

MONITORING OF ENVIRONMENTAL POLLUTION AS A RESULT OF THE ACTIVITY OF REARING AND PRODUCTION OF SWINE

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Abstract

The Danish company Premium Porc Group is the second largest producer of pork on the local market, the production activity being carried out in the 12 pig farms in Vrancea, Brăila, Constanta, Olt, Sibiu, and Brasov and since 2013 also within the Negreni farm in Olt County. The two lagoons for the storage and biological treatment of the liquid dejections have the bottoms and the soles waterproofed with geotextile membrane, and, to prevent the distribution of odours in the village, the dejections stored in these two ponds are permanently covered with a waterproof membrane. The solid dejections storage platform is located at a distance of 35 m from the two liquid dejections storage lagoons. To highlight how the activity of rearing and production of swine within Premium Porc Negreni Company from Olt County affects the quality of environmental factors, samples of air, rain water and groundwater were collected during 2018-2020 and subjected to analysis. The following quality indicators were analysed and monitored: NH₃ and H₂S emission (long-lasting 24 h and short-term 30-minute averages), pollutant emissions from combustion gases from the natural gas thermal power plant (particulate, CO, NO₂ and SO₂) and the noise in the air; pH, total suspended particulates (TSM) and total petroleum hydrocarbons (THP) from meteoric/pluvial water discharged into the Negrișoara stream; pH, nitrites and nitrates species in groundwater.

Key words: air, rearing, swine, waste, water.

INTRODUCTION

The Danish company Premium Porc Group is the second largest producer of pork on the local market, with an annual production of 400,000 heads in Romania, in the 12 pig farms in Vrancea, Brăila, Constanta, Olt, Sibiu and Brașov counties. Premium Porc Group has been operating in Romania since 2006, when pig production began with the acquisition of The Suintest farm in Golești commune, Vrancea County. In 2011, Premium Porc Group acquired the Fantanele and Sibioara farms in Constanta County, and in 2013 took over the Negreni farm in Olt County (Șchiopu, 2020). The Danish Premium Porc Negreni swine farm in Olt County is structured in the following areas (Figure 1):

- the pig-rearing area, where the 12 shelter halls and related feeding and watering facilities are located (Figure 2);

- solid dejections storage area;
- liquid dejections storage and treatment area (made up of two waterproofed lagoons) (Figure 3);
- administrative area consisting of office buildings.

In order to characterize the evolution of milk production, the following indicators were used: number of cattle stocks, of which dairy cows and heifers, milk yield and milk production, milk consumption per inhabitant, number of dairy farms and cow density per ha.

The period analysed in this study was 1990-2010.

The data, collected from Ministry of Agriculture and Rural Development, have been statistically processed and interpreted, building the trend line and setting up the forecast based on simulation models for the period 2012-2015.



Figure 1. Areas related to the swine farm Premium Porc Negreni Company (production halls, solid dejections storage platform, liquid dejections storage lagoons, conservation lagoon/pond)



Figure 2. Location of the 12 pig rearing halls owned by SC Premium Porc Negreni Company (field image and satellite image taken with the help of Google Earth) and the interior of the intensive production and pig farming hall



Figure 3. Solid dejections storage platform and waterproof lagoon for liquid dejections storage

The technological flow related to the swine rearing and production within SC Premium Porc Negreni COMPANY is, as follows (Authorization integrity environmental, 2018):

- preparation of the halls for population: the cleaning and sanitization of the halls is carried out according to the production cycles (after the depopulation of the halls and before a new population); in the first stage, the liquid fraction flow systems are unlocked, producing a vacuum which ensures a rapid and efficient emptying of

this fraction from the waste collection basins; removal of solid dejections from collecting basins, placed under the grates of the halls, cleaning of the floor, feeders and channels for the dejections discharge (using pressure water); sanitization of all hall compartments (with biodegradable disinfection solutions); the resulting waste water is routed and pumped into the two biological degradation basins;

- supply, storage and distribution of food: prepared feeding stuffs are purchased for use

- directly for the pigs feeding, transported by special trucks equipped with pneumatic loading system; storing the feed in the bunkers adjacent to the halls (three for the C5 and C6 breeding halls and two for the other 10 fattening halls C1 - C4, C7 - C12);
- supply of weaned piglets (weighing 7 to 9 kg);
 - pig rearing: in special purpose halls C5 and C6, by ensuring a lifestyle regime specific to this weight group;
 - pig fattening: transfer piglets from the breeding halls, in series, to the 10 fattening halls, where they are housed until the optimum weight for delivery is reached;
 - delivery of fattened pigs: by car to various beneficiaries, for slaughtering;
 - carcase storage: collected and transferred daily to a refrigeration room; the services of an authorised operator are used;
 - discharge of liquid and solid dejections with a frequency that depends on the weight of the animals: at 30 days (category 7-30 kg), at 20 days (category 25-50 kg) and at 100 days (weight greater than 50 kg);
 - separation and temporal storage of dejections: collection of the mixture of liquid and solid dejections (in a concrete pool covered with geomembrane); separation of the two fractions; elimination of the solid fractions (on a concrete platform for temporary storage), the discharge of liquid fractions (by means of a concrete basin covered with geomembrane, to a two-compartment basin for filling and emptying the two lagoons covered with concrete plate); temporary storage of the liquid fraction (in two waterproofed lagoons and covered with geomembrane);
 - waste valorisation: the two fractions resulting from the mechanical separation of the mixture of dejections and technologically waste water are periodically removed with specialized machinery for administration on agricultural land.

MATERIALS AND METHODS

The two lagoons for storage and biological treatment of the liquid dejections are located on the hill on the western part of the 12 pig-rearing halls. They have the bottom and soles

waterproofed with geotextile membrane, and to prevent the distribution of odours in the village, the dejections stored in these two ponds are permanently covered with a waterproof membrane.

The solid dejections storage platform is located at a distance of 35 m from the two liquid dejections storage lagoons.

In order to highlight the way in which the activity of swine breeding and production within SC Premium Porc Negreni COMPANY in Olt County affects the quality of the environmental factors, in October 2020, field visits were made to identify the possible unpleasant smells.

In addition, in order to determine whether the rearing and production activity of swine contributes to environmental pollution in 2018-2019 were collected air, rainwater and groundwater samples and were subjected to analysis (Popa & Pecingină, 2008)

For air were investigated:

- ammonia NH_3 and hydrogen sulphide H_2S emissions (long-lasting 24 h and 30-minute short-term averages) by means of UV-VIS spectrometry;
- pollutant emissions from the combustion gases of the natural gas thermal power plant (particulate - by gravimetric method, carbon monoxide CO , nitrogen dioxide NO_2 and sulphur dioxide SO_2 - by automatic method with the help of the analyser equipped with specific sensors MULTILYZER NG);
- noise level - with the sonometer.

For meteoric/pluvial water discharged into the Negrișoara stream were monitored:

- pH using automatic pH-meter, total suspended particulates (TSM) by gravimetric method and total oil hydrocarbons (THP) by chromatographic method.

For groundwater were monitored:

- pH using automatic pH-meter, nitrites and nitrates by UV-VIS spectrometry.

RESULTS AND DISCUSSIONS

In the areas related to Premium Porc Negreni Company in Olt County, no unpleasant odour has been reported, so the quality of the environment and life in that area is not affected due to this organoleptic indicator, taking into account the following:

- the lagoon pond is in a state of conservation (Figure 4);
- the Negrișoara stream is dried up and the riverbed is polluted with waste from anthropogenic activities, especially PETs (Figure 5);
- the human settlements in the area are protected by forest curtains consisting of acacia, ulmus and willow.



Figure 4. Conservation-based lake and armoured pipe through which animals' dejections were transported in the past



Figure 5. Negrișoara creek polluted by waste from human activity, and forest curtain surrounding a property

The monitoring of air quality indicated the following aspects:

- ammonia NH_3 (long-lasting 24 h) (Figure 6) and 30-minute short-term averages (Figure 7) and hydrogen sulphide H_2S (long-lasting 24 h (Figure 8) and 30-minute short-term averages (Figure 9) did not exceed the maximum permitted limits according to STAS 12574/1987;
- pollutant emissions from combustion gases from the natural gas thermal power plant: particulate (Figure 10), carbon monoxide CO (Figure 11), nitrogen dioxide NO_2 (Figure 12) and sulphur dioxide SO_2 (Figure 13) did not exceed the maximum limits set by Order 462/1993);
- the equivalent noise level recorded at the limit of the functional unit of Premium Porc

Company does not exceed the limit of 65 dB (SR 10009/2017) (Figure 14);

Regarding the *analysis and monitoring of the quality of rainwater* discharged into the Negrișoara stream, the following have been concluded:

- the pollutants in the meteoric/pluvial water discharged into the Negrișoara stream (total suspended materials and total THP oil hydrocarbons), do not exceed the maximum permitted limits of NTPA 001/2005 - Normative setting limits for the loading of industrial and urban waste water with discharge into natural receptors (Figure 15, Figure 16 and Figure 17).

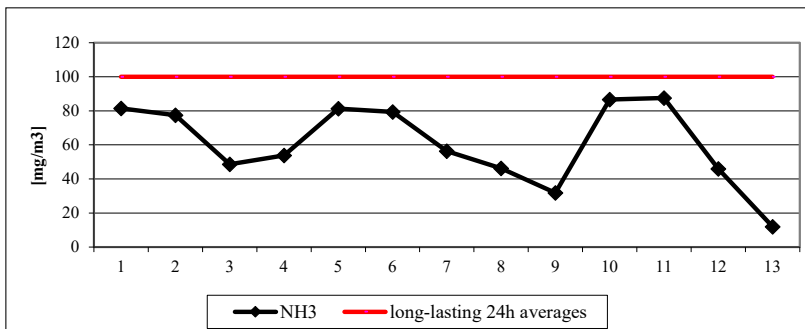


Figure 6. Variation in the concentration of NH₃ emission (long-lasting 24 h averages)

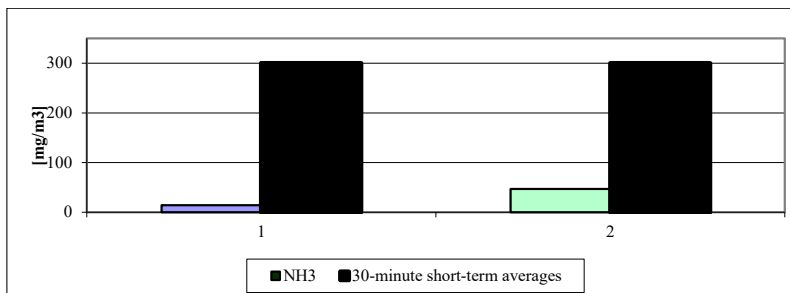


Figure 7. Variation in the concentration of NH₃ emission (30-minute short-term averages)

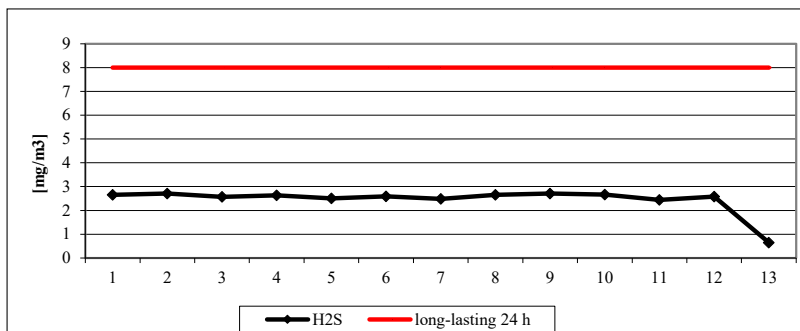


Figure 8. Variation in H₂S emission concentration (long-lasting 24 h averages)

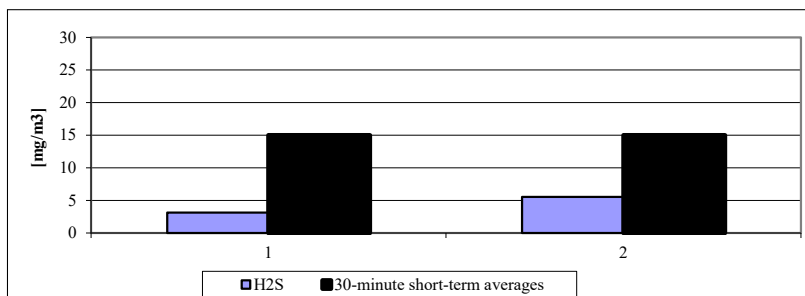


Figure 9. Variation in H₂S emission concentration (30-minute short-term averages)

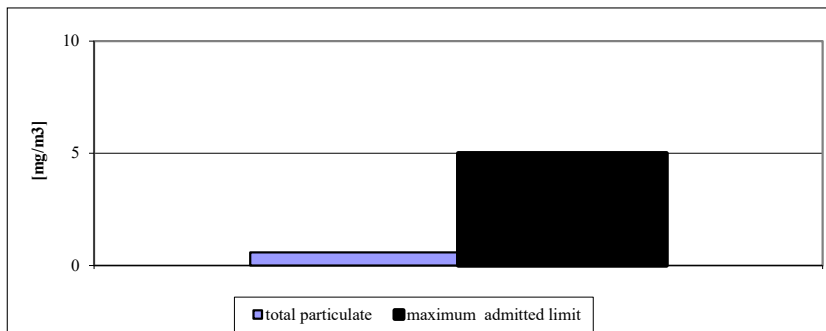


Figure 10. Variation in the concentration of total particulate from the combustion gases discharged by the power plant exhaust chimney

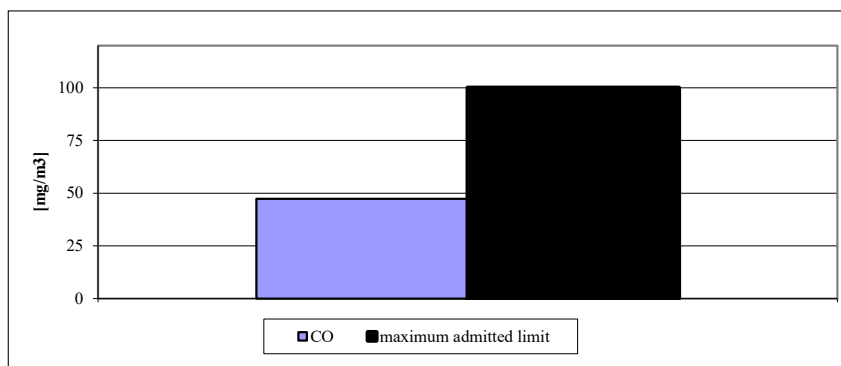


Figure 11. Variation in the concentration of carbon monoxide (CO) from the combustion gases discharged by the power plant exhaust chimney

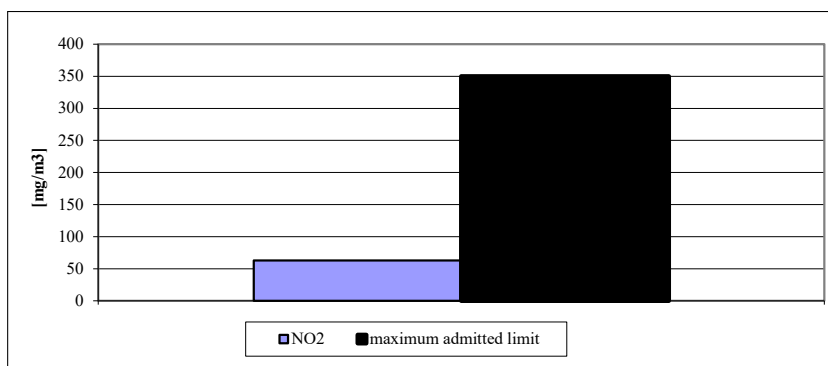


Figure 12. Variation in the concentration of nitrogen dioxide (NO₂) in the combustion gases discharged by the power plant exhaust chimney

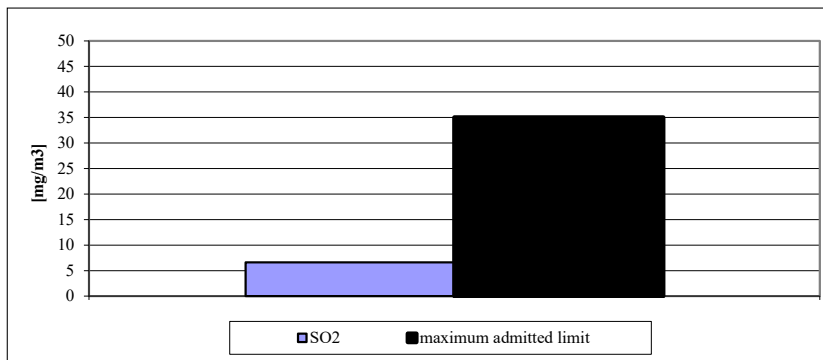


Figure 13. Variation in the concentration of sulphur dioxide (SO₂) in the combustion gases discharged by the power plant exhaust chimney

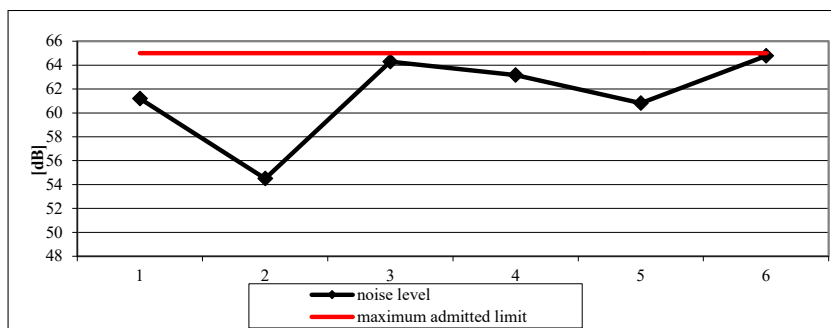


Figure 14. Noise level recorded at the boundaries of the functional unit of Premium Porc Company

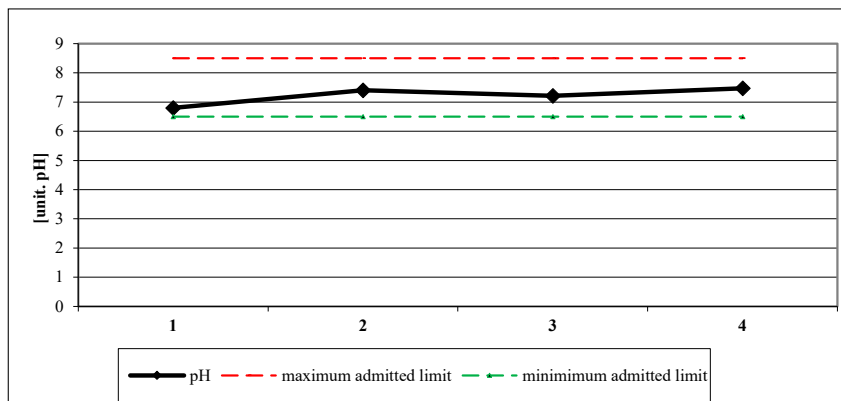


Figure 15. pH changes in meteoric/pluvial water

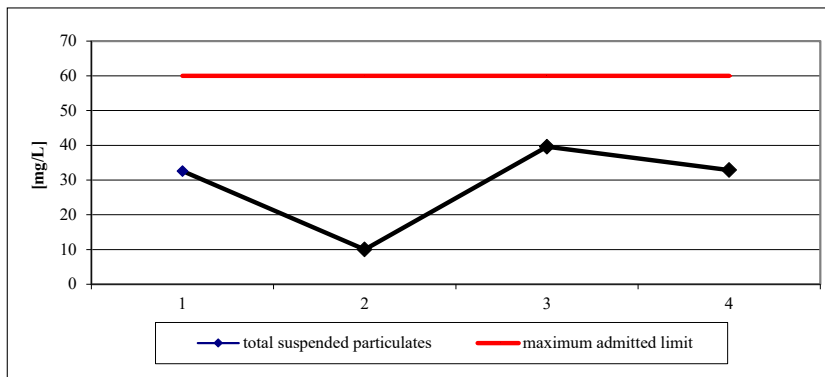


Figure 16. Total suspended particulates changes in meteoric/pluvial

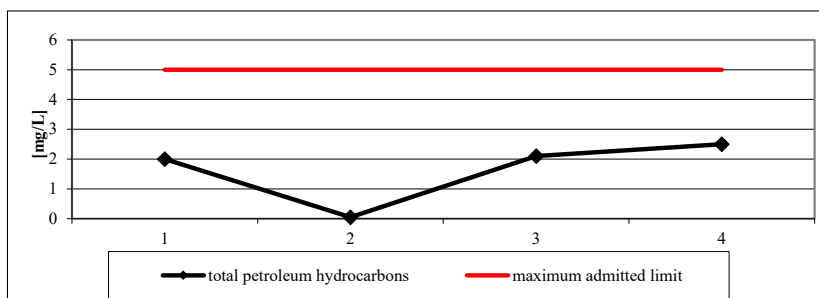


Figure 17. Variation of total petroleum hydrocarbons (THP) in meteoric/pluvial water

Analysis of groundwater indicated that pH and nitrogen pollutant species (nitrite, nitrate) levels do not exceed limits imposed by legislations (Law

458/2002), (Figures 18-20). F1-F6 represents the forages made in six groundwater collecting points.

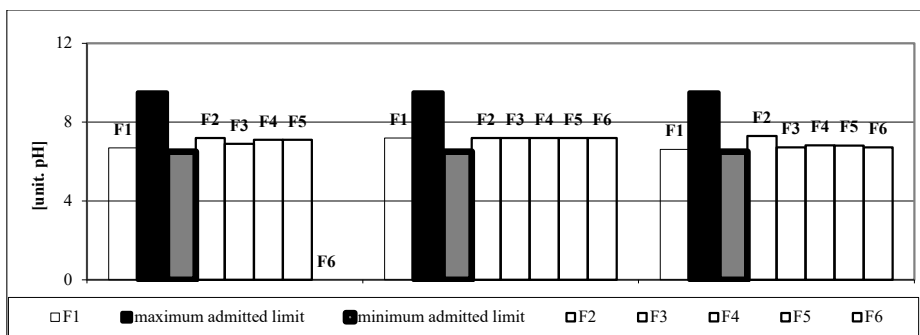


Figure 18. pH variation in groundwater

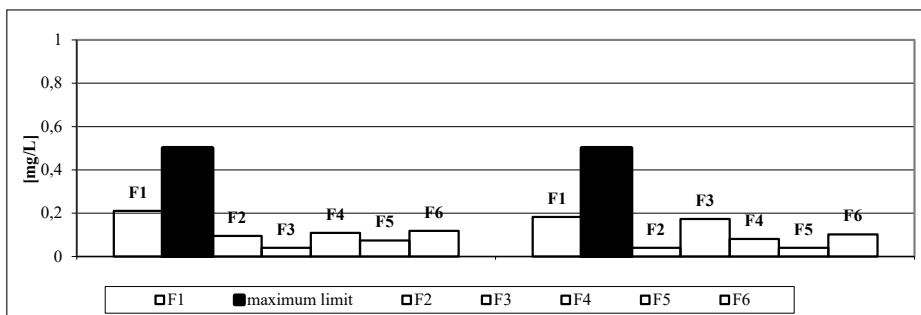


Figure 19. Nitrite - NO₂⁻ variation in groundwater

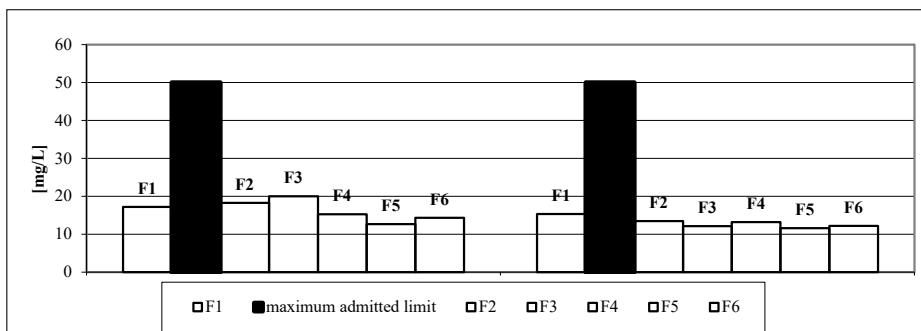


Figure 20. Nitrate - NO₃⁻ variation in groundwater

CONCLUSIONS

According to the monitoring and analyses performed in order to evaluate the pollution level generated by activity of swine farming and production, the following conclusions could be drawn:

- investigated quality indicators and pollutants levels did not exceeded maximum admitted levels according to legislation
- the lack of pollution is due to the application of the best available techniques for the prevention of environmental pollution in the zootechnical field, called Best Available Techniques in the national and European legislation
- leaks, emissions are formed, to contribute at the pollution of the environmental factors.

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