Competent Authority Report

Public version

SULFURYL FLUORIDE/VIKANE (PT8)

DOCUMENT III-B7

Ecotoxicological Data for the Biocidal Product

Rapporteur Member State: Sweden

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KEMIKALIEINSPEKTIONEN

SWEDISH CHEMICALS INSPECTORATE

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Please note:

- **The dossier on sulfuryl fluoride submitted under Directive 98/8/EC contained studies and information prepared originally for the dossier submitted under Directive 91/414/EEC. This was accepted by the RMS since the compilation of the dossier was made at an early stage, i.e. prior to the finalisation of the guidance document on how to utilize PPP dossiers for the preparation of BP dossiers.**

- **As a consequence, in many studies submitted by the applicant, the numbering system and format adopted under Directive 91/414/EEC and used for Plant Protection Products have been used. Several cross-references done by the applicant in the text of the studies, as well as in the text within justifications for non-submission of data, also refer to the dossier submitted under Directive 91/414/EEC (e.g., "PPP IIA 2.1.2/01"). A guide to the numbering system of 'BP vs. PPP' can be found in the last appendix of Doc I.**

- **In the reference list, however, the studies submitted are sorted also by reference number to facilitate the location of a study after its generic reference number (which is the same regardless of which directive it was submitted under).**

- **The CA's evaluations and in those cases where new study summaries have been submitted by the applicant, the numbering system of the TNsG on Preparation of Dossiers and Study Evaluation, adopted under Directive 98/8/EC, has been used.**

Section B7.1
Annex Point IIB, VII.7.1

Foreseeable Routes of Entry into the Environment on the Basis of the Use Envisaged

Official use only

7. **Identify measures necessary to minimize contamination of the environment and the impact on non-target species.**

Minimization of environmental contamination is most effectively achieved by maximizing fumigation parameters, in particular, sealing of the structure and length of fumigation. Dose is a function of concentration and time. Better sealing of the structure will increases the half-loss time, thus maintaining fumigant concentrations within the structure allowing for a more rapid accumulation of concentration • time product (CT). This also allows the fumigator to decreasing the amount of fumigant required at the initiation of the fumigation to obtain the same CT as a structure with a shorter half-loss time. Utilization of the longest practical fumigation time allows for the accumulation of CT with a lower initial application rate. These concepts are part of the product stewardship process and Dow AgroSciences fumigation training course. These considerations also have a direct cost implication to the fumigator. By maximizing sealing the fumigator will reduce the amount of gas fumigant required to achieve desired control of the pest, thus reducing their fumigant cost and increasing their profitability.

During the typical fumigation (~24 hr) one and many times more than one half-loss time will occur resulting in the loss of at least 50% and majority of times 75% or more of the sulfuryl fluoride to the atmosphere via slow leakage from the fumigated structure. There is no practical means of capturing sulfuryl fluoride lost to leakage during fumigation.

Gas absorbers and scrubbers to minimise fumigant emissions have been investigated and several systems have been patented for various fumigants (i.e. methyl bromide, phosphine and to a lesser extent sulfuryl fluoride). The efficiency of these recovery systems has been stated to be 50 to 95%. These systems have been developed for relatively small volume structures (less than 300 m^3) and aerated at relatively slow rates (typically less than 1 m^3/s). The limited capacity of these systems would be commercially impractical for larger structures such as churches, houses, and other large structures (> 2000 m^3). The time to aerate the structure would be so long that it would be commercially prohibitive and the volume of absorbent material or scrubber solution required to capture or destroy the fumigant would pose additional hazards to workers and the environment. These systems though technically possible on a relatively small scale at a fixed location, they are not practical on a commercial scale.

7.1 **Foreseeable routes of entry into the environment.**

- **Information on how the active substance due to handling it or from a waste water treatment plant, etc., to which compartment of the environment (soil, sediment, water, air) can be released into the environment, and an estimation on how large the amounts released are.**

Affected compartment(s): Sulfuryl fluoride as a fumigant will be released into the air after application.

Distribution into the environmental compartments was calculated using a

Section B7.1 Annex Point IIB, VII.7.1	Foreseeable Routes of Entry into the Environment on the Basis of the Use Envisaged	
	Level II fugacity (Mackay) model. **(Ref.** PPP **M-III, section 5, IIIA 9.0.1/01, K24)**	X(1)
Water	Distribution calculated using a Level II fugacity (Mackay) model. **(Ref.** PPP **M-III, section 5, IIIA 9.0.1/01, K24)** 0.0068% of sulfuryl fluoride released will partition into water	
Sediment	Distribution calculated using a Level II fugacity (Mackay) model. **(Ref.** PPP **M-III, section 5, IIIA 9.0.1/01, K24)** 0.0000% of sulfuryl fluoride released will partition into the sediment	X(2)
Air	Distribution calculated using a Level II fugacity (Mackay) model. **(Ref.** PPP **M-III, section 5, IIIA 9.0.1/01, K24)** 99.9932% of sulfuryl fluoride released will partition into the air	
Soil	Distribution calculated using a Level II fugacity (Mackay) model. **(Ref.** PPP **M-III, section 5, IIIA 9.0.1/01, K24)** 1.37 x 10^{-7}% of sulfuryl fluoride released will partition into the soil	
	• **Sources of environmental exposure: for example production, distribution, storage, mixing and loading, uses and disposal or recovery should be described. The measured or estimated extent of release: frequency and intensity (eg. dose and duration) should be indicated. The descriptions should cover the most significant routes of exposure**	
Production	Sulfuryl fluoride is produced outside of the European Union, in Pittsburg, CA, USA.	
Distribution	Sulfuryl fluoride is packaged in the end use container which is a steel cylinder fitted with an appropriate valve. All cylinders are leaked tested prior to shipment from the manufacturing plant. Any environmental exposure would be through the accidental rupturing of a cylinder.	
Storage	Sulfuryl fluoride is packaged in the end use container which is a steel cylinder fitted with an appropriate valve. All cylinders are leaked tested prior to shipment from the manufacturing plant. Any environmental exposure would through the accidental rupturing of a cylinder.	
Mixing and Loading	No mixing or loading activities for this product. Sulfuryl fluoride is packaged and shipped in the end use product, therefore no potential exposure form mixing and loading activities.	
Uses	During the conduct of a fumigation all fumigant released into the area being treated is eventually released into the atmosphere. Approximately 25 to 90% of the initially released amount of fumigant will be loss to the atmosphere during the fumigant holding period (fumigation) dependent on half-loss time. The remaining fumigant is vented to the atmosphere during the aeration phase.	
Disposal and Recovery	Upon the completion of the fumigation process all fumigant gas has dissipated in the atmosphere, therefore there is no fumigant for disposal. Due to the high vapour pressure of sulfuryl fluoride recovery of the gas from the atmosphere inside of a fumigated structure would be similar to	

Section B7.1 Annex Point IIB, VII.7.1	Foreseeable Routes of Entry into the Environment on the Basis of the Use Envisaged	
	recovering Oxygen (O_2) from the atmosphere. Though this recovery is technically possible it is not commercial feasible. Recovery of the fumigant by adsorption to a material, such as activated charcoal, would not be practical from point of view of commercial scale fumigation. Gas absorbers and scrubbers to minimise fumigant emissions have been investigated and several systems have been patented for various fumigants (i.e. methyl bromide, phosphine and to a lesser extent sulfuryl fluoride). The efficiency of these recovery systems has been stated to be 50 to 95%. These systems have been developed for relatively small volume structures (less than 300 m^3) and aerated at relatively slow rates (typically less than 1 m^3/s). The limited capacity of these systems would be commercially impractical for larger structures such as churches, houses, and other large structures (> 2000 m^3). The time to aerate the structure would be so long that it would be commercially prohibitive and the volume of absorbent material or scrubber solution required to capture or destroy the fumigant would pose additional hazards to workers and the environment. These systems though technically possible on a relatively small scale at a fixed location, they are not practical on a commercial scale.	
	• **Define aquatic recipients in detail: for instance surface water, ground water, estuaries or marine environment. Assess possible ways of transformation and distribution.**	
	Sulfuryl fluoride will not be present at aquatic environments because of its physical properties; the predicted environmental concentration in surface water is [redacted] (please note that this is a confidential figure). Sulfuryl fluoride is a gas under all environmental conditions (boiling point -54°C, see **PPP IIA 2.1.2/01, A15**), and has an extremely high vapour pressure (1,611,467 Pa at 20°C, **PPP IIA 2.3.1/01, A20**). This result has been confirmed by fugacity modelling (**PPP IIIA 9.0.1/01, K24)** which demonstrated that only 0.007% of sulfuryl fluoride emitted to the environment will partition to surface (ocean) water.	
	• **Information on the representative measured concentrations of monitoring data, for example, in wastewater or the environment or on concentrations based on model calculations, which can be used as predicted environmental concentrations in the relevant environmental compartments.**	
Intended use(s)	The percentage distributions for affected compartments are based on the global fugacity modelling, which yields corresponding PECs based on the total annual production volume ([redacted] (please note that this is a confidential figure)), while the PECs resulting from a single application are also presented. The 3840 kg input is not from a regional scenario, it is from a single use scenario. An example calculation for surface water is given below:: [redacted] (please note that this is confidential)	X(3) X(4)
Affected compartments:	Distribution calculated using a Level II fugacity (Mackay) model. **(Ref. 91/414 Doc M-III, section 5, IIIA 9.0.1/01, K24)**	
PECwater	0.0068% of sulfuryl fluoride released will partition into water. . PECwater = [redacted] (please note that this is a confidential figure)µg/L (based on total annual global production and emissions).	X(5)
PECsediment	0.0000% of sulfuryl fluoride released will partition into the sediment. .	X(2,6)

Section B7.1 Annex Point IIB, VII.7.1	Foreseeable Routes of Entry into the Environment on the Basis of the Use Envisaged	
	PECsediment = [redacted] (please note that this is a confidential figure) mg/kg (based on total annual global production and emissions).	
PECair	99.9932% of sulfuryl fluoride released will partition into the air. PECair = [redacted] (please note that this is a confidential figure) ppt (volume/volume) (ppt = parts per trillion, 10^{12}) (based on total annual global production and emissions), or [redacted] (please note that this is a confidential figure) ng/m^3.	X(7)
PECsoil	1.37 x 10^{-7}% of sulfuryl fluoride released will partition into the soil. PECsoil = [redacted] (please note that this is a confidential figure) mg/kg (based on total annual global production and emissions).	X(8)
Predicted concentration in the affected compartment(s)	PECs based on a realistic maximum application to a building volume of 30 000 m^3 at a dose rate of 128 g/m^3 (total = 3840 kg). PECs estimated by multiplying the PECs estimated for annual production and use values by the maximum realistic application in a single application (3840 kg / [redacted] (please note that this is a confidential figure) kg annually). (The building volume was assumes the worst case in terms of size – a very large building (e.g. mill) to be fumigated).	X(9)
PECwater, single use	9.7 x 10^{-12} µg/L, (based on a single use of 3840 kg).	X(10)
PECsediment, single use	2.2 x 10^{-16} mg/kg (based on a single use of 3840 kg).	X(11)
PECair, single use	0.0002 ppt (volume/volume) (ppt = parts per trillion, 10^{12}) or 6.3 x 10^{-4} ng/m^3 (based on a single use of 3840 kg).	X(12)
PECsoil, single use	1.1 x 10^{-16} mg/kg (based on a single use of 3840 kg).	X(13)
Chapter 2.5, PT8, Wood preservatives	**Quantify emission fluxes. Information should be supplied on the binding of the active substance to wood or other treated materials, on factors influencing binding properties and information should be supplied on how and in what percentage the active substance or its transformation products are released from the treated material by evaporation, dissolving or another way. Release rates to be given can be either default estimates or measured leaching rates.** Sulfuryl fluoride will completely evaporate from the treated material and leave no residue after treatment. After aeration of the treated material no active substance is left on the treated materials. Sulfuryl fluoride has therefore no residual action.	

Section B7.1 **Foreseeable Routes of Entry into the Environment on the Basis of the Use Envisaged**

Annex Point IIB, VII.7.1

Evaluation by Competent Authorities

	EVALUATION BY RAPPORTEUR MEMBER STATE
Date	October 2004
Materials and methods	X1. The fugacity modelling can be found in section B7.5. (this document). X2. When the first Level I modelling was made using the default, regional-scale (100 000 km^2) environmental properties, it was shown that the sediment (as well as fish, suspended sediment, aerosols and soil) contained a negligible fraction of sulfuryl fluoride at equilibrium ($\leq 10^{-6}$%). When the global environment was simulated the volume of the sediment compartment (and fish and suspended solids) was set to zero and therefore the percentage output result will of course be 0%. X3. The wrong figure on global annual production/emission amount is given ([redacted] (please note that this is a confidential figure) kg). The right figure, i.e. the same figure used in the study on phototransformation/fate and behaviour in air (Doc III A7.3.1, K28), should be [redacted] (please note that this is a confidential figure) kg. This figure represents the average global, annual production/emission of sulfuryl fluoride from 1992-2000. *Please note that this figure is highly confidential and may not be disclosed outside the government regulatory authorities.* X4. In the fugacity modelling wrong input value was used by mistake (see further section B7.5 of this document). The annual production volume should have been [redacted] (please note that this is a confidential figure) kg (*confidential figure*). This implies that the calculation example for PEC*single_use* suffers from two errors (PEC*annual_use* and kg*annual_use*). The corrected figures on PEC*single_use* can be found further below. The calculations of PEC for the different compartments as a result of global use of sulfuryl fluoride, suffer from one error and the corrected values are: X5. PECwater = [redacted] (please note that this is a confidential figure) µg/l X6. PECsediment = [redacted] (please note that this is a confidential figure) mg/kg X7. PECair* = [redacted] (please note that this is a confidential figure) ppt or [redacted] (please note that this is a confidential figure) ng/m^3 X8. PECsoil = [redacted] (please note that this is a confidential figure) mg/kg * This PEC value is less than the estimated limit of detection for the analysis of sulfuryl fluoride in remote tropospheric air samples which is <0.5 ppt (III-A7.3.1, K28). Therefore a worst case estimate of $PEC_{air-global}$ is considered to be 2.1 ng/m^3 (=0.5 ppt). X9. Here, PEC values for the different compartments on a global scale have been calculated with a single use (amount) input. The value of this is questionable but nevertheless, since these PEC values suffer from miscalculations as explained above, the right values can be found below. It should be pointed out though, that since sulfuryl fluoride is a gas under normal environmental conditions the calculations of PEClocal, PECregional or PECsingle_use will be highly imaginary

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Annex Point IIB, VII.7.1

	and of little value for the understanding of the distribution and the levels to expect in the environment. Sulfuryl fluoride emitted to the atmospheric environment (or to any environmental compartment) will not only be distributed within the boundaries of the local or regional scales but will be distributed over a much larger area (or rather volume). But, in theory any theoretical spatial scenario can be modelled if the amount of sulfuryl fluoride emitted is known together with a knowledge of the compartmental volumes of interest. The PEC_{single_use} values could rather be seen as the contribution of one fumigation event to the concentrations of the global environment. X10. PECwater, single use = 1.2 x 10^{-11} µg/L X11. PECsediment, single use = 2.6 x 10^{-16} mg/kg X12. PECair, single use = 7.6 x 10^{-4} ng/m^3 X13. PECsoil, single use = 1.3 x 10^{-16} mg/kg The best, worst case estimate of PEC_{air_local} can instead be found in section B7.8 (this document). In the justification for non-submission of data under section B7.8 the monitoring values of air concentrations at various positions around mills during the fumigation and venting processes are presented. From these, the maximum 24-hour time weighted average concentrations for a range distances from the mill have been estimated (see Table 7.8.1-1 of B7.8). The 90^{th} percentile of 1.51 ppm (6.2 mg/m^3) at 5 metres was taken to represent the "worst-case" scenario of maximum exposure for any individuals in the vicinity of the mill, i.e. worst case PEC_{air_local}.
Conclusion	Applicant's version is adopted.
Reliability	Reliability indicator 2: Study conducted in accordance with generally accepted scientific principles, possibly with incomplete reporting or methodological deficiencies, which do not affect the quality of relevant results.
Acceptability	The information is considered acceptable. The information of the predicted concentrations of the global environment after an input of sulfuryl fluoride from a single fumigation event (PEC_{single_use}) is, however, of limited use.
Remarks	No remarks.

Section B7.2 **Annex Point IIB, VII.7.2**	**Information on the Ecotoxicology of the Active Substance in the Product**	
	JUSTIFICATION FOR NON-SUBMISSION OF DATA	Official use only
Other existing data [x] **Limited exposure [ ]**	**Technically not feasible [ ]** **Scientifically unjustified [ ]** **Other justification [ ]**	
Detailed justification:	The “product” Vikane is the active ingredient sulfuryl fluoride (99.8%). Information on the ecotoxicity of sulfuryl fluoride can be found in Doc. III-A7. Vikane is no formulated product therefore no co-ingredients can influence the outcome of the risk assessment.	
Undertaking of intended data submission [ ]	No further studies are planned.	
	Evaluation by Competent Authorities	
	EVALUATION BY RAPPORTEUR MEMBER STATE	
Date	October 2004	
Evaluation of applicant's justification	Applicant's justification is considered to be acceptable.	
Conclusion	Applicant's justification is considered to be acceptable.	
Remarks	No remarks.	

Section B7.3 **Annex Point IIB, VII.7.3**	**Available Ecotoxicological Information relating to Exotoxicological Relevant Non-Active Substances**	
	JUSTIFICATION FOR NON-SUBMISSION OF DATA	Official use only
Other existing data [ ] **Limited exposure [ ]**	**Technically not feasible [ ]** **Scientifically unjustified [ ]** **Other justification [x]**	
Detailed justification:	Not applicable, Vikane is the active ingredient 99.8%), there are no other non-active ingredients present in Vikane.	
Undertaking of intended data submission [ ]	No studies are planned.	
	Evaluation by Competent Authorities	
	EVALUATION BY RAPPORTEUR MEMBER STATE	
Date	October 2004	
Evaluation of applicant's justification	Applicant's justification is considered to be acceptable.	
Conclusion	Applicant's justification is considered to be acceptable.	
Remarks	No remarks.	

Section B7.4 Annex Point IIIB, XII.1	Where Relevant all the Information Required in Accordance with Paragraph A7.1 and A7.2	
	JUSTIFICATION FOR NON-SUBMISSION OF DATA	Official use only
Other existing data [ ] **Limited exposure [ ]**	**Technically not feasible [ ]** **Scientifically unjustified [ ]** **Other justification [x]**	
Detailed justification:	Not applicable, Vikane is the active ingredient 99.8%), there are no other non-active ingredients present in Vikane.	
Undertaking of intended data submission [ ]	No studies are planned.	
	Evaluation by Competent Authorities	
	EVALUATION BY RAPPORTEUR MEMBER STATE	
Date	October 2004	
Evaluation of applicant's justification	Applicant's justification is considered to be acceptable.	
Conclusion	Applicant's justification is considered to be acceptable.	
Remarks	No remarks.	

Section B7.5 **Test for Distribution and Dissipation (Fugacity Model)**

Annex Point IIIB, XII.2

Fugacity Modelling (IIIA 9.0.1/01, K24)

Report: Krieger, M.S. (2001)
Environmental Fugacity Modelling of Sulfuryl Fluoride (SO_2F_2)
Dow AgroSciences, unpublished report GH-C 5307, November 2001, **K24.**

Guidelines: None

GLP: No (modelling study)

Methodology: Fugacity models from the Canadian Environmental Modelling Centre (available at http://www.trentu.ca/academic/aminss/envmodel/welcome.html) were used to determine the environmental distribution of sulfuryl fluoride after release to the atmosphere. The physical properties of sulfuryl fluoride used as inputs were log K_{ow} = 0.14, water solubility = 1040 g/m^3 at 20°C, vapour pressure = 1611467 Pa at 20°C, and a melting point of –136.7°C.

A Level I fugacity model was used to determine the equilibrium distribution of a fixed quantity of sulfuryl fluoride in a closed environment. Sulfuryl fluoride was assumed not to degrade or move between environmental compartments by advection or other intermedia transport processes. The environmental compartment which receives the emission is unimportant because the chemical is assumed to partition instantaneously to equilibrium conditions. Level I models determine a chemical's behaviour in a representative environment based on its physical-chemical properties.

Two different Level I simulations were performed using the same physical-chemical properties for sulfuryl fluoride but differing environmental properties. The first simulation used the default, regional-scale (100,000 km^2) environmental properties from the Canadian Environmental Modelling Centre's EQC model, while the second simulation used environmental properties reflecting the global environment. Preliminary results using the EQC regional environment indicated that the sediment, suspended sediment, fish, aerosol compartments contained a negligible fraction of sulfuryl fluoride at equilibrium ($\leq 10^{-8}$%); therefore these compartments (with the exception of the aerosol compartment) were not included in the global environment simulation. For the global environmental simulation, the height of the atmosphere was assumed to be 12 km (the average height of the troposphere), the volume of the water compartment was assumed to be the volume of the mixed layer of the ocean (average mixed layer depth 75 m) and the volume of the soil compartment was assumed to be the surface area of ice-free land to a depth of 15 cm. The volume of the aerosol compartment was estimated by assuming an aerosol concentration of 10 µg/m^3 throughout the troposphere and a density of 2 g/cm^3.

The Level II model was run using the global environmental parameters as described for the Level I simulation. Level II fugacity models add degradation reactions within environmental compartments and advective transport between compartments to the Level I fugacity model; Level II fugacity models also assume a constant input rate of the chemical. The results of a Level II fugacity model are therefore the steady-state and equilibrium distribution of the chemical. The advective flow residence times were set to large values (1 x 10^{20} hr) so that essentially no mass would be removed from the modelled system by advective transport; this was done to simulate a nonbounded global environment. Realistically, advective transport of sulfuryl fluoride through the tropopause and into the stratosphere, followed by photodegradation by ultraviolet light, probably occurs. However, in order to maintain the conservative nature of the simulation this pathway was ignored.

For sulfuryl fluoride all degradation rates were assumed to be negligible ($t_{1/2} = 1 \times 10^{11}$ hr) with the exception of hydrolysis in ocean surface waters ($t_{1/2}$ = 41 min, see **IIA 7.2.1.1/01, A12a**) and degradation in air ($t_{1/2}$ = 3.2 yr, see **IIA 7.2.2/01, K28**). The mass input of sulfuryl fluoride into the system was assumed to be [redacted] (please note that this is a confidential figure) kg ([redacted] (please note that this is a confidential figure) kg/hr), which represents the average annual emissions of sulfuryl fluoride from 1992-2000.

No Level III or IV fugacity models were evaluated. Level III fugacity models require 12 different mass transfer coefficients (for example, air side air-water mass transfer coefficient, water side air-water mass transfer coefficient, soil-air boundary layer mass transfer coefficient) that are not known for sulfuryl fluoride. In addition, given its extremely high vapour pressure and Henry's law constant, higher tier (> Level II) fugacity models were not considered likely to yield any new information on the environmental distribution and fate of sulfuryl fluoride.

Findings: The results of the Level I fugacity model are shown in **Figure 9.0.1-1**. The model predicts that >99.99% of sulfuryl fluoride released into the environment will partition into the air phase at equilibrium, and that negligible amounts ($\leq 10^{-6}$%) will partition into soil, sediment, fish, or aerosols. There was no significant difference between the results obtained from either the EQC regional environment or global environment parameters. The only environmental compartment other than air with measurable amounts of sulfuryl fluoride is surface water, with equilibrium partitioning values of ≤0.007%. Because the estimated atmospheric lifetime (≤4.5 years, equivalent to an atmospheric half-life of ≤3.2 years) is greater than typical intra- and inter-hemispheric atmospheric mixing times (0.5 years), we assume that sulfuryl fluoride will be uniformly distributed throughout the troposphere. Therefore ocean water will be the predominant form of surface water important for partitioning of sulfuryl fluoride.

The results of the Level II fugacity model are shown in **Figure 9.0.1-2**. The Level II model confirms the Level I model results that >99.99% of sulfuryl fluoride released into the environment will partition into the air phase, with ≤0.007% in the water phase.

The predicted equilibrium concentration in the atmosphere, [redacted] (please note that this is a confidential figure) ng/m^3, is equivalent to [redacted] (please note that this is a confidential figure) ppt (volume/volume, assuming 1 ppt = 2.46×10^7 molecules/cm^3). This is consistent with the current estimated concentration of sulfuryl fluoride in air from actual measurements of <0.5 ppt (**IIA 7.2.2/01, K28**). Note that the atmospheric half-life used for this modelling exercise (3.2 years) is actually an upper limit; any decrease in the actual value of the half-life will lead to a decrease in the predicted steady-state concentration in the atmosphere.

Although the predicted steady-state concentration in the surface water compartment is essentially zero ([redacted] (please note that this is a confidential figure) µg/L), the Level II fugacity model predicts that 73.5% of the sulfuryl fluoride removed from the environment will be via this compartment. This is because at average oceanic pH and temperature values (8.1 and 17°C, respectively), the half-life of sulfuryl fluoride due to base-catalysed hydrolysis is

41 min (**IIA 7.2.1.1/02, A12a**). The significant contribution of oceanic hydrolysis to the degradation of a trace atmospheric gas is not an unexpected result, as degradation in ocean waters is a significant dissipation route for trace atmospheric gases such as methyl bromide, methyl chloroform, and carbonyl sulfide. Each of these gases hydrolyses more slowly than sulfuryl fluoride, with estimated degradation half-lives of 7 days, 0.8-1.1 years, and 2.4 days for CH_3Br, CH_3CCl_3, and COS, respectively, in dissolved ocean water.

Figure 9.0.1-1. Results (partitioning diagram) of Level I fugacity modelling for SO_2F_2. EQC Regional Environment (top) and Global Environment (bottom).

[redacted] (please note that this figure contains confidential information)

[redacted] (please note that this figure contains confidential information)

Figure 9.0.1-2. Results (partitioning diagram) of Level II fugacity modelling for SO_2F_2.

[redacted] (please note that this figure contains confidential information)

Conclusions: Fugacity Modelling

Sulfuryl fluoride will be uniformly distributed throughout the global environment because its physical properties determine that it will be a permanent gas and because its atmospheric lifetime is greater than the interhemispheric mixing time. Sulfuryl fluoride will reside principally in the air compartment after release to the environment, with >99.99% of the mass of sulfuryl fluoride predicted to be found in air. The surface (ocean) water compartment will be the only other environmental compartment with a measurable fraction of sulfuryl fluoride, however the fraction is <0.007%. The aerosol, sediment, suspended sediment, and fish compartments are all predicted to contain ≤10^{-7}% of the total mass of sulfuryl fluoride. The predicted environmental concentrations for sulfuryl fluoride, based on current estimates of emissions and degradation rates in air and ocean water, are 0.086 ppt (volume/volume) for air, [redacted] (please note that this is a confidential figure) µg/L for surface water, [redacted] (please note that this is a confidential figure) mg/kg for soil, and [redacted] (please note that this is a confidential figure) mg/kg for sediment.

Section B7.5 Annex Point IIIB, XII.2	Evaluation by Competent Authorities

EVALUATION BY RAPPORTEUR MEMBER STATE

Date October 2004

Comments on applicant's data

The Level I fugacity modelling is a simulation of the equilibrium distribution of a fixed quantity of a chemical in a closed environment at equilibrium. The Level II simulation describes a situation in which a chemical is continuously emitted at a constant rate and achieves a steady state *and* equilibrium condition at which the input and output rates are equal. Therefore, it cannot be said that the Level II simulation confirmed the Level I simulation results since the two simulations will show the same results in terms of distribution of sulfuryl fluoride (percentage found in the different compartments). The resulting predicted environmental concentrations, on the other hand, will be different even though the same environmental properties (global) were used since the total mass of sulfuryl fluoride within the system is different (see further below).

The following environmental properties (i.e. volumes of the different environmental compartments) where used in the fugacity model simulations:

Level I EQC (EQuilibrium Criterion), regional scale (100,000 km^2):

	Air	Water	Soil	Sediment	Susp. sediment	Fish	Aerosol
Volume (m^3)	1×10^{14}	2×10^{11}	9×10^{9}	1×10^{8}	1×10^{6}	2×10^{5}	2000
Density (kg/ m^3)	1.206	1000	2400	2400	1500	1000	2000
Organic carbon (g/g)	-	-	0.02	0.04	0.2	0.05[1]	-

[1]Lipid content

Level I and II global scale (values on density and organic carbon content same as for the regional scale):

	Air	Water	Soil	Sediment	Susp. sediment	Fish	Aerosol
Volume (m^3)	6.1×10^{18}	2.7×10^{16}	2×10^{13}	0[2]	0[2]	0[2]	3.05×10^{7}

[2] When the first Level I modelling was made using the default, regional-scale environmental properties, it was shown that the sediment, suspended sediment, fish, aerosols and soil contained a negligible fraction of sulfuryl fluoride at equilibrium. Therefore, when the global environment was simulated the volume of the sediment compartment, suspended solids and fish were set to zero.

By mistake, the wrong figure on the annual, global production amount (=emission) was used as input mass ([redacted] (please note that this is a confidential figure)kg) into the Level I fugacity models (both regional and global). The right figure, i.e. the same figure used in the study on phototransformation/fate and behaviour in air (Doc III A7.3.1, K28), should be [redacted] (please note that this is a confidential figure)kg. This figure represents the average, global annual emission of sulfuryl fluoride during the period 1992-2000. *Please note that this figure is highly confidential and may not be disclosed outside the government regulatory authorities.*

In the Level I models the input mass is the same as the total mass within the system. In the Level II model, the input mass, or rather rate value, should have

Section B7.5 Annex Point IIIB, XII.2	Evaluation by Competent Authorities
	been [redacted] (please note that this is a confidential figure) kg/h (= [redacted] (please note that this is a confidential figure)kg/365d/24h) instead of [redacted] (please note that this is a confidential figure) kg/h. The total mass within the system at steady state in the Level II model was [redacted] (please note that this is a confidential figure) kg (should have been [redacted] (please note that this is a confidential figure) kg). The resulting predicted environmental concentrations of Level I and II (global scale) should, because of the wrong input amounts/rates, be increased with approx. 2% and for convenience the corrected concentrations for Level II simulation are given here: Air = [redacted] (please note that this is a confidential figure)ppt or [redacted] (please note that this is a confidential figure) ng/m^3 Water = [redacted] (please note that this is a confidential figure) mg/l Soil = [redacted] (please note that this is a confidential figure) mg/kg Sediment = [redacted] (please note that this is a confidential figure) mg/kg In the regional scenario of Level I fugacity model the global use was used as input mass. The value of this simulation is questionable and it would have been preferred that a mass reflecting a regional use had been used instead. But, since sulfuryl fluoride when emitted to air after use, will not maintain within a volume corresponding to a regional (or local) scenario the global scale scenario is preferred. Further, it is considered that the best estimates of predicted environmental concentrations are presented in the Level II modelling results. It may seem strange that a predicted concentration could be given for the sediment compartment when the volume of this compartment was set to zero. This is due to the fact that the concentration (C) of any compartment is related to the fugacity capacity (Z) of that compartment and to the overall fugacity (f) of the system through the relationship $C\ (mol/\ m^3) = Z\ (mol/m^3Pa) \times f\ (Pa)$ If the percentage distribution or the total mass of a certain compartment is of interest, however, then the volumes of compartments of interest need to be defined. The fugacity models are most often used to simulate the environmental behaviour of organic compounds, and especially more or less hydrophobic organic compounds. There are, however, no restrictions in the models for not simulating the behaviour of inorganic compounds such as sulfuryl fluoride. As long as the input values concerning the physical properties of the compound are appropriate for the descriptions of the intrinsic properties of the compound there are no limitations. It could be argued though, that sulfuryl fluoride as a non-organic compound may have different sorption mechanisms to solid surfaces than traditional hydrophobic organic compounds. In other words, the traditional octanol sorption model may not be appropriate. However, this point is probably of minor importance and therefore it can be concluded that the high vapour pressure and projected emission to air will ensure that sulfuryl fluoride is almost entirely present in air.
Conclusion	Applicant's version is adopted with the following amendment of the first sentence: Sulfuryl fluoride is assumed to be uniformly distributed throughout the global

Section B7.5 **Annex Point IIIB, XII.2**	**Evaluation by Competent Authorities**
	environment because its physical properties determine that it will be a permanent gas during natural environmental conditions and because its estimated atmospheric lifetime is greater than the interhemispheric mixing time. The corrected values of the predicted environmental concentrations (global scale) can be found above.
Acceptability	The information is considered to be acceptable. The information of the predicted concentrations of the regional environment as the result of an input mass of sulfuryl fluoride corresponding to the annual, global use is, however, of limited use.
Remarks	Existing and future sales volumes can be found in the Annex for Confidential Data and Information.

Section B7.6.1 **Annex Point IIIA, XIII.1.1**	**Acute Oral Toxicity on Birds**	
	JUSTIFICATION FOR NON-SUBMISSION OF DATA	Official use only
Other existing data [ ] **Limited exposure [x]**	**Technically not feasible [ ]** **Scientifically unjustified [ ]** **Other justification [ ]**	
Detailed justification:	Sulfuryl fluoride is a gas under all environmental conditions (boiling point -54°C, see PPP **IIA 2.1.2/01, A15**) and has an extremely high vapour pressure (1,611,467 Pa at 20°C, see PPP **IIA 2.3.1/01, A20**). Consequently, it is not expected to partition to soil or vegetation. This initial assumption, based on the physical properties of sulfuryl fluoride, was confirmed using Level 1 and Level 2 fugacity modeling, which indicated that >99.99% of the sulfuryl fluoride released to the environment will partition into the atmosphere, while $<10^{-6}$ % will partition to soil. The PEC_{soil} is therefore ca. [redacted] (please note that this is a confidential figure) ppm (see PPP **IIA 9.1.3/01, K24**). Additionally, the use pattern of sulfuryl fluoride as a structural fumigant followed by direct release to the atmosphere, with no terrestrial or aquatic use patterns, essentially eliminates the potential for contamination of soil or vegetation. Sulfuryl fluoride is used exclusively in enclosed spaces (e.g. mills, fumigation chambers, food storage facilities). Consequently, there is no likelihood of oral or dietary exposure for birds and therefore no studies have been conducted with regard to this aspect. TER_A, TER_{ST} and TER_{LT} values have not been calculated since oral and dietary routes of exposure are not relevant for Vikane. Sulfuryl fluoride is not used in baits, pellets and granules or on prills and treated seeds and, consequently, no data are presented with regard to these aspects. No study on acute oral toxicity has been conducted since direct oral consumption of the product is not a relevant route of exposure.	X
Undertaking of intended data submission [ ]	No studies are planned.	
	Evaluation by Competent Authorities	
	EVALUATION BY RAPPORTEUR MEMBER STATE	
Date	October 2004	
Evaluation of applicant's justification	Applicant's justification is considered to be acceptable.	
Conclusion	Applicant's justification is considered to be acceptable.	
Remarks	TER refers to toxicity-to-exposure-ratio and is used in the evaluation and authorization of plant protection products under directive 91/414/EEC (A=acute, ST=short term, LT=long term).	

Section B7.7.1.1 **Annex Point IIIB, XIII.2.1.1**	**Particular Studies with Fish and other Aquatic Organisms**	
	JUSTIFICATION FOR NON-SUBMISSION OF DATA	Official use only
Other existing data [x] **Limited exposure [ ]**	**Technically not feasible [ ]** **Scientifically unjustified [ ]** **Other justification [ ]**	
Detailed justification:	Sulfuryl fluoride has no aquatic use patterns and will not directly impact surface water bodies because of its physical properties (boiling point -54°C, PPP **IIA 2.1.2/01, A15** and vapour pressure 1,611,467 Pa at 20°C, PPP **IIA 2.3.1/01, A20**). The environmental distribution of sulfuryl fluoride was examined using Level I and Level II fugacity models simulating the global environment (PPP **IIIA 9.2.3/01, K24**). Sulfuryl fluoride will reside principally in the air compartment after release to the environment, with >99.99% of the mass of sulfuryl fluoride predicted to be found in air. Therefore, there is essentially no opportunity for aquatic species to be exposed to sulfuryl fluoride following its use. Consequently, only those studies required to enable Vikane to be labelled and classified (i.e. acute toxicity tests on <u>one</u> fish species, *Daphnia magna* and a green algal species) have been conducted. These studies are summarized in Doc. III-A 7.4.	
Undertaking of intended data submission [ ]	No studies are planned.	
	Evaluation by Competent Authorities	
	EVALUATION BY RAPPORTEUR MEMBER STATE	
Date	October 2004	
Evaluation of applicant's justification	Applicant's justification is considered to be acceptable.	
Conclusion	Applicant's justification is considered to be acceptable.	
Remarks	No remarks.	

Section B7.7.1.2 **Annex Point IIIB, XIII.2.1.2**	**Residue Data in Fish**	
	JUSTIFICATION FOR NON-SUBMISSION OF DATA	Official use only
Other existing data [ ] **Limited exposure [x]**	**Technically not feasible [ ]** **Scientifically unjustified [ ]** **Other justification [ ]**	
Detailed justification:	Sulfuryl fluoride has no terrestrial or aquatic use patterns and will not directly impact surface water bodies because of its physical properties (boiling point -54°C, PPP **IIA 2.1.2/01, A15** and vapour pressure 1,611,467 Pa at 20°C, PPP **IIA 2.3.1/01, A20**). The environmental distribution of sulfuryl fluoride was examined using Level I and Level II fugacity models simulating the global environment (PPP **IIIA 9.2.3/01, K24**). Sulfuryl fluoride will reside principally in the air compartment after release to the environment, with >99.99% of the mass of sulfuryl fluoride predicted to be found in air. Therefore, there is essentially no opportunity for aquatic species to be exposed to sulfuryl fluoride following its use. Consequently, only those studies required to enable Vikane to be labelled and classified (i.e. acute toxicity tests on <u>one</u> fish species, *Daphnia magna* and a green algal species) have been conducted. Since there is essentially no opportunity for aquatic species to be exposed to Vikane, TER_A and TER_{LT} values are not relevant and have not been calculated.	X
Undertaking of intended data submission [ ]	No studies are planned.	
	Evaluation by Competent Authorities	
	EVALUATION BY RAPPORTEUR MEMBER STATE	
Date	October 2004	
Evaluation of applicant's justification	Applicant's justification is considered to be acceptable.	
Conclusion	Applicant's justification is considered to be acceptable.	
Remarks	TER refers to toxicity-to-exposure-ratio and is used in the evaluation and authorization of plant protection products under directive 91/414/EEC (A=acute, LT=long term).	

Section B7.8 Annex Point IIIB, XIII.3	Effects on other Non-Target Organism	
	JUSTIFICATION FOR NON-SUBMISSION OF DATA	Official use only
Other existing data [ ] **Limited exposure [x]**	**Technically not feasible [ ]** **Scientifically unjustified [ ]** **Other justification [ ]**	
Detailed justifications:		
7.8.1 Terrestrial vertebrates other then birds	As in the case of the avian risk assessment, there is no likelihood of oral or dietary routes of exposure for mammals and, consequently, no studies have been conducted with regard to this aspect. TER_A, TER_{ST} and TER_{LT} values have not therefore been calculated. Vikane is not used in baits, granules or on treated seeds and there is no opportunity for secondary poisoning to occur, given that 99.99% of the released Vikane will reside in the air compartment. The risk assessment for mammals relates, therefore, only to the potential risks associated with animals in the vicinity of the building inhaling Vikane gas at the time of venting. Estimates of exposure have been calculated using the measured values from mill fumigation trials, conducted to support the human health risk assessment (see **IIIA 7.2.2**). Monitoring the air concentrations at various positions around mills during the fumigation and venting processes has yielded maximum 24-hour time weighted average concentrations for a range distances from the mill (see Table 7.8.1-1). The 90^{th} centile of 1.51 ppm at 5 metres is therefore taken to represent the “worst-case” scenario of maximum exposure for any individuals in the vicinity of the mill. This value may be compared directly to a critical endpoint from the data set on inhalation toxicity (see PPP **IIA 5.10.1 Summary of mammalian toxicology**). Due to the inevitably brief exposure from a gas vented into the atmosphere, the most realistic endpoint for a wildlife risk assessment would be expected to come from an acute exposure study. The acute/short-term neurotoxicity study in the rat (PPP **IIA 5.8.2a/01, G04**) has been selected for the human health (bystander) risk assessment and it is proposed, therefore, that the NOAEL of ≥300 ppm from this study is also applied in the risk assessment for wildlife. Since this study was conducted with two 6-hour exposures within 30 hours, the NOAEL has been normalised to a 24 hour NOAEL of 120 ppm. Comparing this value with the 24-hour TWA of 1.51 ppm leads to a TER of ≥79 for inhalation toxicity. Although no formal triggers for inhalation toxicity are proposed in Annex VI, a “worst case” scenario TER of ≥79, based on a realistic acute exposure and a minimum NOAEL, is considered to be sufficient to confirm the low risk to mammals, even for those individuals remaining close to the fumigated building for 24 hours.	X X X X X

Section B7.8 Effects on other Non-Target Organism
Annex Point IIIB, XIII.3

Table 7.8.1-1 Multidirectional 0-24h Time Weighted Average air concentrations (see PPP IIIA 7.2.2)

MULTI-DIRECTIONAL 24 HR TWA (ppm)											Percentile	
Distance	SOTW	SCFM	ARI, TX	SOTW	US 2002	Germany 2000	Germany 2002	UK 2000	Italy 2001	UK 2002	90th	97.5th
5m	0.60	0.60	0.22	2.71	1.25	0.18	0.97	0.63	1.51	0.08	1.51	2.41
10m	0.38	0.39	0.13	1.95	0.78	0.17	0.48	0.35	0.8	0.08	0.80	1.66
25m	0.17	0.23	0.09	0.83	0.40	0.14	0.26	0.22	0.41	0.09	0.45	0.74
50m	0.28	0.17	0.10	0.30	0.21	0.12	0.14	0.15	0.25	0.05	0.30	0.47
75m	0.21	0.17	0.12	0.14	0.30	0.13	0.09	0.06	0.16	0.01	0.21	0.28
>75m	0.46	0.12		0.09	0.45						0.46	0.46

7.8.2 Honeybees

Hazard quotients for honeybees have not been calculated since oral and contact routes of exposure are not relevant for a gas fumigant product used exclusively in enclosed spaces.

7.8.3 Beneficial Arthropods other than Bees

The use pattern of Vikane as a fumigant followed by direct release to the atmosphere, with no terrestrial use patterns, essentially eliminates the potential for contamination of vegetation and soil. Sulfuryl fluoride is used exclusively in enclosed spaces. Consequently, there is no likelihood of exposure for non-target arthropods and therefore the risk for these species is considered to be low.

7.8.4 Earthworms and other Soil Non-Target Macro-Organisms

Sulfuryl fluoride is a gas under all environmental conditions (boiling point -54°C, see PPP **IIA 2.1.2/01, A15**) and has an extremely high vapour pressure (1,611,467 Pa at 20°C, see PPP **IIA2.3.1/01, A20**). Consequently, it is not expected to partition to soil. This initial assumption, based on the physical properties of sulfuryl fluoride, was confirmed using Level 1 and Level 2 fugacity modeling, which indicated that >99.99% of the sulfuryl fluoride released to the environment will partition into the atmosphere, while <10^{-6} % will partition to soil. The PEC_{soil} is therefore ca. [redacted] (please note that this is a confidential figure) ppm (see PPP **IIA 9.1.3/01, K24**). Additionally, the use pattern of sulfuryl fluoride as a fumigant followed by direct release to the atmosphere, with no terrestrial or aquatic use patterns, essentially eliminates the potential for contamination of soil or vegetation. Sulfuryl fluoride is used exclusively in enclosed spaces.

7.8.5 Soil Non-Target Micro-Organisms

Sulfuryl fluoride is a gas under all environmental conditions (boiling point -54°C, see PPP **IIA 2.1.2/01, A15**) and has an extremely high vapour pressure (1,611,467 Pa at 20°C, seePPP **IIA 2.3.1/01, A20**). Consequently, it is not expected to partition to soil. This initial assumption, based on the physical properties of sulfuryl fluoride, was confirmed using Level 1 and Level 2 fugacity modeling, which indicated that >99.99% of the sulfuryl fluoride released to the environment will partition into the atmosphere, while <10^{-6} % will partition to soil. The PEC_{soil} is therefore *ca.* [redacted] (please note that this is a confidential figure) ppm (see PPP **IIA 9.1.3/01, K24**). Additionally, the use pattern of sulfuryl fluoride as a fumigant followed by direct release to the atmosphere, with no terrestrial or aquatic use patterns, essentially eliminates the potential for contamination of soil. Sulfuryl fluoride is used exclusively in enclosed spaces (e.g. mills, fumigation chambers, food storage facilities).

Section B7.8 **Effects on other Non-Target Organism**
Annex Point IIIB, XIII.3

7.8.6 Effects on Flora and Fauna

Sulfuryl fluoride is a gas under all environmental conditions (boiling point -54°C, PPP **IIA 2.1.2/01, A15**) and has an extremely high vapour pressure (1,611,467 Pa at 20°C). Consequently, Vikane is not expected to partition to soil, vegetation or water. This initial assumption, based on the physical properties of sulfuryl fluoride, was confirmed using Level 1 and Level 2 fugacity modeling, which indicated that >99.99% of the sulfuryl fluoride released to the environment will partition into the atmosphere, while $<10^{-6}$ % will partition to soil. Additionally, the use pattern of sulfuryl fluoride as a fumigant followed by direct release to the atmosphere, with no terrestrial or aquatic use patterns, essentially eliminates the potential for exposure for birds, mammals, aquatic organisms, bees, non-target arthropods and soil-dwelling macro- and micro-fauna. Consequently, the risks for aquatic and terrestrial species are very low.

Undertaking of intended data submission [ ]

No studies are planned.

Evaluation by Competent Authorities

EVALUATION BY RAPPORTEUR MEMBER STATE

Date

October 2004

Evaluation of applicant's justification

Applicant's justification is considered to be acceptable.

Field 7.8.1: PPP IIIA 7.2.2 corresponds to BP Doc III-B6.6.
PPP IIA 5.10.1 corresponds to BP Doc III-A6.18

Table 7.8.1-1 contains some misprints for the UK 2000 scenario and this column should read:

Distance	UK 2000
5m	-
10m	0.39
25m	0.20
50m	0.14
75m	0.07
>75m	-

The conversion of the NOAEL of ≥300 ppm (determined from two 6-hour exposures within 30 hours) to a 24 hour NOAEL of 120 ppm may not be regarded as scientifically straightforward but nevertheless it may be regarded as some sort of worst case value.

The corresponding PEC/PNEC ratio is $<1.3x10^{-2}$ for inhalation toxicity. (No assessment factor is used here. In Doc II-C, however a factor is applied and discussed.)

TER refers to toxicity-to-exposure-ratio and is used in the evaluation and authorization of plant protection products under directive 91/414/EEC.

Conclusion

Applicant's justification is considered to be acceptable.

Remarks

No remarks.

Data protection is claimed by Dow AgroSciences in accordance with Article 12.1(c) (i) and (ii) of Council Directive 98/8/EC for all study reports marked "Y" in the "Data Protection Claimed Y/N" column of the four lists below (numbered 1-4). For studies marked Y(i) data protection is claimed under Article 12.1(c) (i), for studies marked Y(ii) data protection is claimed under Article 12.1(c) (ii). These claims are based on information from the applicant. It is assumed that the relevant studies are not already protected in any other MS of the European Union under existing national rules relating to biocidal products. It is not possible for the rapporteur to confirm the accuracy of this information.

Sweden has earlier received those studies marked with Y(i) to support national product authorisation and according the Biocidal Products Ordinance (SFS 2000:338) section 14, those studies may be used for the benefit of other applicants only after 13 May 2010, while studies marked with Y(ii) may be used for the benefit of another applicant only after the expiry of a period of ten years from the date the active substance was first listed in Annex I or IA to the Biocides Directive 98/8/EC.

Data Owner:	D = Dow AgroSciences
	P= Public domain

1. List of Studies Sorted by Section Number (98/8)

98/8 Section number	91/414 Annex Section	Author	Title	Laboratory	GLP/GEP Study Y/N	Published Y/N	Vertebrate Study Y/N	Data Protection Claimed Y/N	Data Owner	Report No. / Study ID	Report Date	Dow Agro-Sciences Report No	Ref.
B7.2	IIIA 10.2.1/01 see IIA 8.2.1/01	Kirk, H.D., McClymont, E.L., McFaden, L.G., Rick, D.L., Yaroch, A.M.	Sulfuryl Fluoride: An Acute Toxicity Study with the Zebra-Fish, Brachydanio rerio, Hamilton-Buchanan	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	Y	Y (ii)	D	011147R	March 2002	011147R	J01

98/8 Section number	91/414 Annex Section	Author	Title	Laboratory	GLP/GEP Study Y/N	Published Y/N	Vertebrate Study Y/N	Data Protection Claimed Y/N	Data Owner	Report No. / Study ID	Report Date	Dow Agro-Sciences Report No	Ref.
B7.2	IIIA 10.2.1/02 see IIA 8.2.4/01	Kirk, A.D, Yaroch, A.M., Rick, D.L., McClymont, E.L., Krieger, S.M.	Sulfuryl Fluoride: An Acute Toxicity Study with the Daphnid, Daphnia magna Straus	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	N	Y (ii)	D	011146	January 2002	011146	J02
B7.2	IIIA 10.2.1/03 see IIA 8.2.6/01	Kirk, H.D., Rick, D.L., Krieger, S.M., McFadden, L.G.	Sulfuryl Fluoride: Growth Inhibition Test with the Freshwater Green Alga, Selenastrum capricornutum Printz.	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	N	Y (ii)	D	011145	January 2002	011145	J03
B7.5	IIIA 9.0.1/01	Krieger, M.S.	Environmental Fugacity Modeling of Sulfuryl Fluoride (SO2F2)	Regulatory Laboratories, Dow AgroSciences, Indianapolis, Indiana, USA	N	N	N	Y (ii)	D	GH-C 5307	November 2001	GH-C 5307	K24

2. List of Studies Sorted by 91/414 Annex Section

98/8 Section number	91/414 Annex Section	Author	Title	Laboratory	GLP/GEP Study Y/N	Published Y/N	Vertebrate Study Y/N	Data Protection Claimed Y/N	Data Owner	Report No. / Study ID	Report Date	Dow Agro-Sciences Report No	Ref.
B7.5	IIIA 9.0.1/01	Krieger, M.S.	Environmental Fugacity Modeling of Sulfuryl Fluoride (SO2F2)	Regulatory Laboratories, Dow AgroSciences, Indianapolis, Indiana, USA	N	N	N	Y (ii)	D	GH-C 5307	November 2001	GH-C 5307	K24
B7.2	IIIA 10.2.1/01 see IIA 8.2.1/01	Kirk, H.D., McClymont, E.L., McFaden, L.G., Rick, D.L., Yaroch, A.M.	Sulfuryl Fluoride: An Acute Toxicity Study with the Zebra-Fish, Brachydanio rerio, Hamilton-Buchanan	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	Y	Y (ii)	D	011147R	March 2002	011147R	J01
B7.2	IIIA 10.2.1/02 see IIA 8.2.4/01	Kirk, A.D, Yaroch, A.M., Rick, D.L., McClymont, E.L., Krieger, S.M.	Sulfuryl Fluoride: An Acute Toxicity Study with the Daphnid, Daphnia magna Straus	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	N	Y (ii)	D	011146	January 2002	011146	J02
B7.2	IIIA 10.2.1/03 see IIA 8.2.6/01	Kirk, H.D., Rick, D.L., Krieger, S.M., McFadden, L.G.	Sulfuryl Fluoride: Growth Inhibition Test with the Freshwater Green Alga, Selenastrum capricornutum Printz.	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	N	Y (ii)	D	011145	January 2002	011145	J03

3. List of Studies Sorted by Author

98/8 Section number	91/414 Annex Section	**Author**	Title	Laboratory	GLP/GEP Study Y/N	Published Y/N	Vertebrate Study Y/N	Data Protection Claimed Y/N	Data Owner	Report No. / Study ID	Report Date	Dow Agro-Sciences Report No	Ref.
B7.2	IIIA 10.2.1/02 see IIA 8.2.4/01	Kirk, A.D, Yaroch, A.M., Rick, D.L., McClymont, E.L., Krieger, S.M.	Sulfuryl Fluoride: An Acute Toxicity Study with the Daphnid, Daphnia magna Straus	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	N	Y (ii)	D	011146	January 2002	011146	J02
B7.2	IIIA 10.2.1/01 see IIA 8.2.1/01	Kirk, H.D., McClymont, E.L., McFaden, L.G., Rick, D.L., Yaroch, A.M.	Sulfuryl Fluoride: An Acute Toxicity Study with the Zebra-Fish, Brachydanio rerio, Hamilton-Buchanan	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	Y	Y (ii)	D	011147R	March 2002	011147R	J01
B7.2	IIIA 10.2.1/03 see IIA 8.2.6/01	Kirk, H.D., Rick, D.L., Krieger, S.M., McFadden, L.G	Sulfuryl Fluoride: Growth Inhibition Test with the Freshwater Green Alga, Selenastrum capricornutum Printz.	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	N	Y (ii)	D	011145	January 2002	011145	J03
B7.5	IIIA 9.0.1/01	Krieger, M.S.	Environmental Fugacity Modeling of Sulfuryl Fluoride (SO2F2)	Regulatory Laboratories, Dow AgroSciences, Indianapolis, Indiana, USA	N	N	N	Y (ii)	D	GH-C 5307	November 2001	GH-C 5307	K24

4. List of Studies Sorted by Reference Number

98/8 Section number	91/414 Annex Section	Author	Title	Laboratory	GLP/GEP Study Y/N	Published Y/N	Vertebrate Study Y/N	Data Protection Claimed Y/N	Data Owner	Report No. / Study ID	Report Date	Dow Agro-Sciences Report No	**Ref.**
B7.2	IIIA 10.2.1/01 see IIA 8.2.1/01	Kirk, H.D., McClymont, E.L., McFaden, L.G., Rick, D.L., Yaroch, A.M.	Sulfuryl Fluoride: An Acute Toxicity Study with the Zebra-Fish, Brachydanio rerio, Hamilton-Buchanan	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	Y	Y (ii)	D	011147R	March 2002	011147R	J01
B7.2	IIIA 10.2.1/02 see IIA 8.2.4/01	Kirk, A.D, Yaroch, A.M., Rick, D.L., McClymont, E.L., Krieger, S.M.	Sulfuryl Fluoride: An Acute Toxicity Study with the Daphnid, Daphnia magna Straus	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	N	Y (ii)	D	011146	January 2002	011146	J02
B7.2	IIIA 10.2.1/03 see IIA 8.2.6/01	Kirk, H.D., Rick, D.L., Krieger, S.M., McFadden, L.G.	Sulfuryl Fluoride: Growth Inhibition Test with the Freshwater Green Alga, Selenastrum capricornutum Printz.	Toxicology & Environmental Research and Consulting, The Dow Chemical Company, Midland, Michigan, USA	Y	N	N	Y (ii)	D	011145	January 2002	011145	J03
B7.5	IIIA 9.0.1/01	Krieger, M.S.	Environmental Fugacity Modeling of Sulfuryl Fluoride (SO2F2)	Regulatory Laboratories, Dow AgroSciences, Indianapolis, Indiana, USA	N	N	N	Y (ii)	D	GH-C 5307	November 2001	GH-C 5307	K24