SECTION 6. PLANNING THE 2002 FSIS DOMESTIC MONITORING PLAN: PESTICIDES

NOTE TO READER: The compound list, compound scoring, and compound ranking generated for the 2001 NRP were again used in planning the 2002 NRP. The 2002 and 2001 NRP's are not identical, however, for two reasons. First, updated estimates of relative consumption were employed, resulting in some adjustments to the relative number of analyses performed for specific product classes. Second, because of changes in laboratory analytical capability, it was possible to add some new compounds, as well as necessary to suspend analysis of some compounds that were included in the 2001 NRP.

PHASE I - GENERATING AND RANKING LIST OF CANDIDATE COMPOUNDS

LIST OF CANDIDATE COMPOUNDS

The candidate pesticides of concern selected by the Environmental Protection Agency (EPA) members of the Surveillance Advisory Team (SAT) is presented in Table 6.1, *Scoring Table for Pesticides*. Since the Food Safety and Inspection Service (FSIS) wishes to prioritize which *analyses* should be conducted, compounds that are, or are likely to be, detected by the same analytical methodology have been grouped together.

RANKING OF CANDIDATE COMPOUNDS

COMPOUND SCORING

Using a simple 4-point scale (4 = high; 3 = moderate; 2 = low; 1 = none), members of the SAT scored each of the pesticides in each of the following categories. Note that some of these categories differ from those used for the veterinary drugs:

- FSIS Historical Testing Information on Violations
- Regulatory Concern
- Lack of FSIS Testing Information on Violations
- Pre-slaughter Interval
- Bioconcentration Factor
- Endocrine Disruption
- Toxicity

Definitions of each of these categories, and the criteria used for scoring, appear at the end of this section in the "*Scoring Key for Pesticides, FSIS 2002 Domestic Residue Program*."

The results of the compound scoring process are presented in Table 6.1. Where compounds were grouped together, the score assigned to each category is the highest score for all members of the group.

COMPOUND RANKING

Background

Repeating Equation (4.1), we have:

Risk = Exposure x Toxicity (6.1)
= Consumption x Residue Levels x Toxicity
= Consumption x "Risk Per Unit of Consumption"

As stated above, FSIS chose to employ techniques and principles from the field of risk assessment to obtain a ranking of the relative public health concern represented by each of the candidate compounds or compound classes. However, unlike the case with veterinary drugs (see Section 4), FSIS does not have historical data on a sufficient range of different pesticide compounds or compound classes to predict violation scores (and thus risk per unit of consumption) using a regression equation. Therefore, a somewhat different approach (although related to that used for the veterinary drugs) was necessary to estimate the "Risk Per Unit of Consumption" term.

Rating the Pesticides According to Relative Public Health Concern

The categories of "Regulatory Concern," "Pre-slaughter Interval," and "Bioconcentration Factor" were employed as predictors of risk per unit of consumption from pesticides in animal products. As indicated above, the "Regulatory Concern" category reflects EPA's professional judgment of the likelihood that a compound or compound class will exceed EPA's level of concern in meat, poultry, or egg products. Thus, it combines residue level and toxicity information. As with the "Withdrawal Time" category for veterinary drugs, the "Pre-slaughter Interval" category is expected to correlate with residue level because longer pre-slaughter intervals are less likely to be properly observed. When the pre-slaughter interval is not observed, the carcass may contain violative levels of residues, since the time necessary for sufficient metabolism and/or elimination of the pesticide may not have passed. Bioconcentration is a measure of the extent to which a pesticide concentrates within the fat deposits of animals. Pesticides that bioconcentrate are more likely to accumulate to higher levels within animal tissue, thus increasing the potential for human exposure.

The "Toxicity" category reflects both the dose required to achieve a toxic effect and the severity of that effect. It can thus be used directly as a term in Equation (6.1).

By multiplying toxicity times a weighted average of those categories used as indicators of potential residue level, we can obtain a rough estimate of the relative risk per unit of consumption represented by each compound or compound class. And as with the veterinary drugs, we can refine the equation by adding a modifier for "Lack of FSIS Testing Information on Violations." Thus, with appropriate substitution, we obtain the following equation:

Relative Public Health Concern (6.2)
= Estimated relative risk per unit of consumption
x *modifier for* "Lack of FSIS Testing Information on Violations"
= Estimated relative exposure x Relative toxicity
x *modifier for* "Lack of FSIS Testing Information on Violations"
= Weighted average of {"Regulatory Concern," "Pre-slaughter Interval," "Bioconcentration factor"} x "Toxicity" x *modifier for* "Lack of FSIS Testing Information on Violations"

In comparing Equation (6.2), above, to Equation 4.3, it can be seen that the "Weighted average of {'Regulatory Concern,' 'Pre-slaughter Interval,' "Bioconcentration factor'}" has been used in place of "Predicted or Actual Score for 'FSIS Historical Testing Information on Violations'." Endocrine Disruption" was not included in Equation 6.2, because scores for this category were not available for most of the pesticides.

Table 6.1, the pesticides are rated for relative public health concern by combining the scoring categories presented in Equation (6.2), above, using the weighting formula shown in the last column of this table, and presented in Equation (6.3), below. FSIS selected this formula, based on a consensus about the relative importance of each modifier, and of how much each modifier should be allowed to alter the underlying risk-based score for Relative Public Health Concern. The value of the selected mathematical formula is that it formalizes the basis of FSIS's judgement. This enables others to observe and understand the adjustments that were made, and it ensures consistency in how these adjustments were applied across a wide range of compounds.

Relative public health concern rating, pesticides = {[(2*R+P+B)/4]*T}*{[(L-1)*0.05]+1} (6.3)

Where: R = score for "Regulatory Concern"
P = score for "Pre-slaughter Interval"
B = score for "Bioconcentration Factor"
T = score for "Toxicity"
L = score for "Lack of FSIS Testing Information on Violations"

In this formula, "Regulatory Concern" was weighted twice as heavily as both "Pre-slaughter Interval" and "Bioconcentration Factor," because “Regulatory Concern” was considered a more direct measure of exposure. Moreover, as with the veterinary drugs, the final ratings of compounds or compound classes receiving scores of 4, 3, 2, and 1 in "Lack of FSIS Testing Information on Violations" are increased by 15%, 10%, 5%, and 0% respectively. In other words, the rating of a compound or compound class that had never been tested by FSIS (in the production classes and matrices of concern) would be increased by 15%, while the rating of one that had been recently tested by FSIS (again, in the production classes and matrices of concern) would remain unchanged.

The formulas used here for the pesticides, and in Chapter 6 for the veterinary drugs, have been normalized to give the same maximum value. Because the formula for the pesticides uses different terms (i.e., scoring categories) from that for the veterinary drugs, their scores are not precisely comparable. However, because of the normalization the scores for the pesticides and veterinary drugs are comparable in magnitude, thus enabling at least a rough comparison to be made across these two very different categories of compounds.

In Table 6.2, *Rank and Status for Pesticides*, the pesticides are ranked by their rating scores, as generated using the selected weighting formula (Equation (6.3), above). The scores presented in Table 6.2 enable FSIS to bring consistency, grounded in formal risk-based considerations, to its efforts to differentiate among a very diverse range of pesticides and pesticide classes in a situation that is marked by minimal data on relative exposures**.** These rankings do not account for differences in exposure due to differences in overall consumption. Data on relative consumption are applied subsequently, in Phase IV, when relative exposure values for each compound/production class (C/PC) pair are estimated.

PHASE II - SELECTING PESTICIDES FOR INCLUSION IN THE 2002 NRP

Following the completion of the ranking of the pesticides, the SAT (1) used these rankings to select those compounds and compound classes that should be included in the 2002 NRP, based purely on their relative public health concern and (2) determined which of these compounds and compound classes actually could be included in the 2002 NRP, based on the availability of laboratory resources.

The consensus of the SAT participants was that those compounds and compound classes ranked fifteenth or higher represented a potential public health concern sufficient to justify their inclusion in the 2002 FSIS National Residue Program (NRP).

Once these high-priority compounds and compound classes had been identified, it was necessary for FSIS to apply considerations beyond those related to public health to determine the compounds that would be sampled. The principal consideration not related to public health was the availability of laboratory resources, especially the availability of appropriate analytical methods within the FSIS laboratories. Based on these constraints, only the chlorinated hydrocarbon/chlorinated organophosphate (CHC/COP) compound class can currently be included in the NRP. The 39 compounds that will be analyzed in this class are:

HCB, alpha-BHC, lindane, heptachlor, dieldrin, aldrin, endrin, ronnel, linuron, oxychlordane, chlorpyrifos, nonachlor, heptachlor epoxide A, heptachlor epoxide B, endosulfan I, endosulfan I sulfate, endosulfan II, trans-chlordane, cis-chlordane, chlorfenvinphos, p,p'-DDE, p, p'-TDE, o,p'-DDT, p,p'-DDT, carbophenothion, captan, tetrachlorvinphos [stirofos], kepone, mirex, methoxychlor, phosalone, coumaphos-O, coumaphos-S, toxaphene, famphur, PCB 1242, PCB 1248, PCB 1254, PCB 1260, dicofol*, PBBs*, polybrominated diphenyl ethers*, and deltamethrin* (*identification only; not quantitated)

The sampling status of each compound or compound class in the 2002 Monitoring Plan is provided in Table 6.2. For each highly ranked compound or compound class that was not scheduled for inclusion in the 2002 NRP, a brief explanation of the reason for its exclusion is provided. This table will be used to identify future method development needs for pesticides for the FSIS NRP.

It can be seen that a number of highly ranked pesticides could not be included in the 2002 NRP due to methodological limitations. FSIS is currently working with EPA to extend the FSIS CHC/COP method to the chlorinated and non-chlorinated organophosphate compounds that were collectively rated as the highest priority compound class. FSIS will implement this extended methodology as soon as it becomes available**.**

PHASE III - IDENTIFYING THE COMPOUND/PRODUCTION CLASS (C/PC) PAIRS

The CHC/COP class includes pesticides that may be present in the foods animals eat, creating the potential for the occurrence of "secondary residues" (i.e., residues that are not the result of direct treatment) in all classes of animals. Other compounds within this class (such as the PCB's) are environmental contaminants to which any animal may be exposed. *For these two reasons, FSIS judged it prudent to sample for CHC's and COP's in all production classes.* FSIS also wishes to continue sampling for these compounds in all production classes as a means of monitoring for the occurrence of accidental contamination incidents.

PHASE IV - ALLOCATION OF SAMPLING RESOURCES

Since only the CHC/COP compound class will be included in the 2002 NRP, this phase is relatively straightforward. FSIS has sufficient analytical capability to implement CHC/COP analysis in all production classes. To establish a relative sampling priority for each C/PC pair, the ranking score for the CHC/COP's (as calculated in Table 6.1) was multiplied by the estimated relative percent of domestic consumption for each production class (presented in Table 4.4). This is identical to Equation (4.6), which was used to calculate the relative sampling priorities for the veterinary drugs:

$$(\text{Rel. sampling priority})_{C/PC} = (\text{Ranking score})_{C} \times (\text{Est. rel. \% domestic consumption})_{PC} \qquad (6.4)$$

As stated above for veterinary drugs, Equation (6.4) is analogous to the equation used to estimate risk (Equation (6.1)), in which risk per unit of consumption is multiplied by consumption. While the results of Equation (6.4) do not constitute an estimate of risk, they provide a numerical representation of the relative public health concern associated with each C/PC pair, and thus can be used to prioritize FSIS analytical sampling resources according to the latter. Note that the risk ranking provided by Equation (6.4) is based upon average consumption across the entire U.S. population, rather than upon maximally exposed individuals.

A ranking of the C/PC pairs within this single compound class could be obtained merely using the estimated relative percent of domestic consumption for each production class. In other words, the *rank order and the relative magnitude of the score* assigned to each of the C/PC pairs within this compound class is not changed by multiplying all the relative consumption values by the ranking score, since the ranking score is a constant term. Nevertheless, to maintain a rough parity between the sampling numbers assigned to the veterinary drugs and those assigned to the pesticides, all of the relative consumption figures were multiplied by the ranking score for the CHC/COP compound class. Then, rather than simply dividing the production classes into quartiles, the initial sampling levels were chosen using the same cutoff numbers employed in Table 4.5 for the veterinary drugs. The cutoff scores are as follows: >29 = 460 samples; 2.3 - 29 = 300 samples; 0.14 - 2.2 = 230 samples; < 0.14 = 90 samples. The results of this are presented in Table 6.3, *Pesticide Compound/Production Class Pairs, Sorted by Sampling Priority Score, with Adjusted Number of Analyses*. As described in Section 3, above, these sampling levels provide varying probabilities of detecting residue violations. Thus the larger sample sizes, which provide the greater chance of detecting violations, are directed towards those C/PC pairs that have been identified as representing higher levels of relative public health concern.

Because the numbers of squab produced and consumed are very limited, and because quantitative data on squab production were not available, squab were not included in the above determination, and were instead assigned a sampling frequency of 45 animals. This number was judged to be appropriate relative to the estimated annual U.S. production of squab.

ADJUSTING RELATIVE SAMPLING NUMBERS

Adjusting for historical data on violation rates of individual C/PC pairs

Extensive FSIS historical testing information on violations, subdivided by production class, is available for the CHC/COP compound class. This information has been used to further refine the relative priority of sampling each C/PC pair. Table 6.3 lists, for the period 1/1/90 -12/31/99, the total number of samples analyzed by FSIS in each production class under its Monitoring Plan (i.e., random sampling only), and the percent of samples found to be violative (i.e., present at a level in excess of the action level or regulatory tolerance; or, for those compounds that are prohibited, present at any detectable level). Using these data, the following rules were applied to adjust the sampling numbers:

1. C/PC pair never tested over the 10-year period: +1 level (i.e., increase by one sampling level, e.g., from 230 samples to 300 samples)
2. At least 300 samples tested over the 10-year period, violation rate $\geq$ 0.25%: +1 level
3. The maximum number of samples to be scheduled for testing is 460

The three exceptions to this system are:

1. Geese are not scheduled for more than 90 samples. Sampling destroys the entire goose carcass. Because very few geese are produced, and because virtually all geese are slaughtered by a very limited number of establishments, collecting a larger number of samples would present an unfair burden to these establishments.
2. As explained above, squab are automatically assigned 45 samples for each analysis performed.
3. Because the use of the CHC/COP method to test for phenylbutazone did not start until recently, FSIS has limited data on the occurrence of this drug in the production classes of interest. Therefore, all production classes for which phenylbutazone was designated as of potential concern (in Table 4.3, with a "✯") were assigned a minimum of 300 samples.

All of the above adjustments were applied. The sampling numbers obtained following these adjustments are listed in Table 6.3 under the heading "INITIAL ADJ. #" (initial adjusted number of samples).

Adjusting for laboratory capacity

No adjustments for laboratory capacity were necessary. Therefore the final sampling numbers for the pesticides, which are listed in the last column of Table 6.3 under the heading "FINAL ADJ. #" (final adjusted number of samples), are unchanged from those listed under the heading "INITIAL ADJ. #."

SCORING KEY FOR PESTICIDES
2002 FSIS DOMESTIC RESIDUE PROGRAM

FSIS Historical Testing Information on Violations (1/1/90 - 12/31/99)

Violation rate scores were calculated by two different methods, A and B, using violation rate data from FSIS random sampling of animals entering the food supply:

Method A: Maximum Violation Rate. Identify the production class exhibiting the highest average violation rate (the number of violations over the period from 1990 - 1999, divided by the total number of samples analyzed). Score as follows:

4 = > 0.5%
3 = 0.25% - 0.5 %
2 = 0.07% - 0.24%
1 = < 0.07%
NT = Not tested by FSIS.
NA = Tested by FSIS, but violation information does not apply.

Method B: Violation Rate Weighted by Size of Production Class. For each production class analyzed, multiply the average violation rate (defined above) by the relative consumption value for that class (weight annual U.S. production for that class, divided by total production for all classes for which FSIS has regulatory responsibility). Add together the values for all production classes. Score as follows:

4 = > 0.08%
3 = 0.035% - 0.08%
2 = 0.003% - 0.034%
1 = < 0.003%
NT = Not tested by FSIS.
NA = Tested by FSIS, but violation information does not apply.

The final score is determined by assigning, to each pesticide or pesticide class, the greater of the scores from Method A and Method B.

It can be seen that Method A identifies those pesticides that are of regulatory concern because they exhibit high violation rates, independent of the relative consumption value of the production class in which the violations have occurred. Method B identifies those pesticides that may not have the highest violation rates, but would nevertheless be of concern because they exhibit moderate violation rates in a relatively large proportion of the U.S. meat supply. By employing Methods A and B together, and assigning a final score based on the highest score received from each, both of the above concerns are captured.

Regulatory Concern

These scores represent EPA's professional assessment of the extent to which the acute or chronic dietary exposure to this compound may exceed EPA's level of concern. For compounds other than carcinogens, this was determined by comparing a compound's Acute or Chronic Population Adjusted Dose (PAD) (whichever was lower) to the estimated level of exposure. The Acute and Chronic PAD's are calculated as follows:

The Acute Reference Dose (Acute RfD) is an estimate (with uncertainty spanning an order of magnitude or greater) of a single oral exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects.

The Chronic Reference Dose (Chronic RfD) is an estimate (with uncertainty spanning an order of magnitude or greater) of a daily oral exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime.

The Acute and Chronic RFD's are calculated by dividing the No Observed Adverse Effect Level (NOAEL) (i.e., the highest dose that gave no observable adverse effect) or the Lowest Observed Adverse Effect Level (LOAEL) (i.e., the lowest dose at which an adverse effect was seen) by Uncertainty Factors (UF). UF's are used to account for differences between different humans (intraspecies variability) and for differences between the test animals and humans (interspecies extrapolation). If the LOAEL is used, an additional UF is required.

RfD = (NOAEL or LOAEL)/Total UF

The Acute and Chronic Population Adjusted Dose (PAD) are the Acute and Chronic RfD, respectively, modified by the FQPA Safety Factor:

Acute or Chronic PAD = (Acute or Chronic RfD)/FQPA Safety Factor

The acute and chronic dietary risks are expressed as a percentage of the Acute or Chronic PAD. A dietary risk of 100% of the Acute or Chronic PAD (*whichever is lower*) is the target level of exposure that should not be exceeded (i.e., the estimated risk associated with any exposure that is less than 100% of the PAD has been judged not to be of concern). In the following, "PAD" is the lower of the Acute and Chronic PAD's.

4 = PAD exceeder or carcinogen.

3 = Close to PAD.

2 = Exposure estimated to be a low percentage of PAD.

1 = Exposure estimated to be a very low percentage of PAD.

Lack of FSIS Testing Information on Violations

This represents the extent to which FSIS analytical testing information on a residue is limited, absent or obsolete.

4 = FSIS has not included this compound in its sampling program within the past 10 years (1/1/90 - 12/31/99); or FSIS has included this compound within its program only between 6 and 10 years ago (1/1/90 - 12/31/94), but the sampling does not meet the criteria specified for a "3;" or FSIS has included this compound in its sampling program, but the information is not at all useful in predicting future violation rates, because of subsequent significant changes in the conditions of use of the compound (e.g., the reduction in withdrawal time for carbadox), or because regulatory intelligence information indicates that the situation has changed significantly since the last time the compound was sampled; or because the compound is of concern in several production classes of interest, but testing has been carried out in only one.

3 = FSIS has tested within the past 5 years (1/1/95 - 12/31/99), but in fewer than 75% of the production classes of interest; or the only testing was between 6 and 10 years ago, where FSIS has analyzed at least 75% of production classes of interest for at least 2 of these 5 years, with a total of at least 500 samples per production class during this 5-year period and, in the case of a multi-residue method, the method used covers all compounds of interest within the compound class; or, the compound would normally have qualified for a "1" or "2," but the method used was not sufficiently sensitive to permit accurate determination of the true violation rate.

2 = FSIS has included this compound in its sampling program within the past 5 years in at least 75%, but less than 100% of the production classes of interest; or 100% of the production classes of interest have been sampled, but the amount and duration of sampling has been insufficient to qualify for a "1."

1 = FSIS has included this compound in its sampling program within the past 5 years, and has analyzed each production class of interest for at least 2 of these 5 years, with a total of at least 500 samples per production class during this 5-year period, and in the case of a multi-residue method, the method used covers all compounds of interest within the compound class.

Pre-Slaughter Interval

Pesticides accepted for direct dermal application have a minimum specified pre-slaughter interval. This is the interval between the last dermal application and the time of slaughter.

4 = Dermal application permitted, pre-slaughter interval 1 day or greater.

3 = Dermal application permitted, pre-slaughter interval 0 days.

2 = No direct dermal application permitted, but treatment of premises (e.g., holding cells, feedlots, barns, etc.) is permitted.

1 = No direct dermal application or premise treatment permitted.

Bioconcentration Factor

This is a measure of the compound's relative affinity for fat, as measured by the $K_{o/w}$. The $K_{o/w}$ is defined as the logarithm of the partition coefficient between octanol and water. Compounds that have a high affinity for octanol (and thus a high $K_{o/w}$) tend to bioaccumulate in body fat.

4 = log $K_{o/w}$ greater than 3

3 = log $K_{o/w}$ between 2 and 3

2 = log $K_{o/w}$ between 1 and 2

1 = log $K_{o/w}$ less than 1

Endocrine Disruption

This is a measure of the extent to which the compound changes endocrine function and causes adverse effects to individual organisms and/or their progeny, or to organism populations and subpopulations.

4 = Likely.

3 = Suspected.

NT = Not yet tested.

Toxicity

This represents EPA's professional judgment of the toxicity of the compound, including both the dose required to achieve a toxic effect, and the severity of the toxic effect. In the following, "RfD" is the lower of the Acute and Chronic RfD's. [An explanation of Acute and Chronic RfD is provided in the description of Regulatory Concern, above.]

4 = Cholinesterase inhibitor, carcinogen, or low RfD.

3 = Medium RfD.

2 = High RfD.

1 = Very low toxicity concern or eligible for exemption from the requirement of a tolerance.