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SAN JOAQUIN VALLEY UNIFIED AIR POLLUTION CONTROL DISTRICT

OFFICE MEMO

DATE: April 18, 2006

TO: Permit Services Staff

FROM: Sheraz Gill

SUBJECT: **Dairy/Feedlot PM_{10} Mitigation Practices and their Control efficiencies.**

Purpose:
The purpose of this memo is to outline the PM_{10} mitigation practices and develop control efficiencies for these practices, to be used for permitting purposes.

Analysis:
The following table outlines all the technologies that have the potential of reducing emissions from dairy/feedlot operations. The table includes the analysis and all assumptions in developing the control efficiency. A sample control efficiency calculation is included below the table.

Note: This is a working document. Mitigation practices will be added or subtracted and the control efficiencies will be revised accordingly based on new research and/or the best available data.

Mitigation Practices	CE	Assumptions/References
Downwind or Upwind Shelterbelts (plant trees or shrubs as a windbreak)	10.0% - 22.5%	WRAP Fugitive Dust Handbook, Countess Environmental, prepared for Western Governors' Association, November 15, 2004. www.ndep.nv.gov/baqp/WRAP/final-handbook.pdf This document outlines a 25% control for planting trees and shrubs as a windbreak. The document does not give any details such as size and height of such windbreaks, therefore a 10.0% control will be applied if upwind windbreaks are installed and a conservative 12.5% control for downwind and a 22.5% control will be applied If both upwind and downwind windbreaks are installed.
Freestall Housing with no Exercise Pens and non-manure based bedding	90%	Freestall housing with no exercise pens require cows to be housed entirely in the freestalls without any access to the open corrals. This eliminates the contact made with the dry manure from the corrals, which almost

		entirely reduces PM_{10} emissions from this portion of the dairy. The only time cows leave their freestall housing is to go to the milking parlor to get milked (twice a day or more depending on milking schedule). The distance from the freestalls to the milking parlor is insignificant and usually involves walking through a wet process (concrete flush lanes). The only source of PM_{10} emissions from this type of housing would be generated from the cow bedding. If non-manure based bedding is used, these emissions will also be eliminated. In order to be conservative and allow for any incidental emissions, a 90% control will be applied to this practice.
Freestall Housing <u>with no Exercise Pens and manure-based bedding</u>	80%	As explained earlier, freestall housing with no exercise pens will reduce a significant amount of emissions. However, since the bedding in the freestalls consist of dry manure or separated solids, there will be some PM_{10} emissions generated. In order to be conservative, the control efficiency will be assumed to be 10% less than freestalls with non-manure based bedding.
Shaded Areas in Open Corrals	8.3%-16.7%	Cows are easily stressed due to heat. The stress can occur at temperatures as low as 70 degrees F. Therefore, if shades are provided in open corrals, cows will tend to spend a majority of their time under the shades. However, since data was not found as to the amount of time cows spend under a shade, it will be assumed, that cows spend a minimum of 4 hours a day (4hrs/24 hrs = 16.7%) under shades. Since heifers are more active than milk cows it will be assumed, that heifers spend a minimum of 2 hours a day (2hrs/24hrs = 8.3%) in the corrals. PM_{10} emissions are reduced because cows spend less time walking on the corrals in the dry sun, hence generating fewer emissions.
Fibrous layer in Dusty Areas (i.e., hay, etc.)	10%	The addition of a fibrous layer will have some benefit since it will cover the source of emissions and will also absorb some of the manure within the fibrous layer. However, the fibrous layer must be consistently removed and a fresh layer be applied in order to achieve a high level of control. If this is done on a regular basis, a control efficiency of greater than 25% may be possible; however since frequent removal and application is costly it will be assumed that the fibrous layer will not frequently be replaced. Therefore a 10% control will be applied at this time.
Sprinkling of Open Corral	15%	Application of water on open corrals has the potential of reducing a significant amount of PM_{10} emissions. The amount of reductions depends on the amount of

		water applied and the frequency of application. Application of substantial water, where saturation occurs will practically eliminate PM_{10} emissions, however, VOC and ammonia emissions will become prevalent in that situation. Therefore, a balance must be maintained. In order to achieve any PM_{10} control, water should be applied at least once on a daily basis during the summer months. Application of sufficient water once a day will conservatively be assumed to reduce emissions by at least 15%. The higher the frequency of application, the higher the control efficiency.
Frequent Scraping and/or Manure Removal (weekly basis) using a Pull Type Manure Harvesting Equipment in morning hours when moisture in air	15%	Manure generated in the open corrals will dry fairly quickly especially in the dry summer months in the SJV. As cows traverse through the corrals, the dry manure is pulverized by the hoof action, resulting in airborne PM_{10} emissions. Therefore, to minimize this effect, the top-layer of manure should be scraped frequently (on a weekly basis). This will remove a large percentage of the source (dry manure pack) of PM_{10} emissions. Additional reductions can be obtained by removing the manure using a pull type harvester rather than a front-end loader. This allows for a uniform removal without causing divots and additional PM_{10} sources in the corrals. To maximize the reductions, scraping with a pull-type harvester should be performed in the morning hours when moisture in the air is at its highest. Therefore, a combination of these practices will be assumed to reduce PM_{10} emissions by at least 15%.
Feeding Young Stock (heifers and calves) Near Dusk	10%	Feeding the cows near dusk will preoccupy the cows when the corrals are at its driest, which will result in fewer emissions. If cows are eating rather than playing in the corrals during this time, PM_{10} emissions are either being eliminated or significantly reduced. Moisture in the air after dusk usually increases and the rate of emissions will decrease if cows exercise during that period. Therefore, a 10% conservative control will be applied for this practice at this time.
Calve Hutches (Calves under three months)	75%-95%	There are several types of hutches/individual pens at a dairy. Individual pens are similar to an open corral type housing, with the exception of the size and the amount of cows held per pen. A control efficiency will only be applied to calves hutches. Calve hutches are either placed directly on the ground with bedding or on grates, where the manure falls onto a concrete lane so that it can be flushed. Calve hutches on the ground

		consist of some bedding below the calves, thus creating a potential for emissions, however, since calves don't move as much and are confined to a small area, this type of housing still has the potential of reducing emissions by at least 75% (from the baseline EF). Emissions from calve hutches on grates, above flush lanes can be considered negligible because it is a wet process, however, to be conservative, a 95% control will be applied to this type of housing.

Example:

A dairy houses their milk and dry cows in freestalls with no exercise pens and non-manure based bedding. The heifers are housed in open corrals with shade structures. The corrals are scraped on a weekly basis using a pull-type harvester during the morning hours. The corrals are also sprinkled on a daily basis. The calves are housed in hutches on grates with a flush system. The dairy is surrounded by upwind and downwind shelterbelts.

Based on the above dairy configuration the control efficiency can be calculated as follows:

Control Efficiency for Milk and Dry Cows:

$CE = [1- (CE_{\text{Upwind/downwind shelterbelts}}) \times (CE_{\text{cows housed in freestalls no exercise and non-manure based bedding}})]$

$CE = [1- (1-0.25) \times (1-0.9)] = 92.5\%$

Control Efficiency for Heifers:

$CE = [1- (1-CE_{\text{Upwind/downwind shelterbelts}}) \times (1-CE_{\text{Shaded Areas}}) \times (1-CE_{\text{Sprinkling}}) \times (1-CE_{\text{Scraping}})]$

$CE = [1- (1-0.25) \times (1-0.083) \times (1-0.15) \times (1-0.15)] = 50.3\%$

Control Efficiency for Calves:

$CE = [1- (CE_{\text{Upwind/downwind shelterbelts}}) \times (CE_{\text{Hutches with flush system}})]$

$CE = [1- (1-0.25) \times (1-0.95)] = 96.25\%$