirements.]

E. Manure storage [outside of animal houses]

13. [Within one year of the date of entry into force of the present Protocol for it, a Party shall use for new slurry stores on large pig and poultry farms of 2,000 fattening pigs or 750 sows or 40,000 poultry, - ~~delete~~] **[For new slurry stores outside of animal houses for cattle, pig and poultry,] low-emission storage systems or techniques [shall be used] that have been shown to reduce ammonia emissions by [40 per cent - ~~delete~~] [**80 per cent (option A); 60 per cent (option B); 40 per cent (option C)**]] or more compared to the reference, as listed in the Guidance Document [V adopted by the Executive Body at its seventeenth session (decision 1999/1) and any amendments thereto, or other systems or techniques with a demonstrably equivalent efficiency. 2/ - ~~delete~~].**

14. [For existing slurry stores on large pig and poultry farms of 2,000 fattening pigs or 750 sows or 40,000 poultry, a Party shall achieve ammonia emission reductions of 40 per cent insofar as the Party considers the necessary techniques to be technically and economically feasible. 2/ The timescales for the application of these measures shall be as follows: 31 December 2009 for Parties with economies in transition and 31 December 2007 for all other Parties. 1/ - ~~delete~~] **[For existing slurry stores on farms with more than {five livestock units (option A); 50 livestock units for cattle or 200 livestock units for pigs or 40,000 poultry (option B); 50 livestock units for cattle, 2,000 fattening pigs or 750 sows or 40,000 poultry (option C)}, low-emission storage systems or techniques shall be used that have been shown to reduce ammonia emissions by 40 per cent as compared with the reference described in the Guidance Document. For existing very large lagoons, ammonia emission reductions of 40 per cent should be achieved, as far as the Party considers it technically and economically feasible.]**

15. [For existing and new stores for solid manure, low-emission storage systems such as described in the Guidance Document should be used, so far as the Party considers them technically and economically feasible. When it is considered not feasible, this should be reported.]

16. [As far as technically and economically feasible, all livestock farms should have sufficient manure storage capacity to allow manure to be applied at times most suitable for crop growth.]

[Manure processing and composting

17. Low-emission manure processing and composting systems should be used as far as it is considered feasible.]

F. Manure application

[18. Each Party shall ensure that low-emission slurry application techniques (as listed in guidance document V adopted by the Executive Body at its seventeenth session (decision 1999/1) and any amendments thereto), that have been shown to reduce emissions by at least 30 per cent compared to the reference specified in that guidance document are used as far as the Party in question considers them applicable, taking into account local soil and geomorphological conditions, slurry type and farm structure. The timescales for the application of these measures shall be: 31 December 2009 for Parties with economies in transition and 31 December 2007 for other Parties. 1/ Within one year from the date of entry into force of the present Protocol for it, a Party shall ensure that solid manure applied to land to be ploughed shall be incorporated within at least 24 hours of spreading as far as it considers this measure applicable, taking account of local soil and geomorphological conditions and farm structure. - ~~delete~~]

[18. For slurry and solid manure application, approaches shall be used (as listed in the Guidance Document) that have been shown to reduce emissions as specified in table 2 below. This provision applies to the land application of slurry and solid manure from all livestock types to both arable land and grassland.]

[Table 2 (Option A)

Ammonia emission reduction requirements for slurry and solid manure application to arable land and grassland

<i>Category</i>	<i>Minimum emission reduction compared with the reference^a</i>	<i>Exemptions/conditions</i>
For slurry application to arable land and grassland and for solid manure application to bare soil	To use methods that reduce emissions by at least 60% compared with the reference method	Small farms^b Specific soil conditions^c
For slurry application to solid-seeded winter cereal crops after seedling emergence	To use methods that reduce emissions by at least 50% compared with the reference method	{Note: A relaxation of the requirement applies because the most effective low-emission methods are not suitable in this situation }
For solid manure application only to grassland or arable crops after sowing	To use methods that reduce emissions by at least 30% compared with the reference	The reduction should be achieved as far as the Party considers it feasible. When it is considered not feasible, this should be reported {Note: A relaxation of the requirement applies because the most effective low-emission methods are not suitable in this situation }

^a The reference specified is that listed in the Guidance Document.

^b For livestock farms with less than 50 livestock units for cattle or 200 livestock units for pigs or 40,000 poultry, this requirement is relaxed to 30% reduction. For livestock farms with less than five livestock units, this requirement applies only as far as the Party considers it feasible. The relaxation and exemption do not apply to manure transported for application to arable farms.

^c A relaxation of the requirement to 30% reduction compared with the reference applies due to technical feasibility in the case of fields with: (i) stony soils, (ii) high clay soils (>35% clay particle content) in very dry conditions, (iii) peat soils (>25% organic matter content), and (iv) a slope of more than 15% from horizontal.]

**[Table 2 (Option B):
Ammonia emission reduction requirements for slurry and solid manure application to arable land and grassland**

<i>Category</i>	<i>Minimum emission reduction compared with the reference^a</i>	<i>Exemptions/conditions</i>
For slurry application to arable land and grassland and for solid manure application to bare soil	To use methods that reduce emissions by at least 30% compared with the reference method	Small farms^b Use of small spreaders^c {Note: Exemptions for specific soil conditions are not needed for this option}
For solid manure application only to grassland or arable crops after sowing	To use methods that reduce emissions by at least 30% compared with the reference method	The reduction should be achieved as far as the Party considers it feasible. When it is considered not feasible, this should be reported {Note: Relaxation of the requirement applies because the most effective low-emission methods are not suitable in this situation }

^a The reference specified is that listed in the Guidance Document.

^b For livestock farms with less than five livestock units this requirement applies only as far as the party considers it feasible. The exemption does not apply to manure transported for application to arable farms.

^c When using existing mobile slurry tankers and solid manure spreaders having less than 3m³ capacity, this requirement applies only as far as the Party considers it feasible.]

**[Table 2 (option C):
Ammonia emission reduction requirements for slurry and solid manure application to arable land and grassland**

<i>Category</i>	<i>Minimum emission reduction compared with the reference^a</i>	<i>Exemptions/Conditions</i>
For slurry application to arable land and grassland and for solid manure application to bare soil	To use methods that reduce emissions by at least 30% compared with the reference method	Small farms^b Use of small spreaders^c {Note: Exemptions for specific soil conditions are not needed for this option}
For solid manure application only to grassland or arable crops after sowing	To use methods that reduce emissions by at least 30% compared with the reference method	The reduction should be achieved as far as the Party considers it feasible. When it is considered not feasible, this should be reported {Note: A relaxation of the requirement applies because the most effective low-emission methods are not suitable in this situation }

^a The reference specified is that listed in the Guidance Document.

^b For livestock farms with less than 50 livestock units for cattle or 200 livestock units for pigs or 40,000 poultry, this requirement applies only as far as the Party considers it feasible. The relaxation does not apply to manure transported for application to arable farms.

^c When using any mobile slurry tankers and solid manure spreaders having less than 5m³ capacity, this requirement applies only as far as the Party considers it feasible.]

G. Urea and [~~ammonium carbonate~~] [~~ammonium-based~~] fertilizers

[19. Within one year of the date of entry into force of the present Protocol for it, a Party shall take such steps as are feasible to limit ammonia emissions from the use of solid fertilizers based on urea. - ~~delete~~]

[19. For field application of fertilizers based on urea, approaches shall be used (as listed in the Guidance Document) that have been shown to reduce ammonia emissions by at least {80 per cent (option A); 50 per cent (option B); 30 per cent (option C)} compared with the reference specified in that Guidance Document.]

20. Within one year of the date of entry into force of the present Protocol for it, a Party shall prohibit the use of ammonium carbonate fertilizers.

21. **[For fertilizers based predominantly on ammonium sulphate or ammonium phosphate when applied to calcareous soils, approaches shall be used (as listed in the Guidance Document), that have been shown to reduce mean ammonia emissions by at least {80 per cent (option A); 50 per cent (option B); 30 per cent (option C)} as compared with the reference specified in that Guidance Document.]^c**

Notes

^{1/} For the purpose of the present annex, a country with an economy in transition refers to a Party that, by means of its instrument of ratification, acceptance, approval or accession, has made a declaration stating that it wishes to be treated as a country with an economy in transition for the purposes of [paragraphs 6 and/or 9 - ~~delete~~] [**paragraph 4**] of this annex.

^{2/} Where a Party judges that other systems or techniques with a demonstrably equivalent efficiency can be used for manure storage and animal housing in order to comply with paragraphs 8 and 10, or a Party judges the reduction of emissions from manure storage required under paragraph 9 not to be technically or economically feasible, documentation to this effect shall be reported in accordance with article 7, paragraph 1 (a). - ~~delete~~]

^c This paragraph was proposed based on current understanding, pending full documentation of further evaluations and fertilizer trials.

Appendix

Clean copy of the options for revising technical annex IX

Measures for the control of emissions of ammonia from agricultural sources

1. This annex describes the minimum measures for the control of ammonia emissions. These minimum measures can be reached by using, as a guidance, the techniques for preventing and reducing ammonia emissions, according to the specifications listed in Guidance Document V adopted by the Executive Body at its seventeenth session (decision 1999/1) and any amendments thereto (hereafter referred to as the Guidance Document).
2. Data on animals are converted into livestock units (LU) using the following coefficients: Cattle: under 1 year old: 0.4; 1 year or over but under 2 years: 0.7; 2 years old and over: Male animals: 1.0; Dairy cows: 1.0; Other cows and heifers: 0.8. Sheep and goats (all ages): 0.1. Pigs: Piglets having a live weight of under 20 kg per 100 head: 2.7; Breeding sows weighing 50 kilograms and over: 0.5; and Other pigs 0.3.
3. When taking the minimum measures for the control of ammonia emissions, due account shall be taken of the need to reduce losses from the whole nitrogen cycle. Efforts shall be made to develop strategies for increasing nitrogen-use efficiency in crop and animal production. A high nitrogen-use efficiency is indicative for low nitrogen losses, low risk of pollution swapping and a high economic return on farm expenditure on nitrogen.
4. The time-scales for the application of the minimum measures for the control of ammonia emissions set out in this annex are:
 - (a) {Two years after the date of entry into force of the present Protocol for that Party (options A, B); 31 December 2017 (option C)} or
 - (b) For a Party that is a country with an economy in transition, {five years after the date of entry into force of the present Protocol for that Party (options A, B); 31 December 2019 (option C)} 1/.
5. Where measures are used to meet the requirements of this annex, other than those listed as Category 1 in the Guidance Document, these shall be reported including justification of the verification procedures used to estimate the abatement efficiencies specified, according to the principles set out in the Guidance Document.

A. Advisory code of good agricultural practice

6. An advisory code of good agricultural practice to control ammonia emissions shall be established, published and disseminated, based on the framework code for good agricultural practices for reducing emissions of ammonia, adopted by the Executive Body at its thirty-third session (EB.AIR/WG.5/2001/7) and any amendment thereto. The advisory code shall take into account the specific conditions within the territory of the Party and shall include provisions on the following items:
 - (a) Nitrogen management, taking into account the full nitrogen cycle;
 - (b) Livestock feeding strategies;
 - (c) Low-emission manure spreading approaches;
 - (d) Low-emission manure storage systems;

- (e) Low-emission manure processing and composting systems;
- (f) Low-emission animal housing systems;
- (g) Possibilities for limiting ammonia emissions from the use of mineral fertilizers.

7. The advisory code shall be reviewed and updated at least every five years and whenever the framework code is revised; it shall take into account the most recent insights and developments related to ammonia emissions abatement. The code should be unambiguously titled and as far as feasible linked to other codes of good agricultural practices describing good management of the overall nitrogen cycle.

B. Nitrogen management, taking into account the full nitrogen cycle

8. All available on-farm nitrogen sources and external nitrogen inputs should be used effectively. For that purpose, nitrogen input-output (i.e., farm-gate) balances shall be established on demonstration farms representative of various farming systems and typical farming conditions. Farm-type-specific baseline values of these farm-level input-output balances shall be established as an average of the first five-year period after the date specified in paragraph 5 of this annex. During the second and subsequent five-year periods a relative improvement of {30 per cent (option A); 20 per cent (option B); 10 per cent (option C)} of the nitrogen-use efficiency and a reduction of the nitrogen surplus of {30 per cent (option A); 20 per cent (option B); 10 per cent (option C)} should be achieved relative to the previous five-year average for these demonstration farms. The improvement shall continue under a continuous programme until levels of high efficiency and low nitrogen surplus are achieved according to farm type, as specified in the Guidance Document.

9. Based on the experience gained with the methods applied on demonstration farms, nitrogen input-output balances shall be implemented on all farms {(Option A) with more than five livestock units; (Option B) with more than 50 livestock units for cattle farms, 200 livestock units for pigs or 40,000 places for poultry; (Option C) with more than 50 livestock units for cattle farms, 2,000 fattener pigs, 750 sows or 40,000 poultry} within 10 years of entry into force of the revised protocol. These input-output balances shall be used to ensure a relative improvement of {30 per cent (option A); 20 per cent (option B); 10 per cent (option C)} of the nitrogen-use efficiency and a reduction of the nitrogen surplus of {30 per cent (option A); 20 per cent (option B); 10 per cent (option C)} over a five-year period relative to the previous five-year average on these farms. For the first five-year period, the farm-type-specific baseline values collected on demonstration farms may be used as the reference. The improvement shall continue under a continuous programme until a level of high efficiency is achieved, as specified in the Guidance Document.

10. National nitrogen budgets shall be established as far as is technically feasible, based on available statistics {annually (option A); every three years (option B); every five years (option C)}, in order to follow the changes in overall losses of reactive nitrogen, including emissions of ammonia and nitrous oxide to air and the leaching of N to groundwater and surface water.

C. Livestock feeding strategies

11. Low-protein animal feeding strategies shall be used on all farms where animals are housed with more than {five livestock units (option A); 50 livestock units for cattle farms or 200 livestock units for pigs or 40,000 places for poultry (option B); 50 livestock units for cattle farms or 2,000 fattener pigs or 750 sows or 40,000 poultry (option C)}. Baseline

animal feeding strategies at farm level shall be established as an average of the first five-year period as described in the Guidance Document. During the second and subsequent five-year periods, the Parties shall ensure that these feeding strategies result in a reduction of {15 per cent (option A); 10 per cent (option B); 5 per cent (option C)} relative to the previous five-year period with the aim of reducing both ammonia volatilization potential and the nitrogen excretion until the values specified in the Guidance Document have been achieved.

D. Animal housing

12. For animal housing, systems shall be used (as listed in the Guidance Document) that have been shown to reduce emissions as specified in table 1 below.

Table 1

Ammonia emission reduction requirements for animal housing

<i>Category</i>	<i>Minimum emission reduction compared with the reference^a</i>	<i>Exemptions/conditions</i>
Existing pig and poultry housing on farms with >2,000 fattening pigs or >750 sows or >40,000 poultry	20%	{Note: This target can generally be met with negligible additional net costs}
New or largely rebuilt cattle housing ^b	25%	As far as a Party considers it feasible and acceptable for animal welfare reasons. When it is considered not feasible, this shall be documented
New or largely rebuilt pig housing ^b	{60% (option A); 35% (option B); 25% (option C)}	A relaxation of the {35% (option A); 25% (option B)} reduction requirement applies for locations where the average air temperature of the warmest month exceeds 20°C (based on a five-year mean) {Note: The net cost of option C is negligible. For warm countries there is negligible net cost to option B}
New and largely rebuilt broiler housing ^b	20%	Includes chicken, turkeys, geese and other table birds {Note: The net cost of meeting this target is negligible for all countries}
New and largely rebuilt poultry housing ^b	{60% (option A); 50% (caged layer hens) and 60% (non-caged layer hens) (option B); 30% (caged layer hens) and 60% (non-caged layer hens)}	{Note: As there are larger costs for option A, this target might be restricted to new farms with >40,000 birds}

<i>Category</i>	<i>Minimum emission reduction compared with the reference^a</i>	<i>Exemptions/conditions</i>
	(option C)}	
New and largely rebuilt animal housing on farms for animals other than those already listed in this table ^b	Use of low-emission housing systems	As far as they are considered technically and economically feasible. When it is considered not feasible, this should be reported

^a The reference specified is that listed in the Guidance Document.

^b Livestock farms with five livestock units or less would be exempt from these requirements.

E. Manure storage outside of animal houses

13. For new slurry stores outside of animal houses for cattle, pig and poultry, low-emission storage systems or techniques shall be used that have been shown to reduce ammonia emissions by {80 per cent (option A); 60 per cent (option B); 40 per cent (option C)} or more compared to the reference, as listed in the Guidance Document.

14. For existing slurry stores on farms with more than {five livestock units (option A); 50 livestock units for cattle or 200 livestock units for pigs or 40,000 poultry (option B); 50 livestock units for cattle, 2,000 fattening pigs or 750 sows or 40,000 poultry (option C)}, low-emission storage systems or techniques shall be used that have been shown to reduce ammonia emissions by 40 per cent as compared with the reference described in the Guidance Document. For existing very large lagoons, ammonia emission reductions of 40 per cent should be achieved, as far as the Party considers it technically and economically feasible.

15. For existing and new stores for solid manure, low-emission storage systems such as described in the Guidance Document should be used, so far as the Party considers them technically and economically feasible. When it is considered not feasible, this should be reported.

16. As far as technically and economically feasible, all livestock farms should have sufficient manure storage capacity to allow manure to be applied at times most suitable for crop growth.

Manure processing and composting

17. Low-emission manure processing and composting systems should be used as far as it is considered feasible.

F. Manure application

18. For slurry and solid manure application, approaches shall be used (as listed in the Guidance Document) that have been shown to reduce emissions as specified in table 2 below. This provision applies to the land application of slurry and solid manure from all livestock types to both arable land and grassland.

[Table 2 (Option A)]

Ammonia emission reduction requirements for slurry and solid manure application to arable land and grassland

<i>Category</i>	<i>Minimum emission reduction compared with the reference^a</i>	<i>Exemptions/conditions</i>
For slurry application to arable land and grassland and for solid manure application to bare soil	To use methods that reduce emissions by at least 60% compared with the reference method	Small farms ^b Specific soil conditions ^c
For slurry application to solid-seeded winter cereal crops after seedling emergence	To use methods that reduce emissions by at least 50% compared with the reference method	{Note: A relaxation of the requirement applies because the most effective low-emission methods are not suitable in this situation }
For solid manure application only to grassland or arable crops after sowing	To use methods that reduce emissions by at least 30% compared with the reference method	The reduction should be achieved as far as the Party considers it feasible. When it is considered not feasible, this should be reported {Note: A relaxation of the requirement applies because the most effective low-emission methods are not suitable in this situation }

^a The reference specified is that listed in the Guidance Document.

^b For livestock farms with less than 50 livestock units for cattle or 200 livestock units for pigs or 40,000 poultry, this requirement is relaxed to 30% reduction. For livestock farms with less than five livestock units, this requirement applies only as far as the Party considers it feasible. The relaxation and exemption do not apply to manure transported for application to arable farms.

^c A relaxation of the requirement to 30% reduction compared with the reference applies due to technical feasibility in the case of fields with: (i) stony soils, (ii) high clay soils (>35% clay particle content) in very dry conditions, (iii) peat soils (>25% organic matter content), and (iv) a slope of more than 15% from horizontal.]

Table 2 (Option B):
Ammonia emission reduction requirements for slurry and solid manure application to arable land and grassland

<i>Category</i>	<i>Minimum emission reduction compared with the reference^a</i>	<i>Exemptions/conditions</i>
For slurry application to arable land and grassland and for solid manure application to bare soil	To use methods that reduce emissions by at least 30% compared with the reference method	Small farms ^b Use of small spreaders ^c {Note: Exemptions for specific soil conditions are not needed for this option}
For solid manure application only to grassland or arable crops after sowing	To use methods that reduce emissions by at least 30% compared with the reference method	The reduction should be achieved as far as the Party considers it feasible. When it is considered not feasible, this should be reported {Note: Relaxation of the requirement applies because the most effective low-emission methods are not suitable in this situation }

^a The reference specified is that listed in the Guidance Document.

^b For livestock farms with less than five livestock units this requirement applies only as far as the party considers it feasible. The exemption does not apply to manure transported for application to arable farms.

^c When using existing mobile slurry tankers and solid manure spreaders having less than 3m³ capacity, this requirement applies only as far as the Party considers it feasible.]

Table 2 (option C):
Ammonia emission reduction requirements for slurry and solid manure application to arable land and grassland

<i>Category</i>	<i>Minimum emission reduction compared with the reference^a</i>	<i>Exemptions/Conditions</i>
For slurry application to arable land and grassland and for solid manure application to bare soil	To use methods that reduce emissions by at least 30% compared with the reference method	Small farms ^b Use of small spreaders ^c {Note: Exemptions for specific soil conditions are not needed for this option}
For solid manure application only to grassland or arable crops after sowing	To use methods that reduce emissions by at least 30% compared with the reference method	The reduction should be achieved as far as the Party considers it feasible. When it is considered not feasible, this should be reported {Note: A relaxation of the requirement applies because the most effective low-emission methods are not suitable in this situation }

^a The reference specified is that listed in the Guidance Document.

^b For livestock farms with less than 50 livestock units for cattle or 200 livestock units for pigs or 40,000 poultry, this requirement applies only as far as the Party considers it feasible. The relaxation does not apply to manure transported for application to arable farms.

^c When using any mobile slurry tankers and solid manure spreaders having less than 5m³ capacity, this requirement applies only as far as the Party considers it feasible.]

G. Urea and ammonium-based fertilizers

19. For field application of fertilizers based on urea, approaches shall be used (as listed in the Guidance Document) that have been shown to reduce ammonia emissions by at least {80 per cent (option A); 50 per cent (option B); 30 per cent (option C)} compared with the reference specified in that Guidance Document.

20. Within one year of the date of entry into force of the present Protocol for it, a Party shall prohibit the use of ammonium carbonate fertilizers.

21. For fertilizers based predominantly on ammonium sulphate or ammonium phosphate when applied to calcareous soils, approaches shall be used (as listed in the Guidance Document), that have been shown to reduce mean ammonia emissions by at least {80 per cent (option A); 50 per cent (option B); 30 per cent (option C)} as compared with the reference specified in that Guidance Document.^d

Note

^{1/} For the purpose of the present annex, a country with an economy in transition refers to a Party that, by means of its instrument of ratification, acceptance, approval or accession, has made a declaration stating that it wishes to be treated as a country with an economy in transition for the purposes of paragraph 4 of this annex.

^d This paragraph was proposed based on current understanding, pending full documentation of further evaluations and fertilizer trials.