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### Economic Commission for Europe

Executive Body for the Convention on Long-range  
Transboundary Air Pollution

#### Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

##### Thirty-seventh session

Geneva, 9–11 September 2013

Item 6 (a) of the provisional agenda

**Progress in activities in 2013 and future work: measurements and  
modelling (acidification, eutrophication, photo-oxidants, heavy  
metals, particulate matter and persistent organic pollutants)**

### Measurements and modelling

#### Report of the fourteenth meeting of the Task Force on Measurements and Modelling

##### *Summary*

By its decision 1999/2, the Executive Body for the Convention on Long-range Transboundary Air Pollution requested the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) to provide it with sound scientific support, inter alia, in the area of atmospheric monitoring and modelling (ECE/EB.AIR/68, annex III, appendix III). In that connection, the EMEP Steering Body is tasked with providing the Executive Body and other subsidiary bodies annually with an overall analysis of transboundary air pollution (ibid., para. 4 (a)).

In line with that mandate, the present report presents the results of the fourteenth meeting of the Task Force on Measurements and Modelling, held from 6 to 8 May 2013 in Zagreb, Croatia, and in accordance with the 2012–2013 workplan for the implementation of the Convention (ECE/EB.AIR/109/Add.2, item 2.2).

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## I. Introduction

1. The present report presents the results of the fourteenth meeting of the Task Force on Measurements and Modelling, held from 6 to 8 May 2013 in Zagreb. It describes progress in the implementation of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) monitoring strategy (including Intensive Observation Periods), in ongoing modelling activities (including the EURODELTA3 model inter-comparison project)<sup>1</sup> and in the heavy metals pilot study.

2. Seventy experts from the following Parties to the Convention on Long-range Transboundary Air Pollution attended the Task Force meeting: Belarus, Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, Netherlands, Norway, Slovakia, Spain, Sweden, Switzerland, Ukraine and United Kingdom of Great Britain and Northern Ireland. Also present were representatives from the Chemical Coordinating Centre (CCC), the Meteorological Synthesizing Centre-East (MSC-E), the Meteorological Synthesizing Centre-West (MSC-W), the International Institute for Applied Systems Analysis (IIASA), the European Commission Joint Research Centre (JRC), the World Meteorological Organization (WMO) and the oil companies' European association for environment, health and safety in refining and distribution (CONCAWE).

3. Ms. L. Rouïl (France) and Ms. O. Tarasova (WMO) chaired the meeting, which was hosted by Meteorological and Hydrological Service of Croatia.

4. Ms. Sonja Vidič, Chair of the EMEP Steering Body, updated the Task Force on the amendments to the Protocol to Abate, Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol)<sup>2</sup> and on the amendments of the Protocol on Heavy Metals<sup>3</sup> adopted in May and December 2012, respectively. Amendments to the Gothenburg Protocol related to new national emission reduction commitments for 2020 and beyond (compared with the 2005 base year) for sulphur dioxide, nitrogen dioxide, volatile organic compounds, ammonia and, for the first time, fine particulate matter (PM<sub>2.5</sub>). The amendments also included new tasks and obligations for the Parties related to black carbon (BC): national emission inventories, atmospheric modelling, monitoring of adverse effects on health and environment, cost-benefit analysis, prioritization and evaluation of mitigation measures. The revisions further introduced flexibilities to encourage accession by the countries of Eastern Europe, the Caucasus and Central Asia (article 3 bis on flexible transitional arrangements and annex VII on timescales under article 3). Amendments to the Protocol on Heavy Metals set, in particular, more stringent emission limit values for particular matter (PM), lead, cadmium and mercury and introduced flexibilities to enable accession of the countries of Eastern Europe, the Caucasus and Central Asia. Ms. Vidič also updated the Task Force on the ongoing review of the Convention.

5. Finally, as an introduction, Ms. Rouïl gave a short presentation outlining the agreed workplan for 2013 for the implementation of the Convention with regard to the ongoing revision of the Convention's protocols.

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<sup>1</sup> See <http://www.psi.ch/lac/eurodelta3>.

<sup>2</sup> Available from [http://www.unece.org/env/lrtap/multi\\_h1.html](http://www.unece.org/env/lrtap/multi_h1.html).

<sup>3</sup> Available from [http://www.unece.org/env/lrtap/hm\\_h1.html](http://www.unece.org/env/lrtap/hm_h1.html).

## II. Implementation of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) monitoring strategy

### A. Progress in the implementation of the EMEP monitoring strategy

6. A representative of CCC gave a presentation on the status of the implementation of the EMEP monitoring strategy<sup>4</sup> in the Parties. He proposed an integrated indicator to assess progress in compliance with the objectives of the monitoring strategy in terms of the number of sites, the number of measured variables reported and the number of variables having the adequate time resolution. The targeted variables related to major inorganics in precipitation, major inorganics in air, ozone, PM mass and heavy metals in precipitation. The analysis had been based on data submissions and aimed at comparing data actually reported to those expected according to the monitoring strategy. An “implementation index” had been processed for level 1 sites and a first attempt for level 2 sites was presented. The Task Force welcomed that initiative, which showed that implementation of level 1 monitoring networks was still an issue in several countries. The implementation index would be presented at the thirty-seventh session of the EMEP Steering Body in September 2013 to increase awareness on gaps to be filled in to comply with level 1 site requirements and strengthen level 2 site activities.

### B. EMEP Intensive Observation Periods

7. A representative of CCC presented the status of the Intensive Observation Periods (IOPs) activities within the implementation of the EMEP monitoring strategy. They participated to the development of level 2 monitoring networks and enhanced cooperation and involvement of research groups with more advanced research activities (i.e., level 3). Based on the earlier intensive periods, one reference paper had been published.<sup>5</sup> The IOPs in 2012 and 2013 focused on high-resolved and extended measurements of aerosols and precursors, with special focus on mineral dust and vertical profiles. Thirty-one sites had been instrumented for a wide and relevant panel of measured parameters, including PM speciation, volatile organic compounds, elemental and organic carbon and others. A full year (June 2012–June 2013) of data characterizing chemical composition of PM<sub>2.5</sub> issued from Aerosol Chemical Speciation Monitor (ACMS) measurements would be available, thanks to a fruitful collaboration with network of the Aerosols, Clouds, and Trace gases Research InfraStructure (ACTRIS) project. Links with other research projects (CHARMEX<sup>6</sup> throughout the Mediterranean area, PEGASOS<sup>7</sup> over the Po Valley) had been established.

8. An expert from Switzerland gave a presentation about first results provided by the Aerosol Mass Spectrometer (AMS) and ACMS networks implemented within the ACTRIS project since June 2012. More than 15 stations had been run simultaneously to provide continuous half-hourly measurements of PM<sub>10</sub>, sulphate, nitrate, ammonium, chloride and organics. Those data were used in source apportionment models (e.g., Positive Matrix

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<sup>4</sup> Revised strategy available from <http://www.unece.org/env/lrtap/emep/strategies.html>.

<sup>5</sup> *Lessons learnt from the first EMEP intensive measurement periods* by W. Aas et al., Atmospheric Chemistry and Physics, 12, pp 8073-8094, 2012.

<sup>6</sup> See <http://gsite.univ-provence.fr/gsite/document.php?pagendx=9566&project=lcp-ira>.

<sup>7</sup> See <http://pegasos.iceht.forth.gr/>.

Factorization approach) to assess relative contributions of road and non-road traffic, biomass burning, secondary process, etc., in PM<sub>2.5</sub> composition.

9. An expert from the JRC gave a presentation on the determination of carbonate carbon (CC) in particulate matter. CC related to primary carbonaceous species present in natural ground and building/demolition dust. Its concentration was generally significant in Southern European countries. There was no robust technique to determinate CC in PM, and within the ACTRIS initiative the suitability of various techniques had been assessed. Results were presented as a contribution to the EMEP monitoring strategy.

10. An expert from Italy presented a selection of results issued from the ACTRIS-European Aerosol Research Lidar Network (EARLINET)<sup>8</sup> network. EARLINET had been coordinating 27 stations in Europe since 2000. It provided relevant information about particle layers and their temporal evolution. Vertical profiles of aerosol optical properties were available. The network had performed measurements and their analysis for the whole 2012 summer EMEP IOP.

11. An expert from Spain presented preliminary results of mineral dust measurements in PM<sub>10</sub> obtained during the summer 2012 IOP. Fourteen sites had been instrumented with low-volume samplers to determine concentrations of major elements (sodium, silicon, aluminium, magnesium, phosphorous, calcium and potassium) and trace elements. Currently, spatial variation of major elements and their ratio were being investigated to help in determining the origin of PM episodes. In-depth analysis of African dust events had been presented. It had also been demonstrated how metals could be used as tracers of anthropogenic activities.

12. An expert from France gave a presentation on the French contribution to the EMEP IOPs in 2012 and 2013 with five sites instrumented over the periods. Preliminary results on chemical composition measurements and source allocation were discussed.

13. An expert from the United Kingdom of Great Britain and Northern Ireland gave a presentation on the country's contribution to the EMEP IOPs in 2012 and 2013 from two EMEP supersites that had been equipped with new instruments over the IOPs. Hence, daily mineral dust, elemental carbon and organic carbon concentrations were available for further investigation.

14. During the discussion, experts acknowledged that the EMEP IOP allowed gathering a large number of data, with stringent quality assurance/quality control rules for comparability, which would significantly improve scientific understanding of PM pollution. It was an unprecedented effort, even if a lot remained to be done to analyse and investigate the results. Some Parties requested that the data be released to national experts as soon as possible to speed up feedback and analysis. Links with the modelling community should be made stronger in that phase. Considering the wealth of the information currently available, it was agreed during the meeting that there was no need to plan new IOPs until 2015. The question would be further considered during the next Task Force and EMEP Steering Body meetings, when more investigation on available observation would be performed by the EMEP Centres and the national experts.

### III. The heavy metal case study

15. A representative of MSC-E presented the rationale and the progress in the heavy metal test-case studies launched in 2010 for an in-depth investigation of the inconsistencies

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<sup>8</sup> See <http://www.earlinet.org/>.

between heavy metal emissions, measurement and modelling in several European countries. Currently, three countries (Croatia, the Czech Republic and the Netherlands) were participating in the study. Countries had been requested to provide a number of input parameters, as well as heavy metal and supporting observations. The work completed for Croatia included the impact of high resolution emission data and better meteorology on deposition; the contribution of foreign countries to Croatian air pollution patterns had also been highlighted. Similar results had been achieved for the Czech Republic as well.

16. A representative of the Czech Republic gave a presentation on the main lessons learned from the test-case project. It had focused on cadmium, and had demonstrated the relevance of access to high resolution emission inventories. The influence of local sources was assessed, as was the contribution, potentially high, of foreign sources. The project had helped in improving the national air quality management strategy, and there was interest in undertaking a follow-up study focused on mercury.

17. A representative of the Netherlands, presented fine (5 square kilometres (km<sup>2</sup>) x 5 km<sup>2</sup>) resolution versus coarse (50 km<sup>2</sup>x 50 km<sup>2</sup>) resolution model results of lead ambient concentrations and deposition, established with a high resolution emission inventory (5 km<sup>2</sup> x 5 km<sup>2</sup>). The study showed that the use of a 5 km<sup>2</sup>x 5 km<sup>2</sup> grid gave rather good agreement with observations, although some peak values not caught by measurements had been noted.

18. The representative of MSC-E gave a presentation on in-depth investigations conducted by the Centre to explain model overestimation of lead deposition raised by the Netherlands. It led to a correction of the parameterization of wind re-suspension processes to better account for soil properties.

19. The Task Force acknowledged good progress in the heavy metals test-case study and asked MSC-E to promote the initiative and its results through the publication of a booklet synthesizing the main insights and results. Such results should be presented during the EMEP Steering Body session in September 2013. A follow-up study with new pollutants (e.g., mercury in the Czech Republic) and new countries were highly encouraged. Some work could be initiated with experts from Belarus.

## **IV. Modelling issues**

### **A. Progress in EMEP models**

20. Representatives of both MSC-W and MSC-E gave presentations on products and development of the EMEP models in support to the revision and the implementation of the Convention Protocols.

21. The representative of MSC-W reported on a training organized in spring 2013 for national experts. He presented a panel of simulations results prepared for the revision of the Gothenburg Protocol, all available on the EMEP/MSW website. Finally, the Task Force was given some results regarding trends over the past 10 years for ozone concentrations, sulphate and nitrogen concentrations and deposition, and PM<sub>10</sub> and PM<sub>2.5</sub> concentrations. That analysis raised a number of questions about the interpretation of such results that should be further investigated.

22. The representative of MSC-E reported on the modelling activity of the Centre in support of the implementation of the Protocols and Heavy Metals and Persistent Organic Pollutants. He presented some trends over the past 20 years for those pollutants and an evaluation of the main influencing sources (including long-range transport). An extensive assessment of the quality of the EMEP model results for heavy metals and persistent organic pollutants (POPs) was given as well. The detailed content of country-specific

reports were available on the EMEP/MSC-E website along with information on joint activities with other international initiatives (e.g., the Arctic Monitoring and Assessment Programme, the United Nations Environment Programme, the Stockholm Convention on POPs and other marine conventions).

23. A representative of MSC-W gave a presentation on recent EMEP model developments and evaluation with respect to PM issues. They were based on extensive use of results from the EMEP Intensive observation periods. Such analysis allowed significant improvements of the model to describe properly secondary inorganic aerosol formation, dust contribution, base cation deposition, and more accurate simulation of aerosol radiative forcing. Significant improvements to simulate the influence of Saharan dust events were presented as examples.

24. A representative of MSC-E gave a presentation on recent EMEP model developments with respect to heavy metals and POPs. Measurements from field campaigns were used by MSC-E to improve modelling of mercury atmospheric processes. Refinement of the parameterization of POPs processes (sorption on aerosols and degradation on aerosol surface) and contribution of re-volatilization and re-suspension processes were presented as well. New investigations and promising results on inverse modelling for analysis of heavy metals and POPs emission uncertainties were proposed.

## **B. EURODELTA and model inter-comparison initiatives**

25. A representative of France presented the results of the EURODELTA3 modelling project. Seven modelling teams in Europe had participated in the first phase, which had focused on the evaluation of models' parameterizations, assessing their performances against data from the EMEP field campaigns. The added value of EURODELTA3 was linked to the fact that model results were obtained with rigorously similar input data. Therefore, the models results could be compared to evaluate their internal parameterizations, considering a set of relevant indicators measured during the EMEP IOPs. Insights for further improvements of European chemistry-transport models responses were discussed and the rather good behaviour of the EMEP model, whatever the variable considered, was welcomed. The next step would be to undertake a retrospective analysis (policy issue) to assess the capacity of current models to reproduce monitored changes in air quality thanks to a retro-analysis 2008–1999–1990.

26. A representative of JRC presented the main conclusions of the “model downscaling” study that had been launched during the thirteenth Task Force meeting in 2012. The objective had been to assess the “optimal” spatial model resolution to deal with policy objectives. High resolution simulations required high resolved input data (for emissions and meteorology), which were costly to obtain. High resolution runs also had a significant cost in terms of computing power. Five voluntary modelling teams had performed simulations over the whole of 2009 with horizontal resolution  $1.0^\circ \times 0.5^\circ$ ,  $0.5^\circ \times 0.25^\circ$ ,  $0.25^\circ \times 0.125^\circ$  and  $0.125^\circ \times 0.0625^\circ$  and the same input data. The exercise had been coordinated by a Dutch expert and the Task Force Chair. Preliminary results had been presented at the thirty-sixth session of the EMEP Steering Body in September 2012. The final report and extensive results were presented at the Task Force meeting. They showed limited impact of improved spatial resolution for simulating rural air quality and significant added value for simulating urban patterns. That effect varied with the nature of pollutants. All results and data were available on request and would be published in an EMEP report.

27. An expert from the Netherlands gave a presentation on a study performed with the regional chemical transport LOTOS-EUROS model<sup>9</sup> to assess the scale dependency of source/receptor matrices run for 2020 scenarios. The study had demonstrated the sensitivity of the model results to the spatial scale for the smallest countries.

28. The representative of the United Kingdom gave a presentation on results obtained from a United Kingdom inter-comparison modelling exercise focused on ozone. Eight models had participated and their results had been carefully analysed against observations at the Harwell measurement site. It had been shown that a wide range of model responses could still occur. Hence, it had demonstrated the relevance of multi-model expertise for policy support.

29. The co-Chairs of the Task Force on Hemispheric Transport of Air Pollution gave a presentation on the revised mandate that the Executive Body had given it in 2010. The new mandate focused on the improvement of scientific understanding of the long-range transport of air pollutants across the Northern Hemisphere and the assessment of potential mitigation options inside and outside the ECE domain. A workplan to derive source-receptor analyses at the global scale for various scenarios had been proposed. Collaboration with the Task Force on Measurements and Modelling could be enhanced for the European domain and could provide input data (emissions for instance). In particular, the Task Force on Measurements and Modelling could help in processing and analysis of European-wide results. Conversely, it could be interesting if the Task Force on Measurements and Modelling could have the opportunity to use boundary conditions from the Task Force on Hemispheric Transport of Air Pollution for its own assessments. Links with EURODELAT3 could be established. Finally, regional modellers from the Task Force on Measurements and Modelling were invited to participate in the new Task Force on Hemispheric Transport of Air Pollution project if they were interested in assessing their models outside the European domain.

## V. Emission inventories issues

30. The Task Force and the technical centres regularly reported on the strong dependency that existed between air quality monitoring and assessment tools (measurements and modelling) and emission inventories. Some discrepancies that held when comparing observations and modelled data could still be explained by inaccuracies in emission inventories. In May 2013, the Task Force on Emission Inventories and Projections had organized a workshop to further discuss such issues. Representatives from the Task Force on Measurements and Modelling, MSC-W and MSC-E had attended that meeting and had posed a number of questions and presented requests agreed during the fourteenth Task Force meeting, in particular with regard to:

(a) *The most sensitive parameters in emissions to improve model results:* there was a need for gridded emissions with appropriate spatial resolution, more information on non-inventoried emissions (biogenic emissions, forest fires, re-suspension, road and agricultural dusts), completeness over the ECE domain and high temporal resolution;

(b) *Gaps in activities that needed to be quickly filled in:* the chemical composition of PM, polycyclic aromatic hydrocarbons, volatile organic compounds, dioxins, mercury by sectors, semi-volatile compounds that drove secondary aerosol formation, methodologies to calculate non-inventoried emissions, historical sets of emissions and information related to emissions in other media;

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<sup>9</sup> See <http://www.lotos-euros.nl/>.

(c) *The need for more consistency between global, regional, national and local emission inventories:* in particular, to assess consistency between officially reported data from various countries and to develop relationships with teams that developed scientific-oriented inventories likely to be more fitted to modelling requests;

(d) *Potential requirements from the emission community expressed to the measurement and modelling communities:* participation in the evaluation of emission inventories and inverse modelling.

31. As an illustration of such questions, a representative from Finland gave a presentation on the use of online instrumentation for PM measurements to derive emission factors for various emissions sources (road traffic and industrial power plants especially).

## VI. Collaboration with national experts

32. Several national experts gave presentations on how the EMEP monitoring and modelling strategies are implemented in their countries.

(a) An expert from the United Kingdom gave a talk on chemical climatologies from historical data sets available at two supersites (Harwell and Auchencorth);

(b) An expert from Germany presented the possible chemical characterization of PM<sub>10</sub> by individual electro-microscopic particle analysis. Data from four background monitoring stations in Germany were investigated;

(c) An expert from Sweden gave an overview of wet deposition trends in Sweden since 1955;

(d) An expert from Italy evaluated various methodological approaches to assess monitoring station representativeness;

(e) An expert from the United Kingdom presented trends analyses over the 1999–2012 period for eutrophying and acidifying atmospheric pollutants measured in the United Kingdom;

(f) An expert from France analysed historical sets of volatile organic compound measurements that had been performed in France for more than 10 years.

## VII. Other issues

33. Considering the wealth of data available in the Parties, the huge amount of work undertaken by national experts and the EMEP Centres to analyse those data and promote their use for policy support, and the need to provide the EMEP Steering Body with an objective assessment of the impact of the Protocols to the Convention, the Task Force agreed at the meeting that it would be worthwhile to investigate trends analysis of air pollution indicators. It was decided that the following methodological questions should be covered:

(a) Were observed and modelled trends of the air pollutants in agreement with trends in emissions?;

(b) What were the measured trends of air quality in Europe? Was a “classification” of European regions possible according to those trends?;

(c) Was it possible to establish modelled trends and maps of trends?

34. Specifications to define the project on trend analyses would be proposed by the Task Force and presented at the EMEP Steering Body meeting in September 2013. Several

national experts, MSC-W, MSC-E and the CCC had already expressed their interest in participating in the project and integrating it into the Task Force's workplan for the following years.

## VIII. Future work

35. Following discussion on the activities to be reflected in the 2013 workplan of the EMEP Steering Body, the Task Force agreed to propose the following work items for the remaining part of 2013 and for 2014:

(a) To build up the appropriate framework and support for the implementation of the updated EMEP monitoring strategy, by undertaking the following actions:

(i) Assessing monitoring networks implemented in the Parties thanks to the implementation index proposed by CCC for level 1 sites (task for: CCC/Parties);

(ii) Providing recommendations for the development of similar approaches suited to the level 2 network (CCC);

(iii) Developing cooperation with the atmospheric composition research community and the existing operational monitoring networks, especially for short-lived climate forcers monitoring (e.g., the Global Atmosphere Watch)<sup>10</sup> and the ACTRIS infrastructure.

(b) To contribute to the analysis, interpretation (in terms of policy support) and promotion of the results and observation data obtained from the EMEP IOPs (CCC/Task Force);

(c) To provide guidance and assistance for the implementation of new case studies on heavy metal pollution assessment, aimed at bringing together the know-how for policy support from emission, measurement and modelling communities, and to assess and analyse the results and overall success of the exercise (MSC-E/Task Force);

(d) To publish and promote the results of the first phase of the EURODELTA3 modelling exercise (model evaluation) and to organize and coordinate its follow-up focused on model ability to reproduce past trends in air pollutant concentrations (Task Force/Parties/MSW);

(e) To organize and coordinate a systematic trend analysis of air pollutants indicators over the past 20 years, based on monitoring observation data, modelling results and national expertise (Task Force/Parties/MSW/MSW-E/CCC);

(f) To improve cooperation with the Task Force on Hemispheric Transport of Air Pollution, contributing as far as possible to the interpretation of the results obtained in the modelling exercise over the European domain and eventually providing regional model runs (Task Force, Parties);

(g) To improve cooperation with the Task Force on Emission Inventories and Projections, especially on topics and questions highlighted during the fourteenth meeting of the Task Force and summarized in the present report;

(h) To improve cooperation with the Working Group on Effects, through exchange of results and data dedicated to transboundary air pollution impact assessment. Common work should be organized for the edition of the 10-year assessment report (Task Force);

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<sup>10</sup> [http://www.wmo.int/pages/prog/arep/gaw/gaw\\_home\\_en.html](http://www.wmo.int/pages/prog/arep/gaw/gaw_home_en.html).

- (i) To report on progress at the thirty-eighth session of the EMEP Steering Body (Task Force/MSC-W/CCC/Parties);
  - (j) To consider options and opportunities for enhancing the visibility and promotion of the work of the Task Force, e.g., by means of newsletters or conferences (Task Force/Parties/Centres);
  - (k) To hold its fifteenth meeting in Bologna, Italy, from 7 to 10 April 2014, and to report on its outcomes to the EMEP Steering Body at its thirty-eighth session in 2014 (Task Force).
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