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E. I. du Pont de Nemours & Company

INCORPORATED

WILMINGTON, DELAWARE 19898

CHEMICALS AND PIGMENTS DEPARTMENT

April 22, 1987

Mr. John S. Hoffman, Chairman
Stratospheric Protection Task Force
U.S. Environmental Protection Agency
PM-221
401 M Street, S.W.
Washington, D.C. 20460

Dear John:

I have made an initial review of the draft, "Preliminary Analysis of Costs and Benefits of Stratospheric Ozone Protection," prepared by EPA. Recognizing the severe time constraints under which you are operating, I would like to offer my preliminary observations and numerous requests for further information. The study obviously represents an enormous effort on the part of the EPA and its contractors. As a result, it involves literally hundreds of assumptions and conclusions necessary to summarize the current status, potential options, and expected behavior in nearly one hundred individual market segments. I urge you to seek adequate review by representatives of each of those market segments.

We at Du Pont intend to offer detailed comments on each segment as soon as sufficient information becomes available from EPA. I consider it essential that at least sixty days be allowed for that effort by us and other industry representatives. As I am sure you can imagine, to proceed without adequate review will risk a much more confrontational approach during subsequent regulatory proceedings, whereas I firmly believe that substantial agreement is possible on the basis for this analysis, if adequate review and comment is permitted prior to using the study as a basis for regulatory decisions.

My initial comments and questions are as follows:

- An early chart notes the unavailability of information on ozone depletion potentials for CFCs 114 and 115. The attachment from Du Pont, which you also included, clearly states them.

- I believe all emissions reduction figures are seriously overstated due to the failure to consider unaccounted uses. It appears that the review determines percentage reductions relative to identified uses, implicitly assuming that equivalent reductions are possible for the remaining uses. Our analysis of the totals shows well over 20 percent of the use is unaccounted for. Much of this appears to be in refrigeration (probably after-market) and solvent uses, where recovery is not likely to be feasible or cost justified in one case, or is already being applied to a high degree in the other case. Hence, the reduction estimates are likely to be at least 20 percent too high for achievable reductions at a given cost. It is impossible to tell with the available data how much, but the understatement of costs for a given level of reduction is likely to be much larger.

- Any detailed analysis of the economic study -- an analysis we consider highly worthwhile -- will require as a starting point a list of all cost estimates (broken down as shown in the examples you provided) for each control method, i.e., both those included and those rejected. Useful, subsequent backup data would be a description of the basis for each cost estimate. I recognize that this is a large undertaking, but it is impossible to judge the quality of the final data without first assessing the reasonableness of the inputs.

- Similarly, the next round of decision-making in your analysis is in determining the maximum penetration and reduction effectiveness. The values chosen are a first priority, with the basis for the choices an important follow-up item.

- Particularly for refrigeration applications, but also for the Halons, at least, it is not clear that after-market losses are adequately separated from original equipment applications. It appears that percentages saved are taken as percentages of the entire refrigeration use as opposed to the fraction appropriate. If this was done indirectly by allocating total emissions among the various loss sources, it would be useful to check that loss source allocation against known market conditions under which only 20-25 percent of refrigeration consumption is in the original equipment market. Has this been done?

- The next decision step appears to be the critical one of deciding how individual users will apportion themselves among the various options. Was this done by some objective choice of criterion, such as weighting according to cost per kg. of prevented emissions, or was it a subjective choice? What was the basis of the decision?

- The latter problem is compounded when one moves beyond the short-term. Long-term decisions and short-term actions are not at all independent. Depending upon ultimate goals, user decisions will vary as to which investment to make and when to make it. Users will seek to minimize total net present cost rather than make a series of unrelated decisions. Is this factor accounted for in the various scenario evaluations, or is the entire process viewed as stepwise?

- Please note that the cited Du Pont comments on the question of when new products might be available in volume contained a number of additional caveats regarding toxicology and process technology, which are not fairly represented in your analysis. As a result, any analysis dependent upon this timing must be taken as a best case, i.e., minimum cost estimate. Actual costs are very likely to be higher. It should also be noted that availability of any of the newer possible substitutes identified by the EPA's International Committee would almost certainly be a much longer term prospect due to the dearth of information available on these chemicals today.

- The chart on availability of development quantities of chemicals did not, as the footnote indicates depend upon Du Pont for such firm estimates. We have not provided them.

- The critical path chart for product development significantly understates user development time for many applications, and gives a very optimistic view of the producer side.

- As has unfortunately become typical of early draft EPA documents on the ozone issue, the study contains the ritial list of reasons why the study probably overstates costs or understates benefits (in this case, both). Also as usual, the much larger uncertainty on the other side is neglected. The statements are extreme, unnecessary, and misleading as to the true nature of the uncertainties. We will reserve specific suggestions for later comment. Chart titles alone sufficiently demonstrate the point.

- One comment is appropriate on benefits. The additional calculated benefit of a reduction over a freeze is critically dependent on the assumptions about actions taken by countries outside the U.S. For example, if a true worldwide cap were implemented, <u>the benefits of additional reductions virtually disappear</u>, having been accomplished by other nations' controls <u>at no cost to the U.S.</u> This is an extremely important conclusion in that it demonstrates that control of growth outside the U.S. by careful and productive international negotiation is distinctly more cost effective than U.S. reductions at protecting U.S. citizens. When trade implications are included in costs, the picture becomes even clearer. The most effective regulation is the one with broadest inclusion of parties, and benefits are far more sensitive to that variable than to the amount of U.S. (or even OECD) reduction.

I hope you will consider these comments carefully in your ongoing analysis. I also look forward to receiving the data I requested as soon as possible. I recognize that the request is significant, but I believe our input will be a useful contribution to the quality of your final analysis.

Sincerely,

Joseph M. Steed

Joseph M. Steed
Environmental Manager
Freon® Products Division

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cc: See Enclosed

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U.S. POSITION PAPER
UNEP OZONE LAYER PROTOCOL NEGOTIATIONS
THIRD SESSION: APRIL 27 - 30, 1987
GENEVA, SWITZERLAND

I. Background:

This is the third round of resumed negotiations under UNEP auspices on a protocol to control chemicals which deplete stratospheric ozone.

In the first session (December 1986) there was general agreement on the need for international measures to control emissions of ozone-depleting chemicals. However, differences remained over the scope, stringency, and timing of the controls, and other key issues (e.g., what to control, how to allocate national limits). The U.S. assumed a leadership role at this session, maintaining that the risk to the ozone layer warranted a scheduled phase-down of emissions of the major ozone-depleting chemicals. We also emphasized that the protocol should provide for periodic assessment and possible adjustment of the control measures, based on a periodic review of advances in scientific/technical knowledge.

In the second session (February 1987), and in discussions with the EC and other key participants since then, substantial progress has been made toward acceptance of the U.S. freeze-reduction approach. Other proposals which would seriously disadvantage the U.S. (e.g., proposals to allocate emissions limits on the basis of population and GNP) have been deflected. In addition, the EC, Japan, and possibly the USSR appear to be moving toward broadening coverage beyond CFCs 11 and 12, and have accepted the need for further reduction steps beyond the freeze. U.S. proposals for trade provisions and review mechanisms have also met with general agreement.

The third session is intended by the UNEP organizers and most other participants to resolve remaining issues, particularly the reduction process and schedule.

I. Overall Position:

The general objectives for the USG continue to be as delineated in the Circular 175 of November 28, 1986:

A. A near-term freeze on the combined emissions of the most ozone-depleting substances;

B. A long-term scheduled reduction of emissions of these chemicals down to the point of eliminating emissions from all but limited uses for which no substitutes are commercially available (such reduction could be as much as 95%), subject to C; and

C. Periodic review of the protocol provisions based upon regular assessment of the science. The review could remove or add chemicals, or change the schedule or the emission reduction target.

III. Objectives for this Session:

A. Keep the negotiations focused on elaborating a protocol based on the U.S. freeze-reduction approach (now included in the Chairman's text), and resist efforts to resurrect other options (e.g., Canadian, Soviet).

B. Continue to press for as broad a coverage as possible of potentially major ozone-depleters (CFC 11, 12, 113, 114, 115, Halons 1211 and 1301).

C. Focus attention on defining a meaningful initial reduction step beyond a freeze (of sufficient magnitude to induce technological innovation); try to narrow stringency and timing ranges in the Chair's text.

D. Maintain U.S. position on need for longer-term phasedown, consistent with overall negotiating goal II(B).

E. Elaborate ~~Maintain and strengthen earlier~~ U.S. positions on trade and scientific assessment, which have received strong support.

F. Strive for progress on the LDC issue, emphasizing an approach that will encourage LDCs to join but does not undercut our long-range environmental objectives.

G. Work toward a mix of protocol elements which encourages as many counties as possible to become a member.

after the freeze, diff. control regime

IV. Positions on Specific Topics:

A. Scope of Chemical Coverage: The delegation should strive to have all the major potential ozone depleters (i.e., CFC 11, 12, 113, 114, 115, halon 1211 and 1301) subject to the control article reduction schedule. However, the delegation may consider putting 14, 115, and/or the halons under a different control schedule, as a means of encouraging broader country participation or achieving other key U.S. objectives (see below).

B. Stringency and Timing:

1. Freeze: Virtually all delegations have accepted that the first step should be a freeze at 1986 levels, and the delegation should continue to support this. The delegation should also strongly support a timing of one year after entry into force for the freeze (the EC proposal calls for a timing of 2 years after entry into force).

→ introduce voluntary freeze.

2. Interim steps: The Chair's text calls for a 10-50% reduction (in brackets) for the second phase, in an unspecified period of time. The EC's opening position is for a 20% reduction within six years after entry into force, with an "automatic" trigger -- i.e., it would go into effect unless amended by a two-thirds vote of the Parties.

OPTION 1:

[The delegation should continue to explore various combinations of interim step reductions and corresponding time periods, ranging between the EC proposal and the U.S. Circular 175 authority for "a long-term scheduled reduction of these chemicals down to the point of eliminating emissions from all but limited uses for which no substitutes are commercially available".

Accordingly, the delegation could explore the degree of support for a 50% reduction within 8 years years after entry into force, citing the need for reductions of sufficient magnitude so as to induce technological innovation (the EC could probably reduce emissions by up to 35% without technological innovation, by banning CFC use in aerosols). The delegation is also authorized to explore such variants as:

(a) a 50% reduction of 11, 12, and 113 within 8 years after entry into force -- provided that emissions of 114, 115, and the halons are frozen; or

(b) a 30 - 40% reduction within 4 - 6 years after entry into force -- provided that all chemicals on the U.S. list are included, and the need for including a further reduction step is recognized.

The delegation should not at this meeting definitively agree to specific terms, but rather aim for a bracketed text, consistent with the Circular 175 authority, for further review in Washington.]

OPTION 2:

[The delegation should accept the EC proposal of a 20% reduction for the second step, providing that the EC agrees that:

(a) the timing for this step is 2 years after entry into force of the protocol; and

(b) all chemicals on the U.S. list are included; and

(c) the protocol will include further reduction steps.]

→ ?

3. Final phase: The U.S. position remains that a scheduled reduction of up to 95% within 10-15 years after entry into force.

continue to explore

Tom: cost of bulk will be > than in Europe b/c D in Europe will be less & this drive domestic prod's out of busin. Solution = imports subj to same produc regs as domestic & cld equalize it w/ import regs.

C. Calculation of emissions: The delegation should continue to seek agreement on a formula to use as the basis for control which: does not undercut the control measures, encourages innovative practices in support of those measures, maximizes trade freedom among parties, does not put the U.S. at a competitive disadvantage vis a vis other parties, and encourages the broadest participation possible.

Thus, the delegation should continue to actively support the "adjusted production" formula (P + I - E - D). However, if agreement on this is not possible, and there appears to be no movement (by the EC in particular) the delegation may explore other formulas, on an ad referendum basis, which meet the above criteria.

If there is significant opposition to including "-D" (amount destroyed) in the initial base year calculation, the delegation may discuss letting D = 0 for the first 1-3 years after entry into force of the protocol. The delegation should reserve its position on whether "permanently encapsulated" should be counted in this term.

D. Trade between Parties and Non-Parties: The delegation should actively support trade provisions which: (a) protect countries party to the protocol from being put at a competitive disadvantage vis a vis non-parties; (b) create an incentive for non-parties to join the protocol; and (c) discourage the movement of production to non-parties.

Therefore, the delegation should continue to support the trade article developed at the last session, and resist attempts to weaken it. The delegation should seek the drafting improvements recommended by the inter-agency trade issues group (see attached paper).

E. Developing Countries: The delegation should continue to be open to an "LDC" provision, in order to encourage broader membership in the protocol. The delegation may consider ~~per capita exemptions~~, delayed timing, or other types of provisions, on an ad referendum basis. However, the delegation should stress that any form of exemption must not significantly undermine the environmental goals of the protocol.

taking it out.

F. <u>Scientific Assessment</u>: The delegation should insist that scientific assessment be an integral part of the protocol. The delegation should support having a legal drafting group take the various texts for assessment mechanisms now on the table, and draft a composite text which provides for possible adjustment of the controls based on regular and emergency review of scientific, technical, and economic information. The report of the scientific sub-group from the last session, and the text of Article IV of the U.S. proposed text (tabled at first session, and largely accepted by the EC), should be used as a focus for this exercise.

Regarding timing of the regular reviews, the delegation should support having CCOL-level reviews every two years, with a major review (like the NASA/WMO/UNEP assessment) every four years.

G. <u>Entry into Force provisions</u>: The draft protocol text (Article XII) calls for entry into force <u>thirty</u> days after deposit of <u>nine</u> instruments of ratification (etc.). At the first session, the USSR opposed the 9/30 format in favor of an 11/90 requirement. If this continues to be a major obstacle to Soviet concurrence on this article, the delegation may accept a 10/60 or 11/90 format.

The delegation should also seek to amend this article so as to ensure that the protocol enters into force only when a sufficient number of the major producer/user countries have deposited instruments of ratification (etc.). Thus, the delegation should propose that this article specify that of the number of instruments required for entry into force:

(a) 50% of total world consumption or production is represented; or

(b) a substantial majority (e.g. 75%) be from countries with an adjusted production (or whatever formula is agreed to) greater than a certain level (the delegation would agree to propose a specific value for this at a subsequent session).

The delegation should also seek to amend this article so as to avoid creating an incentive for some countries to delay entry into the protocol, while reaping the global environmental benefits of reductions by countries which became Parties at the outset. To this end, the delegation should seek to add the following at the end of paragraph 3 of this article:

"Any such Party shall assume all applicable obligations then in effect for all other Parties."

H. Other Legal/Institutional issues: The delegation should seek drafting improvements consistent with the substantive elements of U.S. position.

V. Other Issues:

A. Future Session: In the event that it is not possible to complete work on the protocol at this session (which is likely) the delegation should support UNEP convening a fourth session in early July.

B. Tactics: No members of the delegation shall advocate or indicate support for anything not in this position paper. All members of the delegation are required to obtain approval from the head of delegation before discussing with any person outside the delegation any fall-back position in this position paper.

C. Press: All press inquiries shall be referred to the head or alternate head of delegation, or their designee.

D. Budgetary Commitments: The delegation should not commit the USG to any activity which cannot be funded out of current appropriations.

Drafted by:

Jim Losey - EPA/OIA (382-4894)
Suzanne Butcher - State/OES (647-9312)
4/18/87

Clearances:

State:	Commerce:	CEQ:
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R. T. Watson

DRAFT

RTW

Summary

1. Within the existing limitation of models to accurately simulate the real stratosphere, all models including the fully parameterized model, predicted, within acceptable limits, similar ozone depletions for given CFC control strategies.

2. Under given assumptions for trace gas emissions, stringency of regulations, degree of compliance, and special provisions for developing countries, all regulatory strategies examined will still result in ozone depletion.

3. The amount of ozone depletion depends critically on the control strategy chosen, the substances controlled, the rate of increase in use by developing countries, and other factors. The choice of scenario remains the largest single uncertainty in the model studies presented here.

4. From a scientific stand point, a true global freeze of the emissions of CFC 11, CFC 12, CFC 113, and Halons 1211 and 1301 at or below projected 1990 levels is calculated to result in global depletions of less than 2 % by 2050. This assumes present growth rates are not significantly changed before 1990.

5. However, even when column ozone depletions are small, or do not occur, a redistribution of ozone in the vertical column is still calculated . This may have consequences for future climate and other adverse impacts.

6. Different substances have different potentials to modify the ozone layer. Regulatory measures limited to CFC 11 and CF 12 only would still result in significant growth in the chlorine loading of the atmosphere, and hence O_3 depletion, given the U.S. EPA projected growth rate of CFC 113. Also, should there be increasing unregulated use of bromine containing compounds, such as the Halons, which are believed to be especially efficient ozone depleters, then ozone depletion estimates would have to be revised upwards in the future.

7. There are many uncertainties regarding the ability of models to accurately represent the present and future atmosphere. Unexpected and unexplained changes to the atmosphere may occur. Provision may need to be made within the proposed protocol for promt response to significant ozone changes.

Ad Hoc Meeting of Experts to compare model projections of ozone layer modification relating to the application of control strategies for chlorofluorocarbons under a protocol on the control of chlorofluorocarbons to the Vienna Convention for the Protection of the Ozone Layer

1. PURPOSE OF THE MEETING

Two sessions of the Ad Hoc Working Group of Legal and Technical Experts for the preparation of a Protocol on Chlorofluorocarbons to the Vienna Convention for the Protection of the Ozone Layer (Vienna Group) have been convened by the United Nations Environment Programme during which some progress was made in agreeing the content of a protocol on the control of chlorofluorocarbons. Based on the deliberations of the Vienna Group, its Chairman, Dr. Winfried Lang, prepared a draft of Article II Control Measures and at the request of the meeting the draft Article was included in a sixth revised draft protocol on the control of chlorofluorocarbons prepared by the UNEP Secretariat.

The Article on Control Measures was included in the draft protocol with the understanding of the meeting that it did not necessarily represent the views of those delegations requesting its inclusion.

The text of the Article is expressed in general terms with several alternative versions of provisions to be included but neither specifying quantitative controls which are yet to be agreed nor the time period in which such limits be applied.

The absence of specific control measures within the article reflect the present state of negotiations among delegations. Several important issues have yet to be resolved with respect to scope, stringency and timing and include:

1. The list of potential ozone-depleting substances which is to be addressed by the Protocol.

2. The number of years from the entry into force of the Protocol that control measures must be undertaken by the Parties to the Protocol. (It is assumed that 'annual production and imports' or 'adjusted annual production', as defined by the protocol, will be set at the 1986 level or at another similar level.)

~~3. The number of years from the entry into force of the Protocol before the production of substances not produced at the time of entry into force of the protocol, must not exceed the level of imports in 1986.~~

3. The number of years after entry into force of the Protocol that a reduction from the 'freeze' levels of the substances to be controlled must be achieved.

4. The extent and rate of future reductions of CFCs under the Protocol.

5. The special conditions or exemptions to be applied to developing countries.

In order that delegations have available to them the best possible information to enable them to understand the ramifications of the different choic ~~resolve the above issues~~, UNEP has called the present meeting of scientific experts to review and compare the results of different computer models which simulate the implications for the ozone layer of a standard set of control strategies for ~~scenarios of~~ CFC control (using US EPA assumptions for CFC growth) and other atmospheric perturbations based on the framework Article II Control Measures referred to above and included as Annex I to this report.

The control options ~~scenarios~~ chosen were developed by UNEP in consultation with the Vienna Group Chairman Dr. Lang. Scenarios to illustrate the range of options avail were develo for UNEP b the US EPA. It is appreciated that there are many uncertainties associated with projecting the future composition of the atmosphere, not only with respect to the release of substances (ie CFCs and Halons) considered for control under the protocol which will be governed by economic and political factors but also relative to the change in concentration of other substances (such as methane, carbon dioxide and nitrous oxide), both naturally occuring and man-made which directly affect the ozone layer or processes which influence atmospheric ozone concentrations. It is emphasized that ozone changes are very sensitive to assumptions made with respect to CFC growth rates for non-compliers (both developed and developing nations).

It is also understood that assumptions have been made which may eventually prove to be inaccurate. This applies not only to the future composition of trace gases in the atmosphere but also to the degree of compliance by nations with the provisions of the protocol and the time frame within which agreed regulations will be applied.

~~Finally,~~ The limited ability of all models to accurately simulate the reality of a complex atmosphere and the sensitivity of the ozone layer to perturbation must be kept in mind. As has been frequently pointed out, discrepency between the actual behaviour of the atmosphere and its model prediction ~~such has occurred during the appearance of 'holes' in Antarctica's stratospheric ozone and elsewhere~~, must limit the confidence to be placed in model results.

With regard to results obtained using 1-D and 2-D models The extent to which the various 1-D and 2-D models, developed and run by different groups, show broadly similar depletions (eg for CASE 1, the spread at 2050 is from -6.1% to -10.2% at 2020, -1.7% to -3.3%) may be thought to imply that the results are accurate to this degree (ie ± ~ 30%) However, this is not necessarily the case. The models tend to have similar treatment of atmospheric chemistry and radiation processes. Any significant alteration to the understanding of chemical or dynamic processes, could lead to a change in all these predictions of ozone depletion (in either direction) No model has yet been adequately validated against the real atmosphere (eg current ozone distribution) and their reliability for predicting future states of the atmosphere is still uncertain. Fig ( ) illustrates graphically the effect of the four types of control referred to in the assumptions (viz. yearly compound production increase (0%, 2.5%) and reports decreases due to various control strategies).

5

Never-the-less based on the framework Article II 'Control Measures' a 'best' choice of possible control options has been made and applied simultaneously in a range of European and United States mathematical models and the results compared in an expert group meeting convened by UNEP and participated in by the modellers which carried out the above simulations.

At the second session of the Vienna Group, an analysis of the implications of alternative international control strategies for global ozone depletion ~~and the risk of skin cancer in the United States~~, prepared by the US EPA, was made available to the Group by the United States as a background document. The analysis contained in the paper were derived from a single parameterized model using similar, but not identical, assumptions in the derivation of control strategy scenarios to those used to derive the scenarios used in the present exercise.

It was not possible for the Vienna Group to ascertain the reliability of the results presented by the United States in view of the lack of comparison of those results with results from other models examining identical scenarios.

The purpose of the present meeting is to correct this deficiency and make available to the Vienna Group:

(i) Assessment of the implications for the atmosphere of a range of CFC control strategies based upon the sixth revised draft Protocol on the control of chlorofluorocarbons, currently under development by the Vienna Group.

(ii) Assessments based on analysis by different models employing identical scenarios.

(iii) Evaluation of the differences, similarities, and reliability of model results through intercomparison by experts.

The above is designed to assist the Vienna Group in making the best choice of control strategy for inclusion in the draft protocol on chlorofluorocarbons.

2. PARTICIPATION IN THE MEETINGS

The meeting was attended by the following experts: Dr. R. Watson (USA); Dr. G. Brasseur (Belgium); Dr. I. Isaksen (Norway); Dr. D. ~~Weubles~~ Wuebbles (USA); ~~Dr. P. Connell (USA)~~; Dr. D. Sze (USA); Dr. G. Jenkins (UK); Dr. m Ko (USA); Mr. P. Usher of the UNEP Secretariat acted as Chairman.

3. CONTROL STRATEGIES AND TRACE GAS EMISSION ESTIMATES SUBJECTED TO MODEL ANALYSIS

Based on the draft of Article II control strategies prepared by the Vienna Group Chairman and contained in the sixth revised draft protocol on the control of chlorofluorocarbons emission estimates have been made for ozone depleting substances for the purpose of comparing model estimates of ozone modification. ~~Eight~~ Nine cases of potential future emissions are presented.

Exhibit 1 summarizes the assumptions underlying the ~~eight~~ nine cases.

Exhibit 2 lists the historical emissions that are common to all the cases.

Exhibit 3 presents the trace gas assumptions used (CO_2, CH_4 and N_2O).

Exhibit 4 to 11 present the emissions estimates for the first eight cases.

EXHIBIT 1

ASSUMPTIONS

Assumptions Common to All Cases:

- Baseline Use: In the absence of controls, use grows at an average annual rate of 2.5 percent from 1985 to 2050, with no growth thereafter. However, this overall average rate conceals higher annual rates in early years (e.g. 11.6% for the decade from 1965 – 1970) followed by less than 2.5% annual rate in later years.

- Baseline Emissions: Emissions are estimated based on historical and simulated future use and the expected lags in emissions associated with certain applications (e.g., refrigeration). Note that emissions are not specified directly, but are derived from use.

- Controls: Controls are applied to use; reductions in emissions may lag the reduction in use due to emissions of historical production from existing products (note that for applications other than Halon fire extinguishing systems and rigid PU foam, this lag is reasonably small, less than 10 years).

- Compliance: Compliance less than 100 percent (e.g., 80 percent) is represented as follows:

  A. The baseline is divided into two parts (compliance and non-compliance) using the compliance rate (e.g., 80 percent).

  B. The compliance portion of the baseline follows the prescribed policy (e.g., 80 percent of the baseline remains fixed at the 1986 level in the case of a freeze at 1986 levels).

  C. The non-compliance portion of the baseline grows at the baseline rate (e.g., 20 percent of the baseline grows at 2.5 percent per year through 2050).

  D. The resulting production over time is the sum of the two portions of the baseline (compliance and non-compliance).

- Developing countries: The use in developing countries is allowed to grow under all the cases examined. The limit to growth examined is 0.5 kg/person for CFC-11 and CFC-12. This value is approximately 2.5 times the current global average use per capita for these chemicals. For cases where other chemicals are controlled as well, developing nations are permitted to grow to 2.5 times the current global average use per capita for each of the additional chemicals.

The proportion of use in the developing countries for 1985 is estimated by USEPA to be as follows:

CFC11	76%
CFC12	78%
CFC22	92%
CFC113	83%
CCl_4	78%
$MeCl_3$	85%
Halon 1211	77%
Halon 1301	85%

These proportions are uncertain, and have been guesstimated. They have a dominating influence on the ozone depletion calculated, because of the large compounding increase which the developing countries [illegible].

Assumptions for Case 1: Freeze of CFC-11 and CFC-12, 80% Compliance

- Developed Countries:

  -- Baseline growth from 1985 to 1990
  -- Gradual reduction to 1986 levels from 1990 to 1992
  -- Freeze at 1986 levels from 1992 onward
  -- 80% compliance

- Developing Countries: Limited at
  -- ~~Allowed to grow to~~ 2.5 times current global use per capita
  -- 20% compliance to limit

- Chemicals covered: CFC-11, CFC-12 (all other chemicals grow at the baseline rate)

- Trace Gases:

  -- CO_2 = NAS 50th percentile
  -- N_2O = 0.2%/yr.
  -- CH_4 = 0.017 ppm/yr.

Assumptions for Case 2: Freeze of CFC-11 and CFC-12, 80% Compliance, Compounded Methane

Same as Case 1 except CH_4 grows at 1%/yr. compounded.

Assumptions for Case 3: Freeze of CFC-11 and CFC-12, 100% Compliance

Same as Case 1 except 100% compliance among developed countries.

Assumptions for Case 4: Freeze of CFC-11, CFC-12, CFC-113, 80% Compliance

Same as Case 1, except CFC-113 is also covered.

Assumptions for Case 5: 25% Reduction of CFC-11, CFC-12, CFC-113, 80% Compliance

- Developed Countries:

  -- Baseline growth from 1985 to 1990
  -- Gradual reduction to 75% of 1986 levels from 1990 to 1994
  -- Freeze at 75% of 1986 levels from 1994 onward
  -- 80% Compliance

- Developing Countries:

  -- Allowed to grow to 2.5 times current global use per capita
  -- 40% Compliance.

9

- <u>Chemicals Covered</u>: CFC-11, CFC-12, CFC-113 (all other chemicals grow at baseline rate)

- <u>Trace Gases</u>:

  -- CO_2 = NAS 50th percentile
  -- N_2O = 0.2%/yr.
  -- CH_4 = 0.017 ppm/yr.

Assumptions for Case 6: 50% Reduction of Fully-Halogenated Compounds, 80% Compliance

- <u>Developed Countries</u>:

  -- Baseline growth from 1985 to 1990
  -- Gradual reduction to 50% of 1986 levels from 1990 to 1996
  -- Freeze at 50% of 1986 levels from 1996 onward
  -- 80% Compliance

- <u>Developing Countries</u>:

  -- Allowed to grow to 2.5 times current global use per capita
  -- 40% Compliance

- <u>Chemicals Covered</u>: All fully-halogenated compounds (CFC-11, CFC-12, CFC-113, Halon 1211, Halon 1301), other chemicals grow at baseline rate

- <u>Trace Gases</u>:

  -- CO_2 = NAS 50th percentile
  -- N_2O = 0.2%/yr.
  -- CH_4 = 0.017 ppm/yr.

Assumptions for Case 7: 50% Reduction of Fully-Halogenated Compounds, 80% Compliance, Compounded Methane

Same as Case 6, except CH_4 grows at 1%/yr. compounded

Assumptions for Case 8: 50% Reduction of Fully-Halogenated Compounds, 100% Compliance

Same as Case 6, except 100% compliance among developed countries.

Assumptions for Case 9: A complete worldwide freeze of emissions of all halocarbons ~~(CFCs 11, 12, 113, 22~~, ~~CCl_4, CH_3CCl_3, Halons 1211 and 1301)~~ starting in 1990.

- <u>Chemicals covered</u> CFCs 11, CFC 12, CFC 113, CFC 22, CCl_4, CH_3CCl_3, Halons [redacted] 1211 Halon 1301)

- <u>Trace Gases</u>

  -- CO_2 = NAS 50th percentile
  -- N_2O = 0.2%/yr.
  -- CH_4 = 0.017 ppm/yr.

Assumptions Applied to the Standard Set of Scenario S

In developing scenarios for CFC control measures for model intercomparison it was necessary to make several assumptions relating to the future concentrations and rate of accumulation of trace gases in the atmosphere; the degree of compliance by States with the provisions of an protocol; and the possible exemption from control or the application of less stringent controls by developing countries to be allowed under a protocol. In all these cases, assumptions were made which may well not represent the real situation of a future wold. Possibly, the most questionable of the assumptions made is that relating to future CFC use by developing countries which in all cases has been specified as growing at an overall average of 2.5 % per year up to a limit (in some "complying" countries) of 2.5 time current global use per capita (about 0,5 kg per year).

As the model results show, calculated ozone depletion is extremely sensitive to projected developing country use. Which, at the specified rate, even under conditions of stringent regulatory obligation for developed countries to freeze and cut back production (cases 7 and 8), still results in significant ozone depletion.

Insert A

It should be noted that the 2.5 % average annual growth rate quoted by USEPA represents an average growth over the period 1990 to 2050. Closer examination of the scenarios reveals that considerably more rapid growth is assumend in this century (for CFC 11 and 12 about 3 %, for CFC 22 about 7 %, for Halons about 11 %) than in the next. In consequence ozone depletion projections remain significant under all strategies for controls applied to developed countries, even for 100 % compliance. However this conclusion is critically dependent on the estimate of the current proportion of CFC which is emitted in developing countries.

Fig. x represents a comparison between 3 case scenarios for control with full global compliance with a 2.5 % per year CFC growth, from 1986 levels. Nevertheless, even it the assumptions chosen prove to be unrealistic, by application to all scenarios equally it provides an opportunity for the direct comparison of model performance.

INSERT (A)

~~To~~

The predicted ozone depletion due to emission scenarios 1 to 8 is composed of contributions from ~~Developed countries~~ three sources

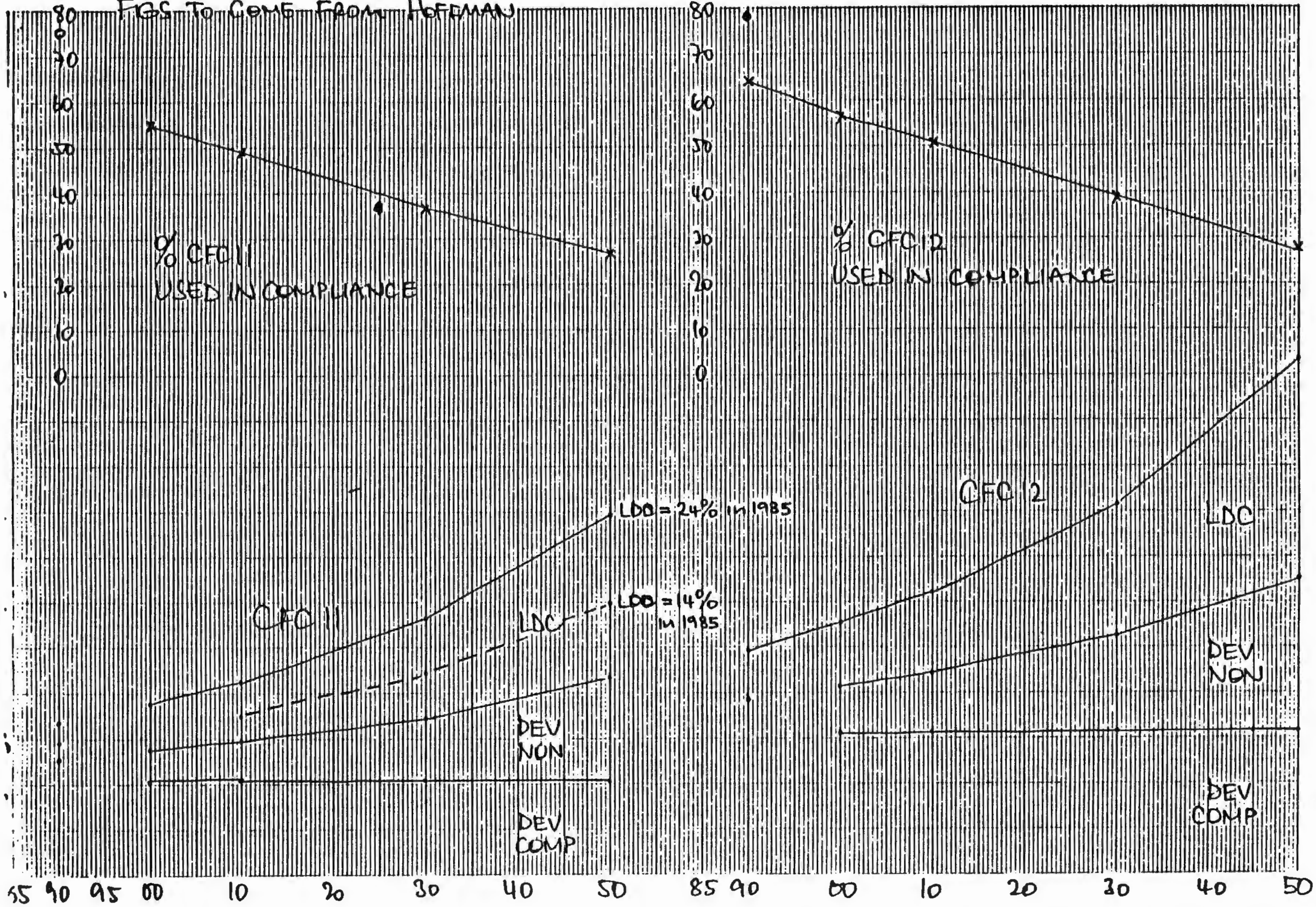
a) Developed countries which comply
b) Developed countries which do not comply
c) Developing countries (no compliance assumed)

Where as group (a) are assumed under some scenarios to be subject to reductions in emissions of 0, 25% or 50%, groups (b) and (c) are allowed unrestrained growth of approximately 2.5% per year (although, as previously mentioned, these are (sometimes very heavily) front end loaded

Whereas the ozone depletion models have not been used in such a way that we can see the contribution to the depletion from groups (a), (b), (c) separately, we can (using the input information from USEPA) show how the emissions of the various compounds is apportioned over the period 1985–2050. This is shown in Fig X (Case 1) and Fig Y (Case 8 ½), and the relative contribution of complies is also indicated. Also shown is an estimate of emission ~~break~~ ~~breakdown~~ split 1985–2050 (Developed Compliant, Developed non-compliant, Developing) using a different ~~assumption~~ estimate for the 1985 value (90% Developed; 10% Developing). ~~It~~ This clearly shows the large sensitivity to the initial ~~input~~ choice of estimate.

CASE I

FIGS TO COME FROM HOFFMAN



Results:

The response of the model calculated column abundance of O_3 to the nine emission scenarios is illustrated in figure 1. Case 9 represents the case where all emissions are frozen at 1990 level. The remainder can be divided into two groups representing control on F-11, F-12 and F-113 (cases 1-5) in one group and a second group providing additional control on H-1211 and H-120) (cases 6-8).

The calculated response of O_3 is conistent with the amount of total chlorine (ranging from 16 ppbv in case 1 to 8 ppbv in case 9) and total bromine (ranging from 10 pptv in case 1 to 15 pptv in case 9) in the models. It should be noted that the effect of bromine is mainly through the interaction of BrO with ClO making the O_3-removal efficiency of bromine on a per molecule basis much higher at elevated chlorine background.

Comparison of cases 1 with 2 and case 6 with 7 illustrates that the effect of differet CH_4 growth rate (1 % per year compound vs 17 ppb per year) is relatively small: about 0.5 % in O_3 change in the AER and Guy Brasseur model up to 1 % difference in the LLNL and Oslo model by the year 2050.

The calculations of ozone depletions from ~~five~~ different models were compared for 4 of the emission scenarios (Figure X). Three of these models (LLNL, AER, GB) are conventional 1-D models, one is a highly parametrized model (Connell, 1986) based on the LLNL 1-D model, and one is a 2D diabatic circulation model. (*)
b. Except for the GB 1-D model and the 2D model, Bromine chemistry is included in the calculations. Bromine chemistry becomes significant for ozone depletion towards the end of the predicted period, due to the assumed fast growth in bromine compounds, making a comparison between studies with, and without, bromine chemistry less certain.

For the time period assigned in the comparisons, 1985 – 2050, the estimated depletions agree within a factor of two. The largest global average depletion is obtained by the 2-D model, while the parametrized model provides somewhat less ozone depletion than the 1-D models in all comparisons made.

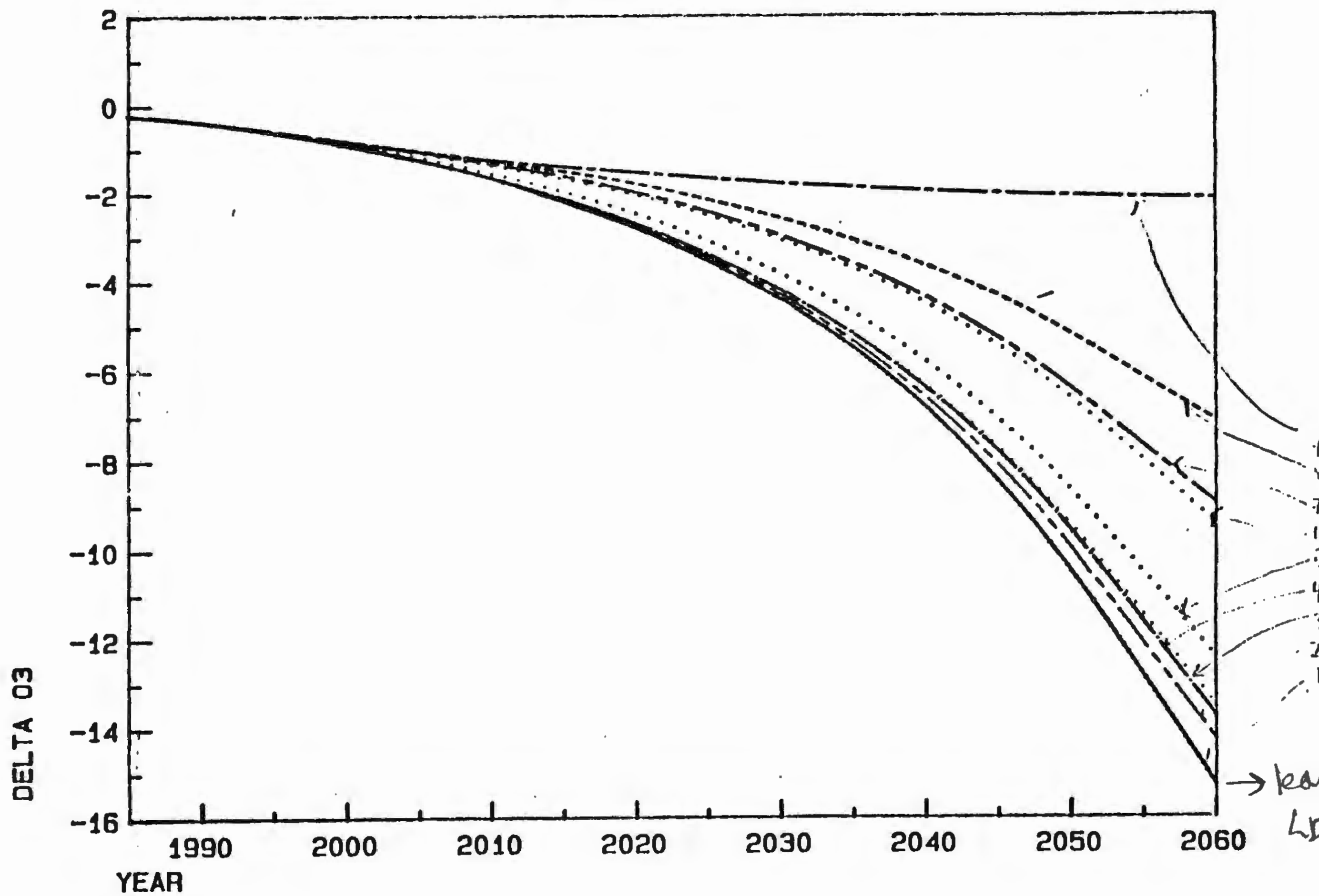
It should be mentioned here that the results are quite sensitive to the bromine scenario, while the parametrized model has not been extensively verified against 1D model for bromine perturbations.

Within the range of cases run, the results are consistent.

(*) Estimated increase in the chlorine content of the stratosphere over the time period of 70 years, differs by less than 10% in the five models, for each of the scenarios.

DELTA O3

CASES 1, 2, 3, 4, 5, 6, 7, 8, 9



→ leaves out LDC's

true freeze -- compliance by all countries protects envir

15

Fig 2a

CASE O ("FREEZE" 1990
LINEAR CH4 g

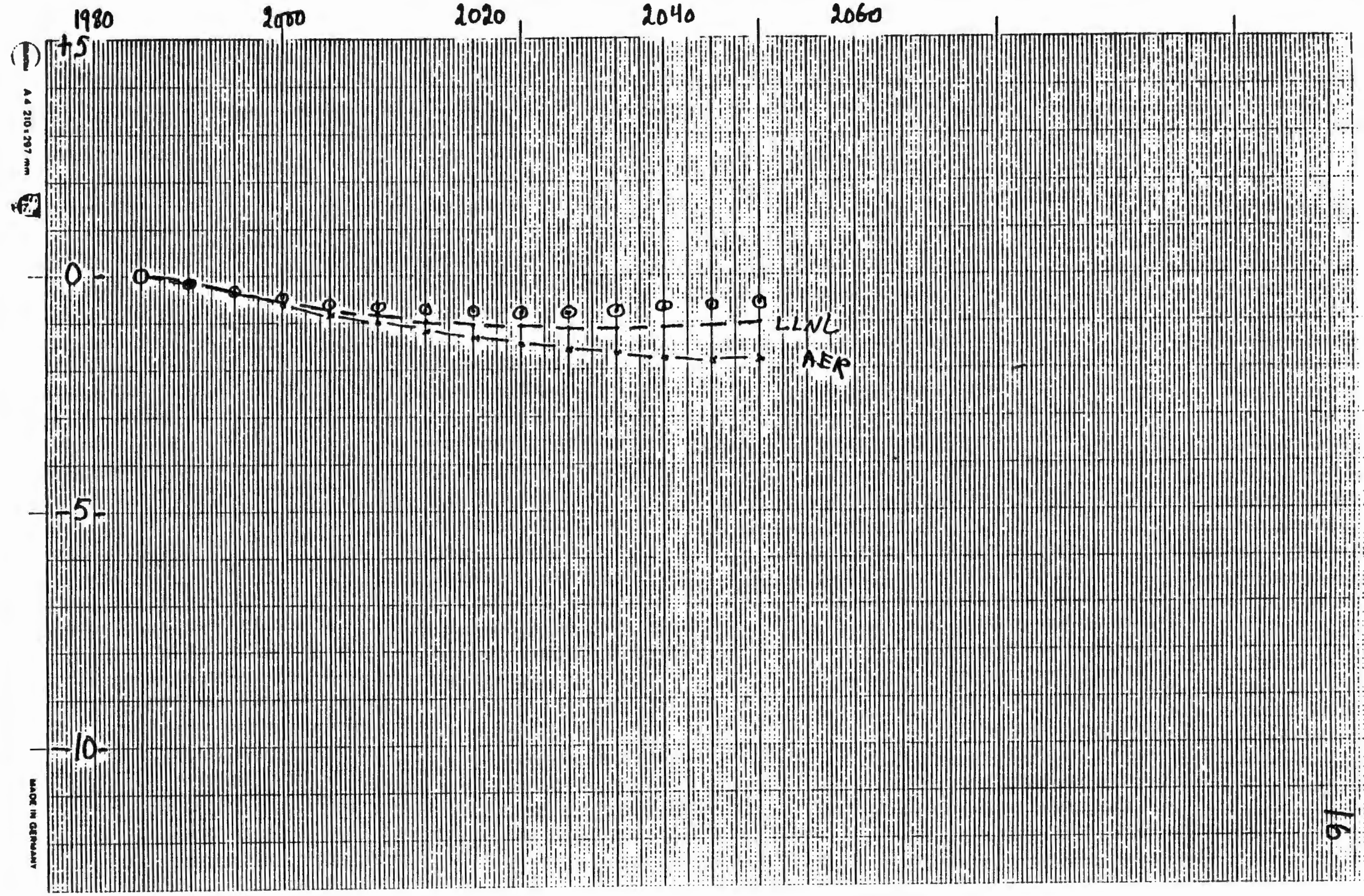
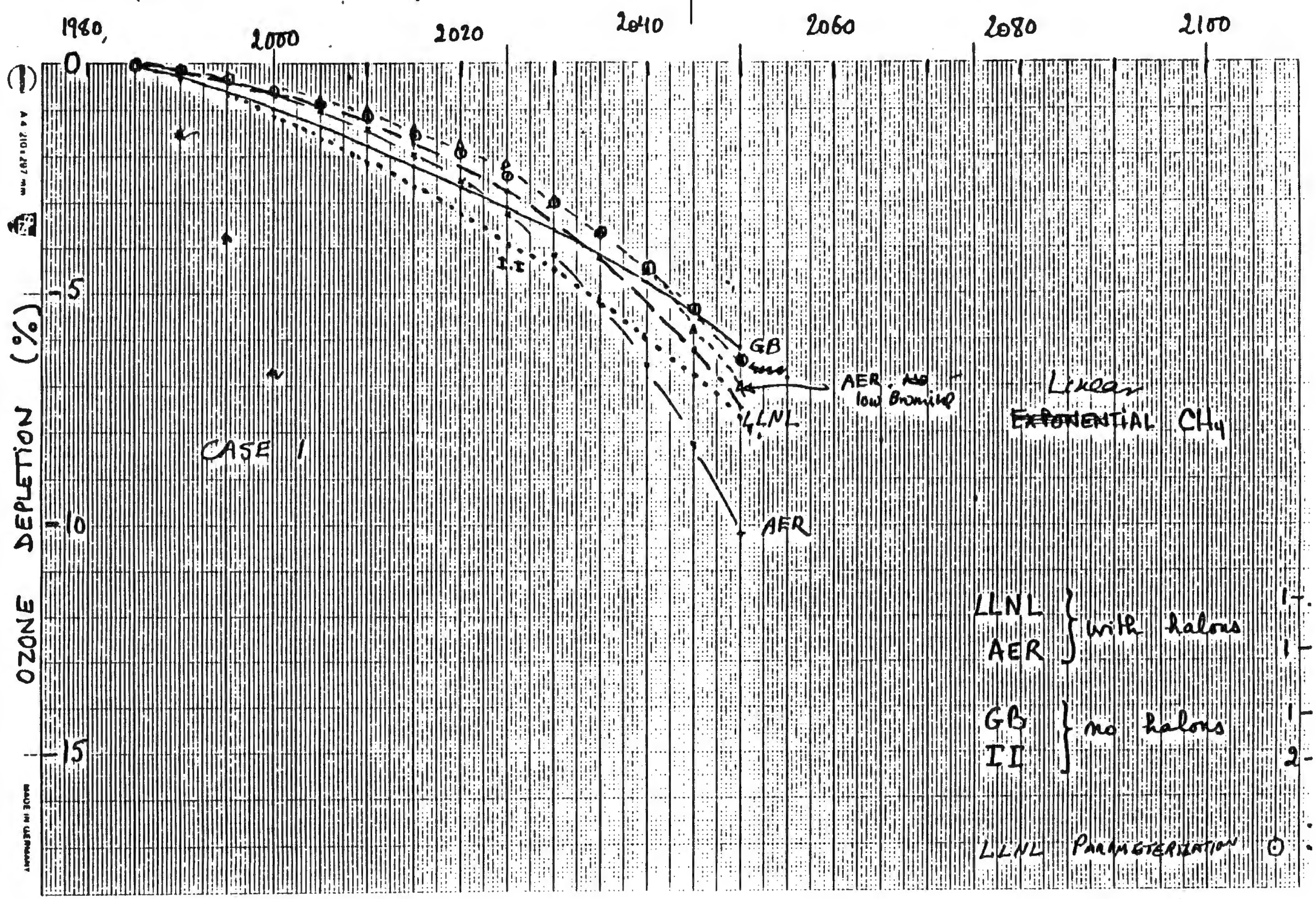


Fig 2b

CASE I



YEAR
1980
2000
2020
2040
2060
2080
2100
0
-5
-10
-15
OZONE DEPLETION (%)
CASE I
GB
AER, no low Bromine
LLNL
AER
I.I
~~EXPONENTIAL~~ Linear CH4
LLNL } with halons
AER
GB } no halons
I.I
LLNL PARAMETERIZATION
A4 210 x 297 mm
MADE IN GERMANY

Fig 2C

CASE2

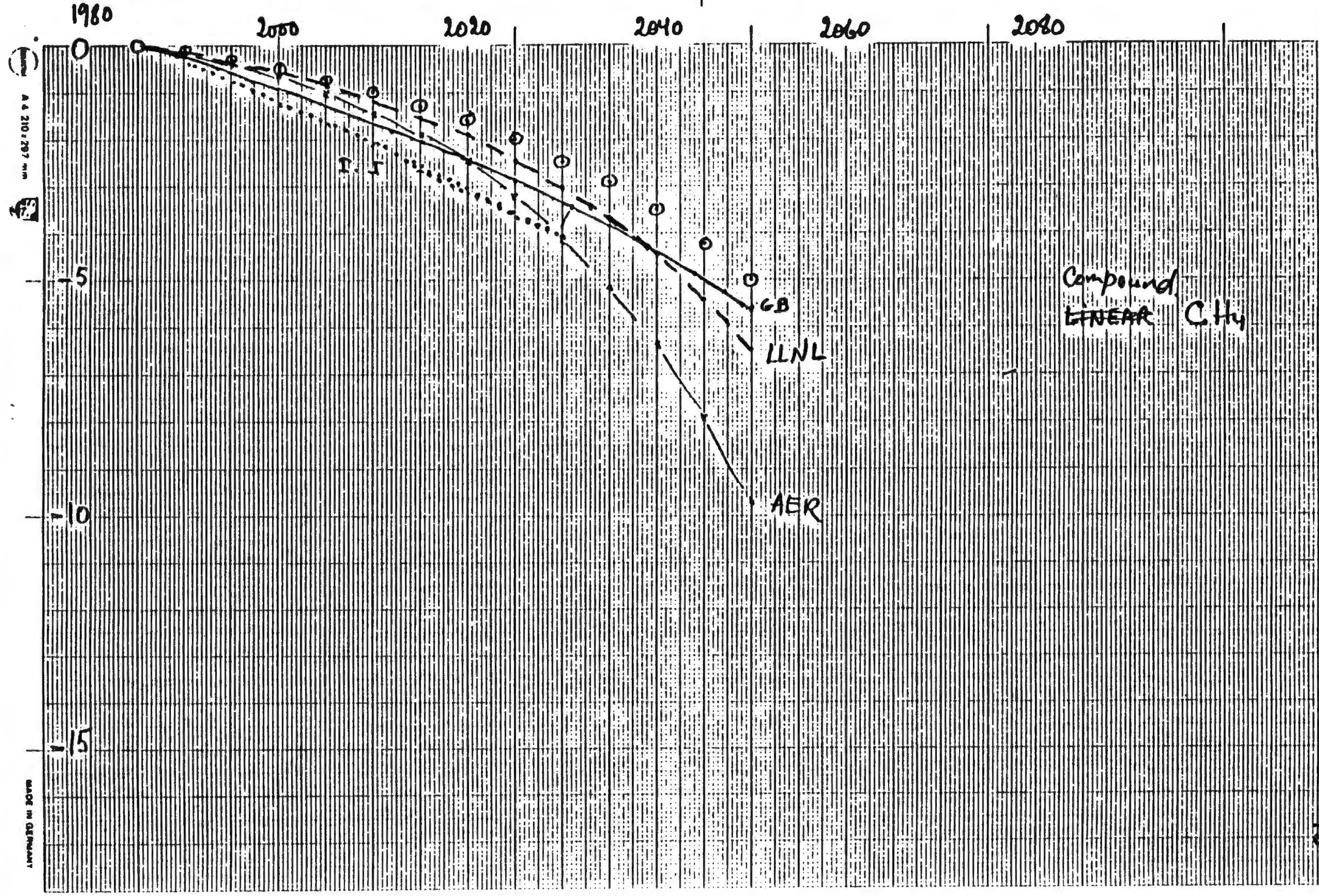
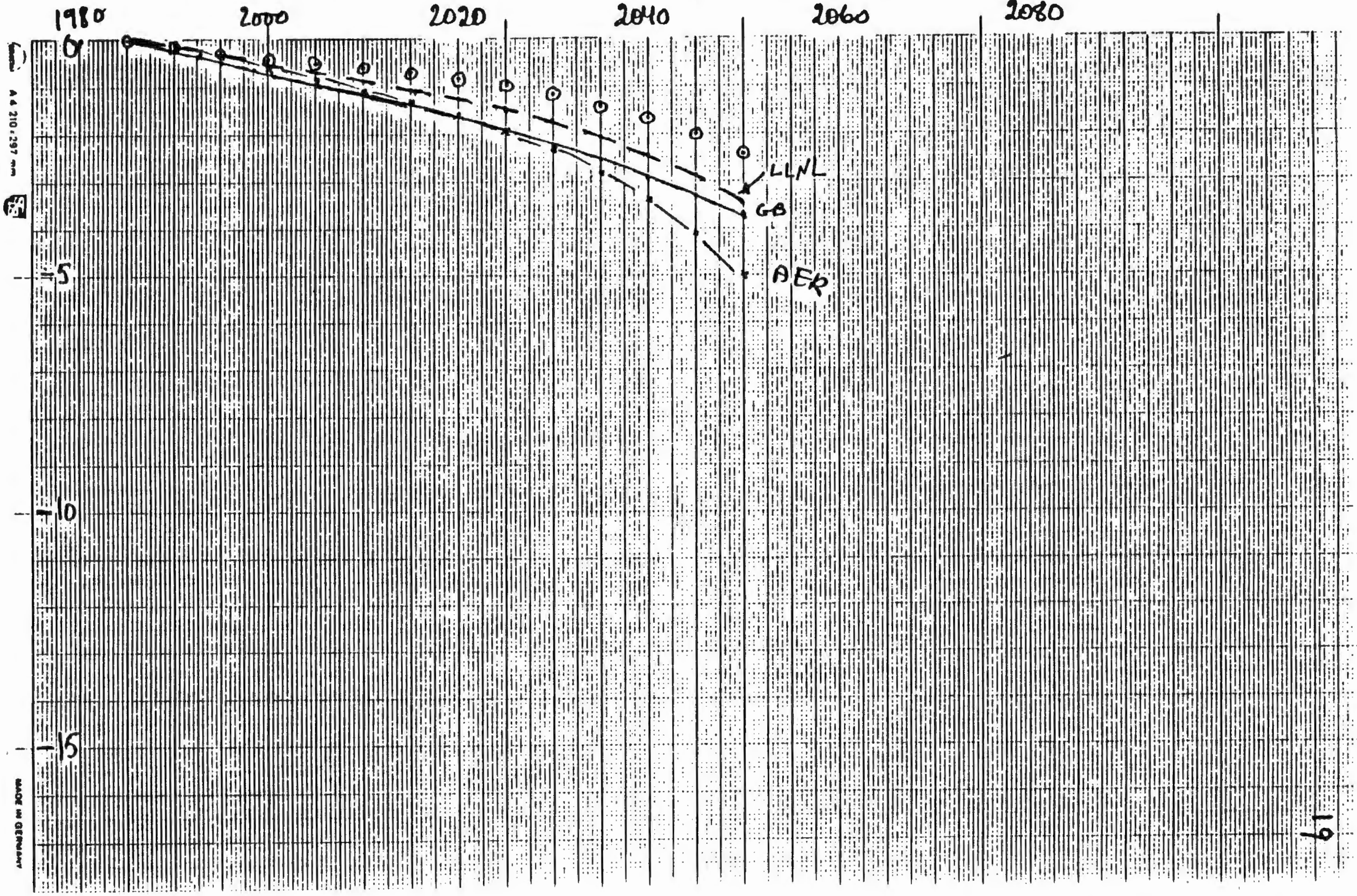

1980
2000
2020
2040
2060
2080
0
-5
-10
-15
GB
LLNL
AER
Compound
~~LINEAR~~ CH_4
A 4 210 x 297 mm
MADE IN GERMANY

Fig 2d

CASE 8


1980
2000
2020
2040
2060
2080
0
5
10
15
LLNL
GB
AER
A4 210 x 297 mm
MADE IN GERMANY

Relative Ozone Depletion Potential

Although all Halocarbons are contributors to stratospheric chlorine and/or bromine, its individual effect (on per unit mass basis) on ozone varies greatly according to the number of Br und Cl atoms it contains, its atmospheric life times and molecular weight and its vertical distribution in the stratosphere. Table (xx) summarizes its calculated ozone depletion potential (ODP) relative to CFC-11 for various halocarbons including H 1301 and H 1211. Those Halocarbons that contain H-atoms (ep. CFC-22, $C_2H_3Cl_3$ and CH_2Cl_2) are calculated to have small ODP values while its ODP SO_2.

The 1 fully halogenated halocarbons are around unity or larger.

Because of the much higher efficiency of the bromine cycle, the calculated ODP for H-1301 and H-1211 are significantyl larger than unity. It should also be noted that, in the case of bromine, ozone is removed by the reaction of BrO with ClO. Thus, the calculated ODP for the Halons will depend on the chlorine burden in the stratosphere. The values in table (xx) are calculated using the present-day chlorine burden of about 2,8 ppb.

OZONE DEPLETION POTENTIAL ~~AND GREENHOUSE POTENTIAL~~ PER UNIT MASS OF CHEMICAL EMITTED RELATIVE TO CFC-11

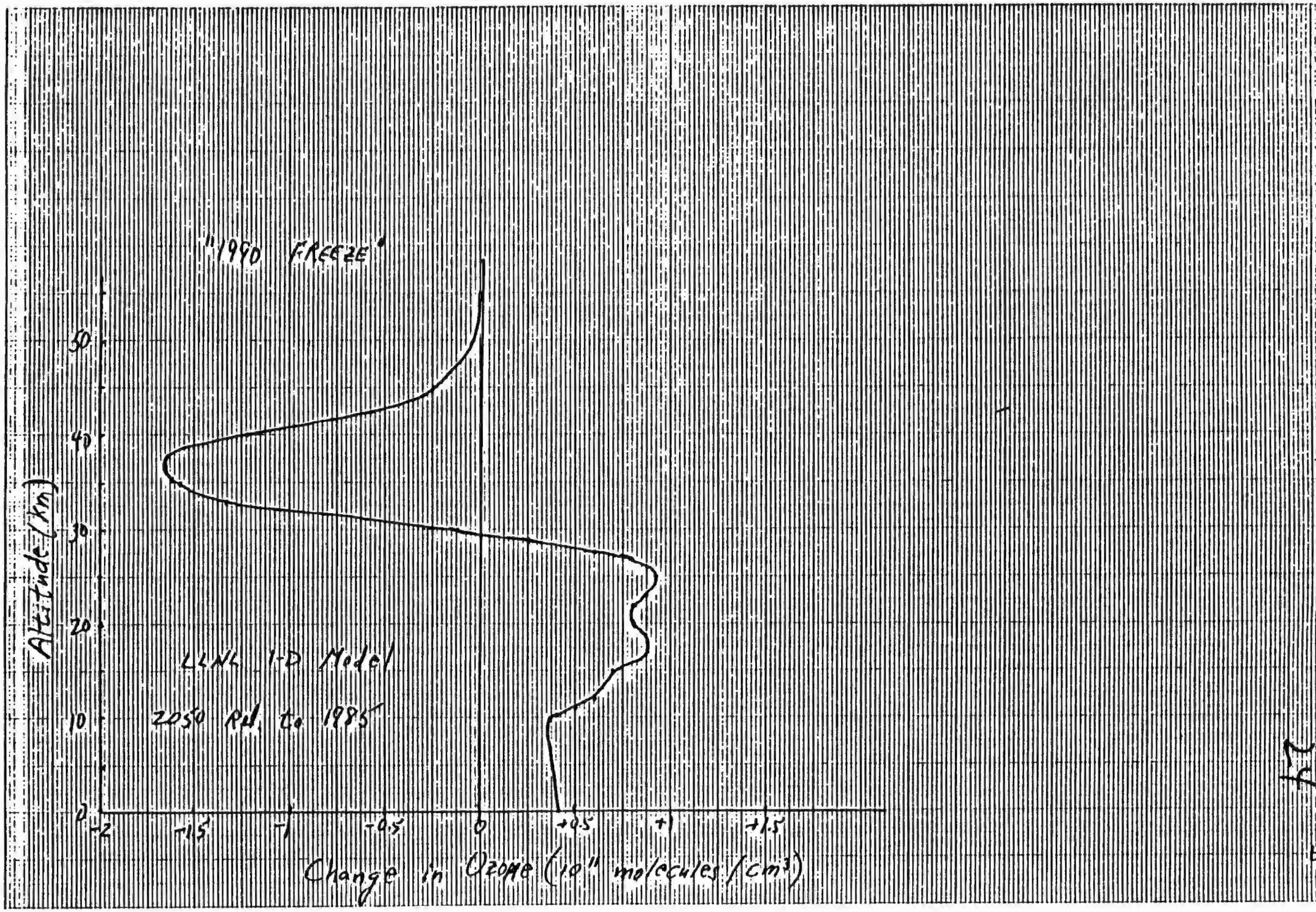
(AER 1-D model)

Chemical	Molecular Weight	Lifetimes (year)	Approx. Global Emission (million kg/yr)	Ozone Depletion Potential
CFC-11 ($CFCl_3$)	137.5	65	342	1
CFC-12 (CF_2Cl_2)	121	130	444	1.1
Carbon Tetrachloride (CCl_4)	154	50	1029	.92
CFC-113 ($C_2F_3Cl_3$)	187.5	90	163	.84
CFC-114 ($C_2F_4Cl_2$)	171	180	-	1.1
CFC-115 (C_2F_5Cl)	154.5	380	—	0.6
CFC-22 (CHF_2Cl)	86.5	20	207	.08
Methyl chloroform ($C_2H_3Cl_3$)	133.5	7.0	545	.13
Methylene chloride (CH_2Cl_2)	85	0.28	-	$3x10^{-3}$
Halon 1301 ($CBrF_3$)	149	110	~ 10	8
Halon 1211 (CF_2BrCl)	165.5	25	~ 10	2

Changes in ozone profile

Attention was also drawn to the fact that in all cases of ozone ~~deption~~ depletion even when zero or negative (ozone increase) there would occur significant redistribution of ozone in the vertical column with ~~[illegible]~~ an increase in tropospheric ozone and a decrease in stratospheric ozone occurring (Figs A and B). Such a change ~~[illegible]~~ would imply consequences for climate (ozone is a greenhouse gas) and in cases of ozone increase at near surface levels consequences for human health and ecosystems related to the formation of photochemical smog and ~~ecosystem damage related [illegible] [illegible] acidic acid deposition related problems~~.


"1990 FREEZE"
LLNL 1-D Model
2050 rel to 1985
Change in Ozone (%)
Altitude (km)
50
40
30
20
10
0
-25
-20
-15
-10
-5
0
+5
+10


"1990 FREEZE"
LLNL 1-D Model
2050 Rel. to 1985
Altitude (km)
0
10
20
30
40
50
-2
-1.5
-1
-0.5
0
+0.5
+1
+1.5
Change in Ozone (10^11 molecules/cm^3)

The Experts participating in the meeting were of the opinion ~~was~~ that the scenarios generated by USEPA should be supplemented by a limited number of other scenarios which were more straightforward and ~~identical~~ similar to those used in the CCOL 1986 report, thus allowing ~~comparability~~ comparisons, viz

a) 1.5% ~~pa~~ per year growth in all Fully Halogenated Halocarbons (CCOL considered only 11 + 12)(Base 198[illegible]

~~b) 3.0% per year growth in all Fully Hallo~~

b) as (a) but 3.0% per year

~~Theses~~

These scenarios were run using the parameterisation, and the ozone depletions ~~are~~ predicted are shown in Fig X.

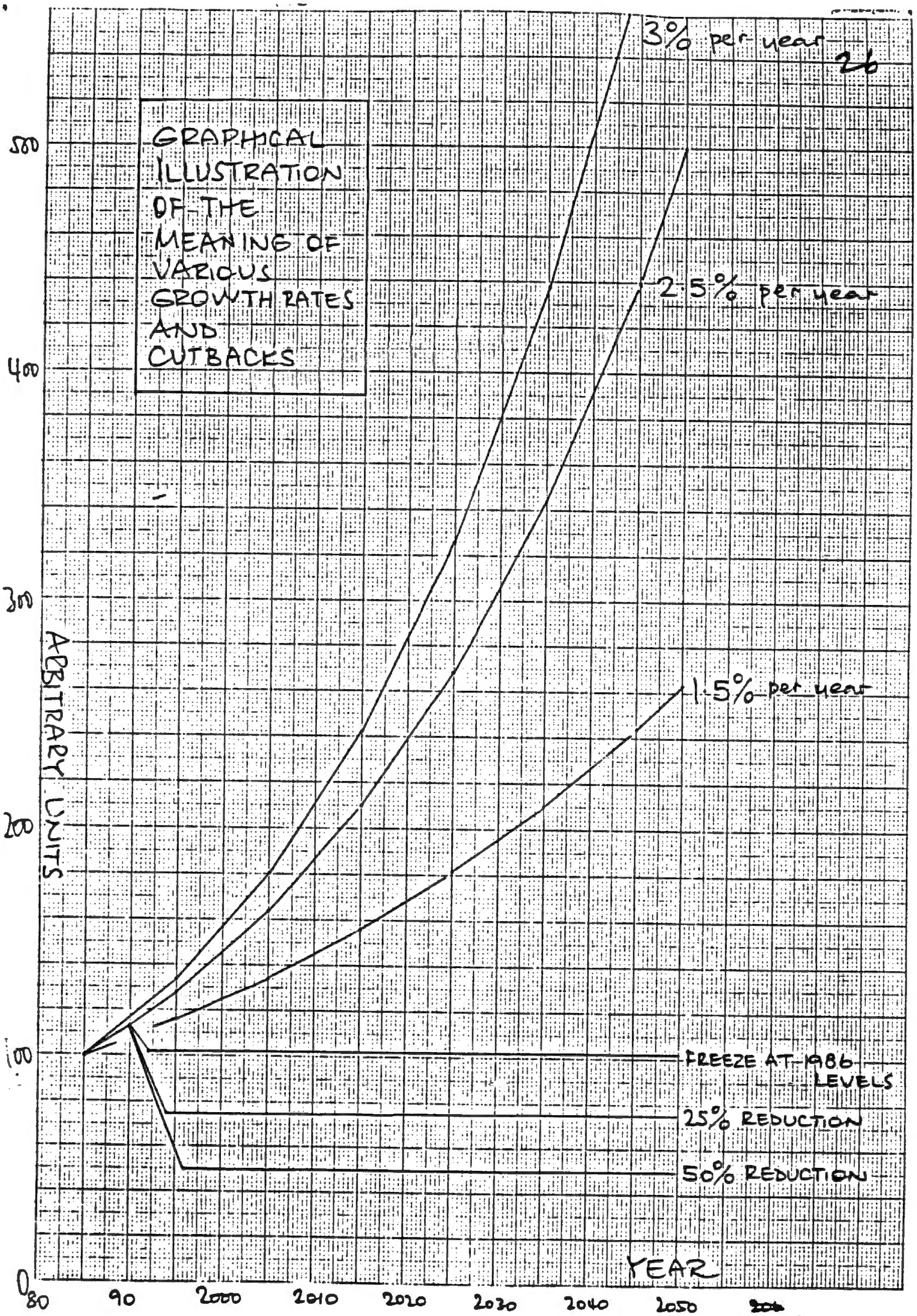
(c) Freeze 11, 12, 113 allow 3% per year growth in Halons

(d) Freeze 11, 12, allow 3% per year growth in 113 and Halons

(e) Freeze all fully halogenated compounds in developed world – allow 3% per year growth in developing world assuming that in 1985 developing countries use 25% of total.

(f) Same as (e) but assume developing countries only used 10% of total in 1985.

Fig P shows illustratively the meaning of some of the projected growth and cutback rates discussed above


GRAPHICAL ILLUSTRATION OF THE MEANING OF VARIOUS GROWTH RATES AND CUTBACKS
3% per year
2.5% per year
1.5% per year
FREEZE AT 1986 LEVELS
25% REDUCTION
50% REDUCTION
ARBITRARY UNITS
YEAR
500
400
300
200
100
0
80
90
2000
2010
2020
2030
2040
2050

Alternative Control Measures for the Ozone Protocol

Problem: Unequal Economic Squeeze on CFC Uses for Different Parties.

Under any of the control options so far put forward, it is likely to work out that the U.S. and other countries that have already banned most aerosol uses of CFCs would have to start cutting back on economically important uses of CFCs while other countries could merely cut back on aerosols. The economic inefficiency imposed on the first group of countries could be quite serious.

Solution: A World-Wide Market-Oriented Approach.

Amend the original EC proposal for a production cap by adding a separate paragraph on free trade in the restricted CFCs. It would read roughly as follows, and would fit best into Article V, on trade controls:

> Each party affected by Paragraph 1 of Article II undertakes to permit free trade among parties in the substances listed in Annex A, unimpeded by any discriminatory duty or other barrier to purchase and export to other parties. That is, all parties shall have equally unrestricted access to these substances at the same f.o.b. price at the point of production. Also, each party undertakes not to grant direct or indirect subsidies whose effect would be to protect or preserve the production or use within its jurisdiction of any product that contains or is produced using these substances.

Discussion:

EPA's cost analysis indicates that the lowest-cost substitutions for CFCs 11 and 12 would take place at price increases for these substances ranging from 10 to 25 percent. These substitutions would reduce the amounts used in the U.S. by from 20 to 35 percent, relative to present uses adjusted for growth. Beyond these easy substitutions, the prices of CFC 11 and CFC 12 would have to jump more sharply to make further substitutions look economical. By contrast, with a very small increase in price the low-priority aerosol uses in Europe would give way to substitutes. In a free market, with equal access for all users within the jurisdiction of the signatory parties, a supply "shortage" created by a production cap would result in bidding up the prices of CFCs 11 and 12 (and of other substances, if any, listed in Annex A.) In Europe the aerosol uses plus the low-priority uses would be squeezed out ahead of high-priority uses in the U.S., giving the right result by indirect means.

Problem: The Production Cap Would Lock the Worldwide Distribution of Output into a Potentially Inefficient Pattern.

Due to changes in exchange rates, relative costs, and other economic factors, the lowest-cost locations for production of controlled CFCs can change. However, a simple production cap would prevent location changes among parties. Shifting production to a location, across a national boundary, that has become more economic since the establishment of the cap would violate the cap at the new location.

Solution: Require free trade in production rights.

Such rights can be made transferable, and the protocol could include a paragraph requiring that a party can secure an increase in its production cap by obtaining an agreed equal reduction in another party's cap, and that parties should impose no barriers to such shifts. A private firm in one country could buy out a right from an firm in another country and shift it abroad.

Discussion:

Under most circumstances a production cap would create monopoly rights to production, inasmuch as the rising prices for the controlled CFCs would generate excess profits for the firms that have the right to produce them. A producing country's production cap has to be enforced either by allocating the cap to specific firms or by levying a tax on production. (In the latter case the country's government would absorb the excess profits, and would in effect own the monopoly right.) The case where the government of the producing country does not tax the controlled CFC is the simplest case, since then the requirement would simply be that the government impose no barrier to a shift of production negotiated among private firms. The case where there is a tax is more troublesome, because in that case the host country stands to lose revenues when there is a shift of production away from it. Hence, it may be preferable to try to prevent the imposition of such taxes, or to include language in the protocol that rules out taking them into account when a shift of production is being negotiated.

April 17, 1987

EPA Position on Ozone Protocol Negotiations

1. Scientific evidence linking CFC emissions to ozone layer depletion continues to justify additional controls.

2. The magnitude of potential risks to aquatic and terrestrial ecosystems, and human health, from disruption of a major global atmospheric system, are completely disproportionate to projected costs of dealing decisively with the source of the problem.

3. Prospects for significant CFC emission reductions at relatively low cost over the next decade are excellent, through a combination of early conservation measures and elimination of non-essential uses and later introduction of new alternative technologies and chemicals. (U.S., European and Japanese industry are already accelerating the search for substitutions.)

4. The U.S. has, through aggressive leadership, been able to focus the international negotiations on refining (and accepting) the basic protocol structure (i.e., freeze-reduction approach) introduced by the U.S., and to deflect other proposals which would seriously disadvantage us.

5. The negotiations are at a critical stage, with the 3rd session intended by the UNEP organizers and most other countries to resolve remaining issues, particularly the reduction step process and schedule.

6. Any indication in Geneva that the U.S. is backing away from the strong position it has advanced, or having second thoughts, will have serious international and U.S. domestic ramifications.

7. Internationally, our damaged credibility would adversely affect U.S. ability to lead other nations on environmental (and possibly other) issues in the future.

8. Domestically, Congressional and public pressure will escalate for early unilateral action, and EPA will undoubtedly be required to promulgate new regulatory measures under the Clean Air Act (the worse possible outcome in the eyes of U.S. industry and virtually all other U.S. interest groups).

9. Consequently, it is essential that the U.S. delegation in Geneva be allowed to negotiate over the full spectrum of issues, seeking as much resolution as possible, and exhibiting the same degree of concern about the problem, commitment to the basic U.S. position and desire for early conclusion of a protocol as in the previous two negotiating sessions. (This recognizes that whatever is agreed to in Geneva, and during any subsequent sessions that may be required, will be subject to full inter-agency review and a final accept/reject decision in Washington as well as in other capitals.)

U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON ENERGY AND COMMERCE

SUBCOMMITTEE ON HEALTH AND THE ENVIRONMENT

2415 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
PHONE (202) 225-4952

3615
166

March 24, 1987

Dr. James C. Fletcher
Administrator
National Aeronautics and Space Administration
400 Maryland Avenue, S.W.
Washington, D.C. 20546

Dear Dr. Fletcher:

I am writing as part of the Health and Environment Subcommittee's continuing oversight of the Clean Air Act to request additional information concerning the depletion of the Earth's stratospheric ozone layer and the recent testimony of Dr. Donald Heath of the Goddard Space Flight Center.

Since 1974 scientists have predicted that the release of chlorofluorocarbons into the Earth's atmosphere would result in a large scale global depletion of the stratospheric ozone layer, which shields the Earth from dangerous ultraviolet radiation. Most experts on this problem have generally agreed with projections such as those offered by NASA's Dr. Robert Watson at the recent Subcommittee hearing where he warned of a 1.5 to 10 percent ozone loss over the next 70 years with potentially disasterous consequences. Dr. Watson also testified that analyses of trends in global ozone have, in general, shown no statistically significant trend since 1970, a result which Dr. Watson notes is consistent with model predictions.

Hence, it was extremely significant when, in testimony before the Subcommittee, Dr. Heath stated that Nimbus 7 satellite observations indicate that global ozone decreased by 4.4 to 7.4 percent over the eight year period between 1978 and 1986. Dr. Heath explained that his findings indicate that the Earth's ozone layer is already undergoing depletion, and at a rate far in excess of that which has been predicted.

I would like to learn more about the implications of this finding for NASA projections of the amount of stratospheric ozone depletion which we might expect in coming years. I request that NASA supply the Subcommittee with estimates of the amount of ozone depletion which can be expected by 1995, and by 2005, based on acceptance and extrapolation of Dr. Heath's findings. That is, if we presume that the Nimbus 7 satellite data as reported by Dr. Heath are accurately describing depletion of the Earth's stratospheric ozone, and if we assume that this depletion is attributable to the release of chlorofluorocarbons, what level of global ozone depletion would NASA predict based on current expectations for continued growth in global production of CFCs.

I understand that NASA is undertaking a review and evaluation of the Nimbus 7 data. In the first public disclosure of the satellite data indicating ozone depletion at a June 10, 1986 hearing of the Senate Subcommittee on Environmental Pollution, Dr. Robert Watson made the following statement:

> It is crucial to evaluate whether the data has been interpreted correctly, and if so, whether the (ozone) decrease is due to natural causes such as a decrease in solar radiation, the 1982 eruption of El-Chichon, or the 1982 El-Nino event, or whether it is due to human activities such as the use of chlorofluorocarbons.

As the Heath data indicates that depletion of the Earth's ozone layer is a more imminent and even greater threat than predicted, I very much agree with Dr. Watson's views on the importance of a careful review. I was, therefore, very disappointed to note that in Dr. Watson's testimony before my Subcommittee earlier this month, a full nine month's after the above message was conveyed to the Senate, he repeated this statement *verbatim*.

I am very concerned about the apparent lack of progress in reviewing this very important data. Please provide the Subcommittee with a detailed status report describing the progress of this review and any conclusions now available. Please provide copies of all written materials, including internal memoranda, and data analysis, relating to this review. Please supply the Subcommittee with information on the amount of time which lapsed between the formation of the review committee and the completion of data collection. Please indicate how much time lapsed after the June 10, 1986 Senate hearing before the review committee was formed. Please provide dates of all meetings of the review committee. Please explain why this review has not yet been completed. Please provide a complete schedule for the remaining steps to be taken and the expected date of completion of this effort.

I am disturbed that NASA apparently does not attach a high priority to this task. The Nimbus 7 data on ozone depletion are of crucial importance to our efforts to protect the Earth's stratospheric ozone layer from a large scale and potentially disasterous depletion. I cannot imagine a more important NASA responsibility than assuring that the best possible use is made of this data. Please provide your views on the importance of this effort, and describe the priority attached to this work by NASA.

As the Subcommittee will be actively working on this issue in the coming weeks, I ask that you provide your response no later than Friday, April 17, 1987.

With every good wish, I am,

Sincerely,

Henry A. Waxman

HENRY A. WAXMAN
Chairman, Subcommittee on
Health and the Environment

HAW/gwn

cc: Mr. Lee Thomas, Administrator
U.S. Environmental Protection Agency

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

DRAFT

Reply to Attn of: EEU

Honorable Henry A. Waxman
Chairman, Subcommittee on
Health and the Environment
House of Representatives
Washington, DC 20515

Dear Mr. Waxman:

This letter is in response to your letter to Dr. Fletcher of March 24, 1987, regarding ozone depletion. NASA attaches a high priority to fulfilling its responsibilities under the Clean Air Act to provide Congress and the Environmental Protection Agency with the best possible scientific assessment of the state of knowledge regarding stratospheric ozone depletion. We provide biennial assessments to the Congress in a timely manner, and will continue to do so. A major component of the report to be transmitted in January 1988 will be a reexamination of all trends data. In preparation, NASA assembled a panel of scientific experts to review the existing data. A copy of the November 5 letter which formed that panel is enclosed.

The major task facing the panel is that of ozone trends, especially the apparent trend of ozone depletion reported by Dr. Donald Heath of Goddard Space Flight Center (GSFC), based on his analysis of Nimbus-7 Solar Backscattered Ultraviolet (SBUV) data, which is the subject of your letter. Dr. Heath began reporting preliminary results of his analysis in the spring of 1986. At the end of May 1986, a special, informal meeting of scientists was held at GSFC to conduct a preliminary review of his approach in order to ascertain if it was scientifically valid, and likely to lead to conclusions that would be scientifically defensible. The analysis is especially difficult because it involves looking for a change in ozone on the order of 5 percent over a 5-8 year period, using data from an instrument that had only been designed to operate for 1-2 years, and thus had no provision for long-term calibration or drift correction. Maintaining the stability of an instrument in the laboratory to within 5 percent over such a long period is an exceedingly difficult undertaking. Doing it, ex post facto, for an instrument on a satellite is far more difficult. Nonetheless, it appeared, at the May review, that Dr. Heath's analysis had merit and was worth continuing. Because of the importance of ozone trend data and the knowledge of Dr. Heath's analysis by some members of the scientific community, Dr. Watson, in his Senate testimony in June, referred to the existence of the data and the need for a careful review of it when Dr. Heath's analysis was finalized. Between June and November, Dr. Heath continued his work, and, in fact, redid the analysis he had presented in May.

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A fundamental component of the scientific method is the publication of data in the scientific literature following peer review of the manuscript. It is not until a paper has been accepted by a journal for publication that the results are considered to be scientifically valid, and available to the scientific community. Dr. Heath was strongly encouraged by NASA Headquarters and his management at GSFC to submit a paper detailing his analysis at the earliest possible opportunity. His paper was submitted in January 1987. At the present time, Dr. Heath is revising his paper, which was not accepted by the journal's peer review process in the form in which he had submitted it.

The importance of Dr. Heath's data, and its apparent inconsistency with the trends reported by the ground-based Dobson network and the Solar Mesosphere Explorer (SME) satellite, led to the formation of the Trends Panel mentioned earlier. The invitation letter forming the Panel was sent last fall even before Dr. Heath's analysis had been finalized into a manuscript. A meeting of the Panel was held at GSFC on December 15-16, 1986. At that meeting, four working groups (WG) were formed to begin examination of ozone trend data: (1) a Calibration WG to examine the accuracy and precision of the instruments' calibrations both before launch and during the mission, and to assess what the uncertainty is in the calibrations; (2) an Algorithm WG to examine the algorithms used to convert the instrumental radiance data into ozone data, and the sensitivities of the algorithms to factors such as aerosols, clouds, etc.; (3) a Satellite/Satellite Intercomparison WG to examine the trends in ozone from the Nimbus-7 SBUV and Total Ozone Mapping Spectrometer (TOMS) instruments, the ozone instruments on the SME satellite, and the Stratosphere Aerosol Gas Experiment instruments; (4) a Satellite/Ground Intercomparison WG to compare satellite data with the Dobson and Umkehr networks, as well as examine the long-term calibration and stability of the ground-based instruments.

These individual working groups augmented their membership with additional people as required, and held separate meetings in the January-March 1987 timeframe. A second meeting of the overall Ozone Trends Panel was held on March 23-24, 1987, to review progress and to set up seven additional working groups on Source Gases, Statistical Approaches, Aerosols, Temperature, Other Stratospheric Trends, Comparison of Theory and Observations, and Antarctic Ozone. Further meetings of the four original groups and of the newly formed groups are scheduled for April and May, in preparation for a third overall Panel meeting in mid-June. We anticipate that at the mid-June meeting, the four original working groups will prepare an interim report, that could be made available to your committee. That report should be able to provide a critical assessment of the accuracy and uncertainty in ozone trend data. We expect the final report of the entire 11 working groups to be prepared in the fall. Enclosed with this letter is a more detailed schedule of the meetings through June.

Although one is always hesitant to prejudge the conclusions of expert committees, there are several factors that can be noted at present:

1. The trend quoted by Dr. Heath of 0.5-1.0 percent/year ozone loss is at the limit of accuracy/uncertainty of the satellite instrument.

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2. In the upper stratosphere, Dr. Heath's decrease in ozone disagrees with the reported increase from the SME satellite.

3. The worldwide Dobson network shows no statistically significant trend in ozone over the last two decades. The global average ozone measurement by the Dobson network for 1985 is within 1-2 percent of the value for 1960.

4. The Dobson network does show a decrease in ozone from 1979 to 1985, due in large part to the fact that ozone in 1979 (the starting year for the Nimbus-7 data) was unusually high. Because of the natural fluctuations in ozone, it will always be possible to find limited time periods over which ozone shows a trend.

5. The trend reported by Dr. Heath is nearly an order of magnitude larger than that predicted to have occurred due to increasing chlorofluorocarbons (CFC's). If the Heath trend is shown to be correct, it cannot be ascribed to CFC's within our current framework of stratospheric chemistry.

The last point is particularly relevant to the issue of modifying predictions of future ozone depletion based on current observations. NASA shares the assessment of the larger scientific community that the best predictor of future impacts of CFC's on ozone is to be obtained from theoretical models. The model predictions cited in Dr. Watson's testimony are from the NASA assessment report (NASA RP 1162) and the international report (WMO Report No. 16), and are, from 1-D models, in the range of 1.5 to 10 percent column depletion over the next 50-100 years, for CFC growth rates of 1-3 percent/year. The Heath data in particular cannot be extrapolated into the future: an extrapolation of that data into the past clearly leads to ozone values in error with those observed by the worldwide Dobson network. Given that discrepancy and the lack of a theoretical framework for interpreting the data in terms of a driving force, it would be scientifically indefensible to attempt to extrapolate the data. A memorandum from Dr. Heath on this point is enclosed. One of the objectives of the Trends Panel is to examine the comparison of theory with observation in order to determine the possibility of establishing a cause-and-effect link that would permit historical data to be used in a predictive mode.

In summary, NASA attaches a very high priority to understanding the data and issues associated with ozone depletion. I am sure that Dr. Watson would be happy to meet with you or your staff to provide further details or discussions regarding these important issues.

Sincerely,

John F. Murphy
Assistant Administrator
of Legislative Affairs

Enclosures

United States Department of State

Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs

Washington, D.C. 20520

April 20, 1987

MEMORANDUM

TO: Office of the Vice President - Ms. Linda Swacina
Agriculture - Dr. Orville Bentley
Commerce - Mr. Michael T. Kelley
Coucil of Economic Advisers - Mr. T. G. Moore
Council on Environmental Quality - Mr. Alan Hill
Defense - Mr. David Parbell
Domestic Policy Council - Dr. Ralph Bledsoe
Energy - Ms. Mary Walker
EPA - Mr. Bill Long
Interior - Ms. B. N. Dunlop
Justice - Mr. Thomas Hookano
NASA - Mr. Shelby Tilford
NOAA - Dr. Joseph Fletcher
Office of Policy Development - Mr. Jan Mares
Office of Science & Technology Policy - Mr. Richard Johnson
OMB - Mr. David Gibbons
Treasury - Mr. Stephen Entin
USTR - Ms. Marian Barell Nelson
E - Mr. Bailey
EB - Mr. Dennis Lamb
L/OES - Ms. Deborah Kennedy
L/EBC - Mr. Gerald Rosen

FROM: OES - John D. Negroponte

SUBJECT: Interagency Meeting on Position Paper for Ozone Negotiations

Attached for your agency's review is the draft position paper, based on our discussion Friday, for the April 27-30 round of the UNEP negotiations to control ozone-depleting chemicals. We will meet on Tuesday, April 21 at 4:30 p.m. in Room 7516. Please have all interested offices in your agency review the paper before then. All agencies need to be represented at the meeting by someone able to speak for the agency, since we should approve the position at this meeting.

cc: Agriculture - Norman Strommen
Commerce - Edwin Shykind
CEA - Stephen DeCanio
CEA - Coleman Nee
Defense - Donald L. Fox
DPC - Vicki Masterman
Energy - Ted Williams
Interior - Martin Smith
NASA - Robert Watson
NOAA - Dian Gaffen
OSTP - Beverly Berger
Treasury - C. Jabara
USTR - Robert Reintein
EB/OT/DCT - Ann Hollick/Alexandra Sundquist
EB/OIA - Sharon Villarosa

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