Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry Point Source Category (40 CFR 432)

EPA-821-B-01-007

January 2002

U.S. Environmental Protection Agency
Office of Water (4303T)
Washington, DC 20460

Complete proposed document available at:
http://www.epa.gov/ost/guide/mpp/
The Final Development Document is available as well.

SECTION 13

LIMITATIONS AND STANDARDS: DATA SELECTION AND CALCULATION

This section describes the data sources, data selection, data conventions, and statistical methodology used by EPA in calculating the long-term averages (LTAs), variability factors (VFs), and proposed limitations. The proposed effluent limitations and standards for each subcategory and option are based on long-term average effluent values and variability factors that account for variation over time in treatment performance within a particular treatment technology.

Section 13.1 briefly describes the data sources (a more detailed discussion of data sources is provided in Section 3) and gives a general overview of EPA's evaluation and selection of facility datasets that are the basis of the proposed limitations. Section 13.2 presents the procedures for data aggregation. Sections 13.3 through 13.5 describe the estimation of daily effluent concentrations and adjustments performed when technology option specific data were unavailable. Section 13.6 provides an overview of the proposed limitations. Procedures for estimation of long-term averages, variability factors, and concentration-based limitations in Sections 13.7 through 13.10. Section 13.11 describes the conversion of these concentration-based limitations into the proposed production-normalized limitations.

13.1 OVERVIEW OF DATA AND EPISODE SELECTION

To estimate the long-term averages, variability factors, and proposed limitations, EPA used the same datasets as were used to calculate the post-compliance loading estimates, as described in Section 9. As described in Section 3, EPA selected 11 MPP facilities for multi-day sampling. The purpose of the multi-day sampling was to characterize pollutants in MPP raw wastewaters prior to treatment, as well as document wastewater treatment plant performance (including selected unit processes). Selection of facilities for multi-day sampling was based on an analysis of information collected during the site visits performed by EPA, as well as on the following criteria:

- The facility performed meat or poultry first processing, further processing, and/or rendering operations representative of MPP facilities;
- The facility used in-process treatment and/or end-of-pipe treatment technologies that EPA was considering for technology option selection; and
- Compliance monitoring data for the facility indicated that it was among the better performing treatment systems, or that it employed wastewater treatment process for which EPA sought data for option selection.

During each multi-day sampling episode, EPA sampled facility influent and effluent wastestreams. At some facilities, samples were also collected at intermediate points throughout the wastewater treatment system to assess the performance of individual treatment units. Some of the facilities chosen for sampling perform rendering and/or further processing operations in addition to meat and/or poultry first processing. For facilities that also performed rendering operations or further processing, wastewater from the rendering and/or further processing operations was sampled separately, when possible.

EPA used the data from sampling episodes to develop long-term average (LTA) effluent concentrations representative of performance of selected technology options.[1] As explained in Section 9, in the absence of sampling episode data for a particular type of process, EPA transferred data from other facilities that employ similar production and treatment processes to establish LTAs. EPA also used production and flow data contained in the MPP detailed surveys for use in deriving production normalized flow values.

From each selected facility data set, an episode-specific long-term average was calculated for each proposed regulated pollutant. Episode-specific long-term averages were then used to calculate option long-term averages, which were then applied to develop the proposed

[1] In developing the proposed limitations, EPA excluded the hexane extractable material (HEM) data collected on day 1 from the sample point 3 and day 2 from the sample point 4 at facility 6443 because the discharge values were found to be extremely variable in comparison to the other days (i.e., there was no evidence that the facility was consistently controlling the HEM discharges). In addition, EPA excluded the ammonia (as N) value on day 5 at episode 6335 because it was inconsistent with the other values at that sample point.

effluent limitations. For the final rule, EPA intends to further review and possibly revise the data selection methodology.

13.2 DATA AGGREGATION

In some cases, EPA determined that two or more samples had to be mathematically aggregated to obtain a single value that could be used in other calculations. As explained in this section, in some cases, this meant that field duplicates and grab samples were aggregated for a single sample point. Appendix F lists the data after these aggregations were completed and a single daily value was obtained for each day for each pollutant.

In all aggregation procedures, EPA considered the censoring type associated with the data. EPA considered measured values to be detected. In statistical terms, the censoring type for such data was 'non-censored' (NC). Measurements reported as being less than some sample-specific detection limit (e.g., <10 mg/L) were censored and were considered to be non-detected (ND). Laboratories can also report numerical results for specific pollutants detected in the samples as right censored. Right censored data are those reported as being greater than the highest calibration value of the analysis (e.g., >1000 ug/l). For calculating the proposed limitations, the right censored data were set to the reported amount and treated as non-censored data. In the tables and data listings in this document and the record for the rulemaking, EPA has used the abbreviations NC and ND to indicate the censoring types.

The distinction between the two censoring types is important because the procedure used to determine the variability factors considers censoring type explicitly. The variability factor estimation procedure models the facility data sets using the modified delta-lognormal distribution. In this distribution, data are modeled as a mixture of two distributions. Thus, EPA concluded that the distinctions between detected and non-detected measurements were important and should be an integral part of any data aggregation procedure. (See Appendix G for a detailed discussion of the modified delta-lognormal distribution.)

Because each aggregated data value entered into the modified delta-lognormal model as a single value, the censoring type associated with that value was also important. In many cases, a single aggregated value was created from unaggregated data that were all either detected or non-detected. In the remaining cases with a mixture of detected and non-detected unaggregated values, EPA determined that the resulting aggregated value should be considered as detected, because the pollutant was measured at detectable levels.

This section describes each of the different aggregation procedures. They are presented in the order that the aggregation was performed. That is, field duplicates were aggregated first and grab samples second.

13.2.1 Aggregation of Field Duplicates

During the EPA sampling episodes, the Agency collected a small number of field duplicates. Generally, ten percent of the number of samples collected were duplicated. Field duplicates are two samples collected for the same sampling point at approximately the same time, assigned different sample numbers, and flagged as duplicates for a single sample point at a facility.

Because the analytical data from each duplicate pair characterize the same conditions at that time at a single sampling point, EPA aggregated the data to obtain one data value for those conditions. The data value associated with those conditions was the arithmetic average of the duplicate pair.

Frequently, both samples in duplicate pair displayed the same censoring type. In this case, the censoring type of the aggregate was the same as the duplicates. When one sample in the duplicate pair was a non-censored and the other a non-detected type, EPA assigned the aggregated value as 'non-censored' because the pollutant had been present in one sample. (Even if the other duplicate had a zero value[2], the pollutant still would have been present had the samples been physically combined.) Table 13-1 summarizes the procedure for aggregating the analytical results from the field duplicates. This aggregation step for the duplicate pairs was the first step in the aggregation procedures for both influent and effluent measurements.

[2] This is presented as a 'worst-case' scenario. In practice, the laboratories cannot measure 'zero' values. Rather they report that the value is less than some level.

Table 13-1. Method for Aggregation of Field Duplicates

If the field duplicates are:	Censoring type of average is:	Value of aggregate is:	Formulas for aggregate value of duplicates:
Both non-censored	NC	arithmetic average of measured values	$(NC_1 + NC_2)/2$
Both non-detected	ND	arithmetic average of sample-specific detection limits	$(DL_1 + DL_2)/2$
One non-censored and one non-detected	NC	arithmetic average of measured value and sample-specific detection limit	(NC + DL)/2

NC - non-censored (or detected). ND - non-detected. DL - sample-specific detection limit.

13.2.2 Aggregation of Grab Samples

During the EPA sampling episodes, the Agency collected two types of samples: grab and composite. Typically, EPA collected composite samples. Of the pollutants proposed for regulation, HEM was the only one for which the chemical analytical method specifies that grab samples must be used. For HEM, EPA collected multiple (usually four) grab samples during a sampling day at a sample point. To obtain one value characterizing the pollutant levels at the sample point on a single day, EPA mathematically aggregated the measurements from the grab samples.

The procedure arithmetically averaged the measurements to obtain a single value for the day. When one or more measurements were non-censored, EPA determined that the appropriate censoring type of the aggregate was ‘non-censored’ because the pollutant was present. Table 13-2 summarizes the procedure.

13.3 DERIVATION OF TOTAL NITROGEN CONCENTRATIONS

Since total nitrogen was not analyzed, its daily concentrations were obtained as the sum of nitrate/nitrite (C005) and total Kjeldahl nitrogen (C021) before aggregation. If one of two values was non-censored, the censoring type of total nitrogen was non-censored. Any non-detect values were set as equal to the sample-specific detection limit in the sum.

Table 13-2. Procedure for Aggregation of Grab Samples

If the grab or multiple samples are:	Censoring type of Daily Value is:	Daily value is:	Formulas for Calculating Daily Value:
All non-censored	NC	arithmetic average of measured values	$\frac{\sum_{i=1}^{n} NC_i}{n}$
All non-detected	ND	arithmetic average of sample-specific detection limits	$\frac{\sum_{i=1}^{n} DL_i}{n}$
Mixture of non-censored and non-detected values (total number of observations is n=k+m)	NC	arithmetic average of measured values and sample-specific detection limits	$\frac{\sum_{i=1}^{k} NC_i + \sum_{i=1}^{m} DL_i}{n}$

NC - non-censored (or detected). ND - non-detected. DL - sample-specific detection limit.

13.4 DERIVATION OF EFFLUENT CONCENTRATION DATA

To the extent possible with available data, EPA calculated the proposed limitations for first processing, further processing, and rendering operations wastewater for each technology option from the daily effluent concentrations at the sampled facility or facilities chosen as representative of the technology option. However, when specific data were unavailable, EPA estimated the daily effluent concentrations for the model technology options, using assumptions similar to those applied during pollutant loading calculations explained in Section 9. This section describes the methodology used to estimate the daily effluent concentrations for the model technology options.

13.4.1 Calculation of Daily Effluent Concentrations

When influent data were available, they were multiplied by a removal fraction for the technology option. When there were more than one facility that could provide a removal fraction, the median of the removal fractions was used. The daily effluent concentrations were calculated as follows:

Effluent concentration = (influent concentration) x (1 - removal fraction) where the removal fraction for a facility was calculated using long-term averages (LTAs) as follows:

(influent LTA concentration - effluent LTA concentration) / (influent LTA concentration).

The calculation of long-term averages is discussed in Section 13.8. The facilities with negative removal fractions were excluded from calculations for the limitations for that specific analyte.

When there were no influent data available, the daily effluent concentrations were derived based on an estimation of the pollutant mass balance between the final effluent and its unit processes of first, further, and rendering wastewaters (as applicable for a facility). For example, the daily effluent concentrations for first processing wastewater could be derived from:

> Daily effluent concentration of first processing wastewater = [(Final daily effluent concentration x Total flow) - (Daily concentration of further processing wastewater[3] x Further processing wastewater flow) - (Daily concentration of rendering wastewater[3] x Rendering wastewater flow)] / (First processing wastewater flow)

The data and equations used to derive the daily effluent concentration values are summarized by technology options in Tables 13-3 through 13-7.

[3] If the daily concentrations for this unit process were from a different facility than the final effluent concentrations, the long-term average of the concentrations for the unit process was used instead of daily values.

Table 13-3. Data and Equations to Derive Technology Option Daily Effluent Concentrations for First Processing, Further Processing, and Rendering Operations Treated Wastewaters for Direct Discharging Meat Facilities (BAT-2 Technology Option)

Facility	First Processing		Further Processing		Rendering Operations		Total Flow (MGD)
	D_1=Daily Effluent Concentrations	F_1=Flow (MGD)	D_2=Daily Effluent Concentrations	F_2=Flow (MGD)	D_3=Daily Effluent Concentrations	F_3= Flow (MGD)	
6440	[(Daily effluent • Total Flow) - (LTA of D_3• F_3)] / F_1	0.83	N/A	N/A	(a) • (rendering influent@6447)	0.52	1.35
6441	[(Daily effluent • Total Flow) - (LTA of D_3• F_3)] / F_1	1.31	N/A	N/A	(a) • (rendering influent@6447)	0.48	1.79
6442	[(Daily effluent • Total Flow) - (LTA of D_3• F_3)] / F_1	1.53	N/A	N/A	(a) • (rendering influent@6447)	0.42	1.95
6447	[(Daily effluent • Total Flow) - (LTA of D_2• F_2)-(D_3 • F_3)] / F_1	0.51	(a) • (further processing influent@6335)	0.07	(a) • (rendering influent@6447)	0.15	0.73

(a) = (1- Removal fraction) where the Removal fraction is the median removal fraction of sampling episodes 6440, 6441, 6442 and 6447.

Table 13-4. Data and Equations to Derive Technology Option Daily Effluent Concentrations for First Processing, Further Processing, and Rendering Operations Treated Wastewaters for Direct Discharging Meat Facilities (BAT-3 Technology Option)

Facility	First Processing		Further Processing		Rendering Operations		Total Flow (MGD)
	D_1=Daily Effluent Concentrations	F_1=Flow (MGD)	D_2=Daily Effluent Concentrations	F_2=Flow (MGD)	D_3=Daily Effluent Concentrations	F_3=Flow (MGD)	
6335	[(reuse water daily effluent • Total Flow) -(D_2 • F_2) - (LTA of D_3 • F_3)] / (F_1)	0.17	(b) • (further processing daily influent)	0.45	(b) • (rendering daily influent@6447)	0.13	0.75

(b) = 1 - Removal fraction of sampling episode 6335 (through reuse water effluent)

Table 13-5. Data and Equations to Derive Daily Effluent Concentrations for First Processing, Further Processing, and Rendering Operations Treated Wastewaters for Direct Discharging Poultry Facilities (BAT-2 Technology Option)

Facility	First Processing) Daily Effluent Concentrations	Further Processing Daily Effluent Concentrations	Rendering Operations Daily Effluent Concentrations
6443	N/A	(a) • further processing influent	N/A
6444	N/A	(a) • further processing inffluent	N/A
6448	N/A	N/A	(a) • rendering influent
6445	Daily effluent	N/A	N/A

(a) = 1 - Removal fraction @ 6445

Table 13-6. Data and Equations to Derive Daily Effluent Concentrations for First Processing, Further Processing, and Rendering Operations Treated Wastewaters for Indirect Discharging Meat Facilities (PSES-1 Technology Option)

	First Processing		Further Processing		Rendering Operations		
Facility	D_1=Daily Effluent Concentrations	F_1=Flow (MGD)	D_2=Daily Effluent Concentrations	F_2=Flow (MGD)	D_3=Daily Effluent Concentrations	F_3=Flow (MGD)	Total Flow (MGD)
6335	[(Daily effluent • (Total Flow) - (D_2 • F_2) - (LTA of D_3 • F_3)] / F_1	0.17	(b) • further processing influent	0.45	(b) • (rendering influent@6447)	0.13	0.75

(b) = 1 - Removal fraction @ 6335

Table 13-7. Data and Equations to Derive Daily Effluent Concentrations for First Processing, Further Processing, and Rendering Operations Treated Wastewaters for Indirect Discharging Poultry Facilities (PSES-1 Technology Option)

Facility	First Processing		Further Processing		Rendering Operations		Total Flow (MGD)
	D1=Effluent Concentrations	F1=Flow (MGD)	D2=Effluent Concentrations	F2=Flow (MGD)	D3=Effluent Concentrations	F3=Flow (MGD)	
6448	N/A	N/A	N/A	N/A	(a) • Rendering Daily Effluent	N/A	N/A
6443	[(Daily effluent• Total Flow) - (D2 •F2)] / F1	0.91	(a) • (further processing daily influent)	0.84	N/A	N/A	1.75
6444	[(Daily effluent • Total Flow) - (D2 • F2)] / F1	0.53	(a) • (further procssing daily influent)	0.02	N/A	N/A	0.55

(a) = (1 - Removal fraction of 6443)

13.4.2 Censoring Type of Calculated Effluent Concentrations

When assigning the censoring type to the calculated concentration, EPA first determined the "lowest potential value" for each analyte. The lowest potential value is the minimum of the lowest detected (non-censored) value and the minimum of the nominal quantitation limits as defined in Appendix A. (Ammonia as nitrogen was the only one instance where the lowest detected value was less than the minimum of the nominal quantitation limits.) Each daily influent or effluent value was then compared to this lowest potential value. If the calculated value was less than the lowest potential value, the censoring type of this value was considered to be non-detect with a sample-specific detection limit equal to the lowest potential value. For example, suppose the influent concentration is non-censored. If the lowest potential value is 10 mg/L and the calculated effluent concentration is 7.5 mg/L, the effluent concentration is considered as a non-detected at a detection limit 10 mg/L. If the calculated value was greater than the lowest potential value, one of the following two methods of substitution was made.

Method 1: When the effluent concentration was calculated as a product of the proportion of residual pollutant concentration after treatment and the influent concentration of the sample point, the calculated effluent concentration was assigned the censoring type of the influent sample. Table 13-8 provides an example of the final censoring type using this method where the lowest potential value is 10 and the removal fraction is 50 percent.

Table 13-8. Example of Final Data Censoring Type Using Method 1

Influent Concentration		Effluent Concentration		
Amount	**Censoring Type**	**Influent Concentration *(1-Removal Fraction)**	**Final Calculated Amount**	**Censoring Type**
10	ND	5	10	ND
20	NC	10	10	NC
22	ND	11	11	ND

Method 2: When the effluent concentration method was calculated based on a facility pollutant mass balance between the final effluent and its unit processes of first, further, and rendering wastewaters (as applicable), it had the censoring type associated with the initial

effluent concentration. Table 13-9 provides an example of the final censoring type using this method where the lowest potential value is 10 and the removal fraction is 50 percent.

Table 13-9. Example of Final Data Censoring Type Using Method 2

Initial Effluent Concentration		Further Processing Effluent	Rendering Effluent	Calculated Effluent Concentration[a]	Final Calculated Effluent Concentration	
Amount	Censoring Type				Amount	Censoring Type
15	NC	10	20	8.75	10	ND
10	ND	10	24	9.70	10	ND
100	ND	10	40	136	136	ND
20	NC	10	10	25.78	25.78	NC

[a] Calculated Effluent Concentration=(Initial Effluent *0.73 - Further Processing Effluent*0.7- (1-Removal Fraction)*Rendering Effluent * 0.15) /0.51

13.5 DATA ADJUSTMENT

Once the daily effluent concentration for a facility was calculated, the data value was compared to the long-term average (LTA) of the actual measured effluent for that facility. When the calculated concentration was less than the LTA, it was replaced by the LTA. After a thorough review of the calculated effluent concentrations, EPA adjusted several of the concentration values when the calculation methodology resulted in effluent concentrations that were generally lower than documented performance values for the technology or lower than actual effluent concentrations. More specifically, the methodology used by EPA in the absence of effluent data for a particular meat or poultry process type was dependent at times on the transfer of data and treatment system performance from different facilities. There were instances when this methodology resulted in calculated concentrations that were below what EPA considered to be reasonable or realistic. In evaluating whether a derived effluent value was reasonable or realistic, EPA compared the data to expected ranges of effluent concentrations as provided in the technical literature.[4] EPA also ensured that a derived effluent data for a particular process type (i.e., first processing, further processing, or rendering) were never lower than the actual effluent concentration as reported in the sampling episodes.

[4] EPA particularly used the ranges presented in "Wastewater Engineering: Treatment, Disposal and Reuse" Metcalf & Eddy, 1995 for each technology option.

13.6 OVERVIEW OF LIMITATIONS

The following sections discuss the data selected as the basis for the proposed limitations, the data aggregation procedures, and the methodology used to obtain daily values for limitations. This section describes EPA's objective for daily maximum and monthly average limitations, the selection of percentiles for those limitations, and compliance with final limitations. EPA has included this discussion because these fundamental concepts are often the subject of comments on EPA's proposed effluent guidelines regulations and in EPA's contacts and correspondence with the industry.

13.6.1 Objective

In establishing daily maximum limitations, EPA's objective is to restrict the discharges on a daily basis at a level that is achievable for a facility that targets its treatment at the long-term average. EPA acknowledges that variability around the long-term average results from normal operations. This variability means that occasionally facilities may discharge at a level that is greater than the long-term average. This variability also means that facilities may occasionally discharge at a level that is considerably lower than the long-term average. To allow for these possibly higher daily discharges, EPA has established the daily maximum limitation. A facility that discharges consistently at a level near the daily maximum limitation would <u>not</u> be operating its treatment to achieve the long-term average, which is part of EPA's objective in establishing the daily maximum limitations. That is, targeting treatment to achieve the limitations may result in frequent values exceeding the limitations due to routine variability in treated effluent.

In establishing monthly average limitations, EPA's objective is to provide an additional restriction to help insure that facilities target their average discharges to achieve the long-term average. The monthly average limitation requires continuous dischargers to provide on-going control, on a monthly basis, that complements controls imposed by the daily maximum limitation. In order to meet the monthly average limitation, a facility must counterbalance a value near the daily maximum limitation with one or more values well below the daily maximum limitation. To achieve compliance, these values must result in a monthly average value at or below the monthly average limitation.

13.6.2 Selection of Percentiles

EPA calculates limitations based upon percentiles chosen with the intention, on one hand, to be high enough to accommodate reasonably anticipated variability within control of the facility and, on the other hand, to be low enough to reflect a level of performance consistent with the Clean Water Act requirement that these effluent limitations be based on the "best" technologies. The daily maximum limitation is an estimate of the 99th percentile of the distribution of the *daily* measurements. The monthly average limitation is an estimate of the 95th percentile of the distribution of the *monthly* averages of the daily measurements.

The 99th and 95th percentiles do not relate to, or specify, the percentage of time a discharger operating the "best available" or "best available demonstrated" level of technology will meet (or not meet) the limitations. Rather, the use of these percentiles relate to the development of limitations. (The percentiles used as a basis for the limitations are calculated using the products of the long-term averages and the variability factors as explained in the next section.) If a facility is designed and operated to achieve the long-term average on a consistent basis and the facility maintains adequate control of its processes and treatment systems, the allowance for variability provided in the limitations is sufficient to meet the requirements of the proposed rule. The use of 99 percent and 95 percent represents a need to draw a line at a definite point in the statistical distributions (100 percent is not feasible because it represents an infinitely large value) and a policy judgment about where to draw the line that would ensure that operators work hard to establish and maintain the appropriate level of control. In essence, in developing the proposed limitations, EPA has taken into account the reasonable anticipated variability in discharges that may occur at a well-operated facility. By targeting its treatment at the long-term average, a well-operated facility should be capable of complying with the limitations at all times because EPA has incorporated an appropriate allowance for variability into the limitations.

While the actual monitoring requirements will be determined by the permitting authority, the Agency has assumed thirty samples per month (i.e., daily monitoring) in determining the proposed maximum monthly average limitations. EPA recognizes that small poultry facilities are unlikely to operate on weekends and is soliciting comment on whether their monthly limitations should be based upon 20 days. Increasing or decreasing monitoring frequency does not affect the statistical properties of the underlying distribution of the data used to derive the limitations. However, monitoring less frequently theoretically results in average values that are more variable. As a consequence, average values based on 20 monitoring samples per month from small poultry facilities theoretically could be numerically larger than average values based upon 30 monitoring samples from non-small facilities. Thus, operators of small poultry facilities may find they need to design treatment systems to achieve an average below the long term average basis of the proposed limitations and/or more control over variability of the discharges in order to maintain compliance with the limitations. Attachment 13-5 in Appendix H provides a list of both the proposed limitations and those derived using a 20-day monitoring assumption.

In conjunction with the statistical methods, EPA performs an engineering review to verify that the limitations are reasonable based upon the design and expected operation of the control technologies and the facility process conditions. As part of that review, EPA examines the range of performance by the facility data sets used to calculate the limitations. Some facility data sets demonstrate the best available technology. Other facility data sets may demonstrate the same technology, but not the best demonstrated design and operating conditions for that technology. For these facilities, EPA will evaluate the degree to which the facility can upgrade its design, operating, and maintenance conditions to meet the limitations. If such upgrades are not possible, then the limitations are modified to reflect the lowest levels that the technologies can reasonably be expected to achieve.

13.6.3 Compliance with Limitations

EPA promulgates limitations that facilities are capable of complying with at all times by properly operating and maintaining their processes and treatment technologies. However, the issue of exceedances[5] or excursions is often raised by comments on proposed limitations (as has been the Agency's experience with proposals for other industries). For example, comments

[5] Values that exceed the limitations

often suggest that EPA include a provision that a facility is in compliance with permit limitations if its discharge does not exceed the specified limitations, with the exception that the discharge may exceed the monthly average limitations one month out of 20 and the daily average limitations one day out of 100. This issue was, in fact, raised in other rules, most notably in EPA's final Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) rulemaking. EPA's general approach there for developing limitations based on percentiles is the same in this proposal, and was upheld in Chemical Manufacturers Association v. U.S. Environmental Protection Agency, 870 F.2d 177, 230 (5th Cir. 1989). The Court determined that:

> EPA reasonably concluded that the data points exceeding the 99th and 95th percentiles represent either quality-control problems or upsets because there can be no other explanation for these isolated and extremely high discharges. If these data points result from quality-control problems, the exceedances they represent are within the control of the plant. If, however, the data points represent exceedances beyond the control of the industry, the upset defense is available.
>
> Id. at 230.

EPA's allowance for reasonable anticipated variability in its effluent limitations, coupled with the availability of the upset defense reasonably accommodates acceptable excursions. Any further excursion allowances would go beyond the reasonable accommodation of variability and would jeopardize the effective control of pollutant discharges on a consistent basis and/or bog down administrative and enforcement proceedings in detailed fact finding exercises, contrary to Congressional intent. See, e.g., Rep. No. 92-414, 92nd Congress, 2nd Sess. 64, reprinted in A Legislative History of the Water Pollution Control Act Amendments of 1972 at 1482; Legislative History of the Clean Water Act of 1977 at 464-65.

13.6.4 Summary of Proposed Limitations

The proposed limitations for pollutants for each option are provided as 'daily maximums' and 'maximums for monthly averages'. Definitions provided in 40 CFR 122.2 state that the daily maximum limitation is the "highest allowable 'daily discharge'" and the maximum for monthly average limitation (also referred to as the "monthly average limitation") is the "highest allowable average of 'daily discharges' over a calendar month, calculated as the sum of all 'daily discharges' measured during a calendar month divided by the number of 'daily discharges' measured during that month." Daily discharges are defined to be the "'discharge of a pollutant' measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of samplings." EPA has proposed daily maximum and monthly average limitations expressed in terms of allowable pollutant discharge (pounds) per unit of production (Live-Weight Killed, Finished Products, Raw Materials). In this document and elsewhere, EPA refers to such limitations as 'production-normalized.' EPA has proposed production-normalized limitations in terms of daily maximums, maximums for 20-day averages (poultry facilities only), and maximum for monthly averages.

To derive the proposed production-normalization limitations, EPA used the modified delta-lognormal distribution to develop limitations based upon the concentration data ("concentration-based limitations"). Sections 13.7 through13.10 describe the calculations for the concentration-based limitations. Section 13.11 describes the conversion of these limitations to "production-normalized limitations" using the model flow rates described in Section 11.

13.7 ESTIMATION OF CONCENTRATION-BASED LIMITATIONS

In estimating the concentration-based limitations, EPA determines an average performance level (the "option long-term average" discussed in the next section) that a facility with well-designed and operated model technologies (which reflect the appropriate level of control) is capable of achieving. This long-term average is calculated from the data from the facilities using the model technologies for the option. EPA expects that all facilities subject to the limitations will design and operate their treatment systems to achieve the long-term average performance level on a consistent basis because facilities with well-designed and operated model technologies have demonstrated that this can be done.

In the second step of developing a limitation, EPA determines an allowance for the variation in pollutant concentrations when processed through extensive and well designed treatment systems. This allowance for variance incorporates all components of variability including shipping, sampling, storage, and analytical variability. This allowance is incorporated into the limitations through the use of the variability factors (the “option variability factor” discussed in Section 13.9) which are calculated from the data from the facilities using the model technologies. If a facility operates its treatment system to meet the relevant long-term average, EPA expects the facility will be able to meet the limitations. Variability factors assure that normal fluctuations in a facility’s treatment are accounted for in the limitations. By accounting for these reasonable excursions above the long-term average, EPA’s use of variability factors results in limitations that are generally well above the actual long-term averages.

Facilities that are designed and operated to achieve long-term average effluent levels used in developing the limitation should be capable of compliance with the proposed limitations, which incorporate variability, at all times.

The following sections describe the calculation of long-term averages and variability factors.

13.8 ESTIMATION OF LONG-TERM AVERAGE CONCENTRATIONS

This section discusses the calculation of LTAs for each sample episode (“episode-specific LTA”) and for each technology option (“option LTA”) for each pollutant. The LTAs discussed in this section were used to develop the proposed limitations.

For each technology option being considered, EPA calculated LTAs that represent the best performing facilities (from the respective of types of treatment in-place and degree of expected pollutant removals). For purposes of proposal, EPA relied on EPA sampling episode data to calculate LTAs. EPA calculated LTAs for the following six meat and poultry processes:

- first processing (meat);
- further processing (meat);
- rendering (meat);
- first processing (poultry);
- further processing (poultry); and
- rendering (poultry).

LTAs were derived for each of the above six meat and poultry processes from effluent concentration data collected during the sampling episodes. Specifically, for each technology option being considered, effluent concentration data from representative facilities were used to derive LTAs for each pollutant of concern. Consistent with the methodology described in Section 9.2, in the absence of data for a particular meat and poultry process at a facility, EPA used the derived effluent concentration data.

13.8.1 Episode-specific Long-Term Average Concentrations

EPA calculated the episode-specific long-term average by using either the modified delta-lognormal distribution or the arithmetic average (see Appendix G). In Appendix H, EPA has listed the arithmetic average (column labeled 'Obs Mean') and the estimated episode-specific long-term average (column labeled 'Est LTA'). If EPA used the arithmetic average as the episode long-term average, then the two columns have the same value.

13.8.2 Option Long-Term Averages

EPA calculated the option long-term average for a pollutant as the *median* of the episode-specific long-term averages for that pollutant from selected episodes with the technology basis for the option. The median is the midpoint of the values ordered (i.e., ranked) from smallest to largest. If there is an odd number of values (with n=number of values), then the value of the (n+1)/2 ordered observation is the median. If there are an even number of values, then the two values of the n/2 and [(n/2)+1] ordered observations are arithmetically averaged to obtain the median value.

For example, for subcategory Y option Z, if the four (i.e., n=4) episode-specific long-term averages for pollutant X are:

Facility	Episode-Specific Long-Term Average
A	20 mg/L
B	9 mg/L
C	16 mg/L
D	10 mg/L

then the ordered values are:

Order	Facility	Episode-Specific Long-Term Average
1	B	9 mg/L
2	D	10 mg/L
3	C	16 mg/L
4	A	20 mg/L

And the pollutant-specific long-term average for option Z is the median of the ordered values (i.e., the average of the 2nd and 3rd ordered values): (10+16)/2 mg/L = 13 mg/L.

The option long-term averages were used in developing the proposed limitations for each pollutant within each regulatory option.

13.8.3 Substitution of LTAs

In a limited number of cases, EPA used substitutions for the calculated option-level LTAs because data existed that indicated the technology option performed at these levels (or better) at MPP facilities. Table 13-10 summarizes the option-level LTA substitutions. For poultry further processing BAT-2, the option LTA of TSS was substituted with 9.76 mg/L, which was the largest value reported in the MPP detailed survey for poultry facilities with further processing operations and implementing BAT-2 level treatment technology. For poultry rendering operation BAT-2, the option LTA of HEM was substituted with 19.5 mg/L, which was the largest value reported in the MPP detailed survey for poultry facilities with rendering operations and implementing BAT-2 level treatment technology. Finally, for poultry rendering operation BAT-1, the option LTA for COD was substituted with the average effluent from a poultry facility performing rendering operations.

Table 13-10. Substitution Values for Option-Level LTA

Pollutant	Substitution Value (mg/L)	Subcategory	Option	Calculated Option LTA (mg/L)	Source of Substitution Value
TSS	9.76	Poultry further processing	BAT-2	537.56	Largest concentration reported value in MPP survey data for poultry facilities with further processing operations at BAT-2.
HEM	19.5	Poultry rendering	BAT-2	334.96	Largest concentration reported value in MPP survey data for poultry facilities with rendering operations at BAT-2.
COD	29.64	Poultry rendering	BAT-2	168.92	Average concentration of treated rendering effluent at sampling episode 6448

13.8.4 Calculation of Poultry BAT-3 Option-Level Long-Term Averages

For poultry BAT-3, the technology option was not represented in the sampling episodes of poultry facilities. Thus, the option LTAs were calculated assuming that the removal fractions between different technology option levels would be the same for meat and poultry facilities (i.e., the removal fraction between meat BAT-2 and meat BAT-3 treatment options would be the same as the removal fraction between poultry BAT-2 and poultry BAT-3 treatment options). Thus, the removal fractions were calculated as follows:

Removal Fraction = (Option LTA from Meat BAT-2- Option LTA from Meat BAT-3)/ Option LTA from Meat BAT-2.

The resulting removal fraction would then be applied to the treated pollutant concentrations calculated for the technology option BAT-2 to obtain the option long-term averages as follows:

LTA = (Option LTA from Poultry BAT-2)*(1-Removal Fraction).

If the LTA was less than the option level LTA of the actual sampled effluent data used for Meat Option 3, it was replaced by the option level LTA of the actual sampled effluent data used for Meat BAT-3. The formula for the option level LTA for the option BAT-3 of Poultry is provided in Table 13-11.

Table 13-11. Formulas for Calculating BAT-3 Technology Option Level LTA for Poultry Facilities

	First Processing	Further Processing	Rendering Operations
RF = Removal Fraction	[(Option LTA of First Processing Meat BAT-2) - (Option LTA of First Processing Meat BAT-3)]/Option LTA of First Processing Meat BAT-2	[(Option LTA of Further Processing Meat BAT-2) - (Option LTA of Further Processing Meat BAT-3)]/Option LTA of Further Processing Meat BAT-2	[(Option LTA of Rendering Operation Meat BAT-2) - (Option LTA of Rendering Operation Meat BAT-3)]/Option LTA of Rendering Operation Meat BAT-2
Option LTA	(1 - RF) • (Option LTA of First Processing Poultry BAT-2)	(1 - RF) • (Option LTA of Further Processing Poultry BAT-2)	(1 - RF) • (Option LTA of Rendering Operation Poultry BAT-2)

13.8.5 Calculation of Independent Rendering BAT-2 Option-Level Long-Term Averages

The option level LTA for the independent rendering facilities was calculated as the average of the option level LTAs of rendering process from Meat BAT-2 and Poultry BAT-2. The formula for the option level LTA for the independent LTA is

Option LTA = [(Option LTA of Rendering Operation Meat BAT-2)+(Option LTA of Rendering Operation Meat BAT-2)]/2.

13.8.6 Adjustments to Option Long-Term Averages

To ensure that the option BAT-2 LTAs were no more stringent than the BAT-3 option LTAs, a comparison was made between the BAT-2 option LTAs and the BAT-3 option LTAs. BAT-2 option LTAs were substituted with BAT-3 option LTAs whenever they were more stringent than the corresponding BAT-3 option LTA. Table 13-12 identifies the cases for which the BAT-3 value was substituted for the calculated BAT-2 long-term average.

Table 13-12. BAT-2 Option LTA Substitutions

Subcategory	Process	Pollutant	Calculated Option BAT-2 LTA (mg/L)	Calculated Option BAT-3 LTA(mg/L)	Final Option BAT-2 LTA (mg/L)[a]
Poultry	First Processing	Ammonia as Nitrogen	0.25	2.34	2.34
		Biochemical Oxygen Demand	2.00	4.68	4.68
		Fecal Coliform	4.63	21.50	21.50
		Total Kjeldahl Nitrogen	1.61	2.08	2.08
		Total Phosphorus	0.77	6.97	6.97
		Total Residual Chlorine	0.22	15.96	15.96
	Further Processing	Ammonia As Nitrogen	0.85	2.34	2.34
		Fecal Coliform	4.63	21.50	21.50
	Rendering	Biochemical Oxygen Demand	2.16	4.68	4.68
		Fecal Coliform	5.60	21.50	21.50
		Total Phosphorus	2.55	6.97	6.97
Meat	First Processing	Ammonia As Nitrogen	0.70	3.75	3.75
	Further Processing	Ammonia As Nitrogen	0.52	2.34	2.34
	Rendering	Ammonia As Nitrogen	1.29	2.34	2.34
		Biochemical Oxygen Demand	6.92	8.35	8.35

[a] These values represent the LTAs that were subsequently used by EPA for deriving effluent limitations.

13.9 CALCULATION OF OPTION VARIABILITY FACTORS

In developing the option variability factors used in calculating the proposed limitations, EPA first developed daily and monthly episode-specific variability factors using the modified delta-lognormal distribution. The variability factors were estimated from the daily effluent data of the facility used to compute the episode-specific LTA's. This estimation procedure is described in Appendix G.

After calculating the episode-specific variability factors, EPA calculated the option daily variability factor as the *mean* of the episode-specific daily variability factors for that pollutant in the subcategory and option. Likewise, the option monthly variability factor was the mean of the episode-specific monthly variability factors for that pollutant in the subcategory and option. For poultry BAT-3, the option variability factors were transferred from the meat BAT-3 because, as described in Section 13.8.4 the technology option was not represented in the sampling episodes of poultry facilities. Because the BAT-3 technology options are the same for meat and poultry, EPA expects the variability to be similar, and thus transferred the variability factors from the meat BAT-3 dataset. Additionally, the variability factors for Independent Rendering BAT-2 were calculated as the average of option VF's from BAT-2 Meat and BAT-2 Poultry because the LTA was based on the average of option LTAs from BAT-2 Meat and BAT-2 Poultry.

13.9.1 Transfers of Option Variability Factors

After estimating the option variability factors, EPA identified several pollutants for which variability factors could not be calculated in some options. This resulted when all episode datasets for the pollutant in the option had too few detected measurements to calculate episode-specific variability factors (see data requirements in Appendix G). For example, if a pollutant had all non-detected values for all of the episodes in an option, then it was not possible to calculate option variability factors. When EPA could not calculate the option variability factors or determined that the calculated option variability factors should be replaced, EPA selected variability factors from other sources to provide an adequate allowance for variability in the proposed limitations. This section describes these cases.

Table 13-13 lists the pollutants for which EPA was unable to calculate option variability factors. For biochemical oxygen demand in Poultry BAT-2, EPA transferred the option variability factors from the Poultry BAT-3. EPA expects that these two options would have similar variability in the effluent concentrations. Likewise for HEM in Poultry BAT-2 and BAT-3 and Meat BAT-3, EPA transferred the variability factors from Meat BAT-2. For ammonia (as N), the variability factors for Poultry BAT-2 were transferred from Poultry BAT-3. EPA determined that the variability factors were unlikely to be more variable than the Poultry BAT-3. For total nitrogen, EPA transferred the option variability factors for total Kjeldahl nitrogen (TKN) from the same option because EPA did not calculate daily total nitrogen values. (Daily values are needed to calculate variability factors.) However, EPA had developed variability factors for the two pollutants, TKN and nitrate/nitrite, which are summed to obtain total nitrogen. Because TKN was the more variable of the two pollutants, EPA selected those variability factors to use in developing the total nitrogen limitations. EPA expects that total nitrogen would be no more variable than TKN.

Table 13-13. Cases where Option Variability Factors Could Not be Calculated

Pollutant	Technology Option	Source of Variability Factors
Biochemical oxygen demand	Poultry BAT-2	Poultry BAT 3
HEM	Poultry BAT-2	Meat BAT-2
	Poultry BAT-3	Meat BAT-2
	Meat BAT-3	Meat BAT-2
Ammonia (as N)	Poultry BAT-2	Poultry BAT-3
Total nitrogen	All technology options	TKN from the same option

13.10 SUMMARY OF STEPS USED TO DERIVE CONCENTRATION-BASED LIMITATIONS

This section summarizes the steps used to derive the proposed concentration-based limitations. For each pollutant in an option for each type of processing operation (first processing, further processing, and rendering), EPA performed the following steps in calculating the proposed concentration-based limitations:

Step 1: EPA calculated the *episode-specific long-term averages* and *daily and monthly variability factors* for all selected episodes with the model technology for the option for each type of processing operation. (See Attachment 13-2 in Appendix H for episode-specific long-term averages and variability factors.)

Step 2: EPA calculated the *option long-term average* as the median of the episode-specific long-term averages. (See Attachment 13-3 in Appendix H.)

Step 3: EPA calculated the *option variability factors* for each pollutants as the mean of the episode-specific variability factors from the episodes with the model technology. (See Appendix 13-3 in Appendix H.) The option daily variability factor is the mean of the episode-specific daily variability factors. Similarly, the option monthly variability factor is the mean of the episode-specific monthly variability factors.

Step 4: For the pollutants for which Steps 1 and 3 failed to provide option variability factors, EPA determined variability factors on a case-by-case basis. (See Table 13-13.)

Step 5: EPA calculated each proposed concentration-based *daily maximum limitation* for a pollutant using the product of the option long-term average and the option daily variability factor. (See Attachment 13-3 in Appendix H.)

Step 6: EPA calculated each proposed concentration-based *monthly average limitation* for a pollutant using the product of the option long-term average and the option monthly variability factor. (See Attachment 13-3 in Appendix H.)

The next section describes the conversion of the concentration-based limitations to the production-normalized limitations that are provided in the proposed regulation.

13.11 CONVERSION TO PRODUCTION-NORMALIZED LIMITATIONS

The previous discussions about the limitations were based upon concentration data. The proposed pollutant limitations are presented in terms of pounds of allowable pollutant discharge per 1,000 pounds of production units (lbs/1000 lbs). This section describes the conversion from concentration-based limitations to the production-normalized limitations in the proposed regulation. This section also provides EPA's methodology for determining the number of significant digits to use for the proposed production-normalized limitations.

13.11.1 Calculation of Production Normalized Limitations

In calculating the proposed production-normalized limitations, EPA used the concentration-based limitations, the production flow rates, and a conversion factor. The concentration-based limitations were calculated as described in the previous section and are listed in Attachment 13-3 in Appendix H. The following paragraphs briefly describe the production flow rates and the conversion factors used to calculate the production-normalized limitations.

The production flow rates used in the calculation are expressed as production-normalized flow rates (PNFs) in terms of gallons of water discharged per 1,000 pound of production units.[6] The production-normalized flow rates are provided in Attachment 13-4 in Appendix H. EPA used the following conversion factor:

$$conversion\ factor = \frac{3.7854\,L}{gal} \times \frac{lb}{453.593 \times 10^{3}\ mg} = 8.3454 \times 10^{n6}\ \frac{L/gal}{mg/lb}$$

The conversion factor assumes that the concentration-based limitations are expressed as milligrams per liter (mg/L). EPA used the production flows and the conversion factor to calculate each production-normalized limitation using the following basic equation:

Production-normalized limitation = Concentration-based limitation × Production-normalized flow rate × conversion factor

The following is an example of applying a conversion factor to the concentration-based limits:

For Meat First Processing technology option, suppose the concentration based daily maximum limitation is 0.1 mg/L. Using the production flow rate of 322.8 gal/1000 lb-LWK (Live-Weight Killed), the production-normalized daily maximum limitation for the First Processing Meat subcategory is:

$$LTA_{pn} = \frac{0.1\,mg}{L} \times \frac{322.8\ gal}{1000 lb - LWK} \times 8.3454 \times 10^{-3}\ \frac{L\ /\ gal}{mg\ /\ lb} = 0.2694\,\frac{lb}{1000\,lb - LWK}$$

[6] Production units include live weight killed (LWK) for first processing, finished product (FP) for further processing, and raw material (RM) for rendering.

13.11.2 Significant Digits for Production-Normalized Limitations

After completing the conversions described in the previous section, EPA rounded the proposed production-normalized limitations to three significant digits. EPA used a rounding procedure where values of five and above are rounded up and values of four and below are rounded down. For example, a value of 0.003455 would be rounded to 0.00346, while a value of 0.003454 would be rounded to 0.00345. The production-normalized limitations listed in Attachment 13-5 of Appendix H have three significant digits.