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Applying Alternative Technologies to CAFOs: A Case Study

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APPLYING ALTERNATIVE TECHNOLOGIES TO CAFOS: A CASE STUDY

Richard Koelsch, Carol Balvanz, John George, Dan Meyer, John Nienaber, Gene Tinker

Abstract

The US EPA National Pollution Discharge Elimination System permit program has regulated open lot livestock production systems since the 1970's, historically requiring collection, storage, and land application of runoff. Under the new Concentrated Animal Feeding Operation (CAFO) regulations, the effluent limitation guidelines (ELG) offer the option of Voluntary Alternative Performance Standards for beef and dairy. This potentially allows runoff management options such as vegetative treatment systems (VTS) that may perform equal to or better than our baseline system while maintaining a challenging standard for application of alternative technologies.

To facilitate application of VTS, the Iowa Cattlemen's Association (ICA) and Iowa State University (ISU), have initiated several pro-active efforts including field-based demonstration and evaluation of these technologies and development of performance models for estimating performance. They also enlisted USDA Natural Resource Conservation Service (NRCS) to assist with the assembly of the current science and access to cost share resources.

This paper will 1) summarize the process used for facilitating an alternative technologies application on CAFOs, 2) review the critical issues in applying new technologies from the perspective of EPA, industry, research community, and private sector; and 3) summarize lessons learned in this process. Significant obstacles exist for alternative technology applications on CAFOs. Stakeholders in livestock environmental issues will need to play pro-active roles if alternative technologies will be permitted under the CAFO regulations.

Introduction

Runoff from open lot livestock production systems poises an environmental risk. Traditionally, storage ponds collect and store runoff until land applied. Technology based standards under the ELG of the CAFO regulations have defined this approach as the only currently acceptable option. VTS is proposed as an alternative technology for runoff management. A VTS approach utilizes forage or grass based production areas to filter contaminants and infiltrate runoff into the soil. Significant VTS research, typically on non-CAFO applications, has identified potential environmental benefits for this technology.

The specific objectives of this paper are to:

1. Introduce by case study example (application of VTS to control of runoff from open lot systems) an effort to apply an alternative technology to CAFOs under the new CAFO regulations.
2. Introduce the perspectives of individual organizations participating in this process.
3. Share from our experiences the opportunities and challenges for implementation of alternative technologies on CAFOs.

Overview of Applicable CAFO Regulations

The U. S. EPA's CAFO ELGs, published on February 12, 2003, establishes the technology-based standards that must be included in National Pollution Discharge Elimination System (NPDES) permits for large CAFOs (more than 1,000 beef feeders or dairy heifers or 700 mature dairy cattle). The 2003 final federal rule (Federal Register, 2003) states that for Large CAFOs with dairy cows or beef cattle:

"(a) there must be no discharge of process wastewater pollutants into waters of the U.S. from the production area.

(1) Whenever precipitation causes an overflow of manure, litter, or process wastewater, pollutants in the overflow may be discharged into U.S. waters provided:

a) The production area is designed, constructed, operated and maintained to contain all manure, litter, and wastewater including runoff and the direct precipitation from a 25-year, 24-hour rainfall event;

b) The production area is operated in accordance with the additional measures and required by 412.37 (a) and (b)". (defines management and record keeping expectations)

(2) Voluntary alternative performance standards. Many CAFO subject to this Subpart may request the Director to establish NPDES permit effluent limitations based upon site-specific alternative technologies that achieve a quantity of pollutants discharged from the production area equal to or less than the quantity of pollutants that would be discharged under the standards as provided by paragraph (a)(1)…"

Part (1) sets the 25-year, 24-storm as the technology standard for the baseline system (runoff holding facility). Part (2) allows for an alternative technology application. The "site-specific comparison" provision assigns the burden of proof to the individual producer for proving site-specific alternative technology application as equal to or better than the baseline technology.

Performance Requirements for Alternative Technologies

The CAFO ELG require the following technical analysis for alternative technologies:[1]

1. All daily inputs to the storage system, including manure, litter, all process wastewaters, direct precipitation, and runoff.
2. All daily outputs from the storage, including losses due to evaporation, sludge removal, and the removal of waste waster for use on cropland at the CAFO or transport off site.
3. A calculation of the predicted <u>median</u> annual overflow volume based on a 25-year period of actual rainfall data applicable to the site.
4. Site-specific pollutant data for nitrogen (N), phosphorus (P), five day Biochemical oxygen demand (BOD_5), and total suspended solids (TSS) from representative sampling and analysis of all sources of input to the storage system or other appropriate data source.
5. Predicted annual average discharge of pollutants, expressed as a daily mass discharge, and calculated based upon concentration of pollutants and annual overflow volumes.

The performance model of the baseline technology must be based upon a conventional runoff pond sized to meet the ELGs. The ELG states that the containment facility must be "designed, constructed, operated and maintained to contain all manure, litter, and process wastewater including the runoff and the direct precipitation from a 25-year, 24-hour rainfall event."

A similar performance analysis for the alternative technology to that described for the baseline technology is necessary. The "target" for the alternative system is performance equal to or better than the baseline technology. In order to make the comparison for a 25-year period of actual rainfall data, modeling of the performance of a VTS is necessary. ISU has undertaken the task of assembling models for estimating performance of the baseline and VTS technologies.

VTS Application to CAFOs

With the individual CAFOs bearing the burden of proof for site-specific application of VTS, Iowa Cattlemen's Association (ICA) championed the application of VTS for Iowa feedlots. Iowa State

[1] Five identified steps are from Section 412.21 for Voluntary Alternative Performance Standards, Concentrated Animal Feeding Operations Point Source Category, Federal Register, Vol. 68 No 29, February 12, 2003.

University (ISU), in cooperation with ICA, initiated field research of this technology as well as development of the performance modeling tools. ICA enlisted the assistance of USDA NRCS for cost share assistance and technical design assistance and of EPA for monitoring the on-farm demonstrations.

Three primary outcomes resulted from these efforts. First, NRCS established of a work group with the intent of converting the current science-based knowledge into a guidance document for design and management. Representatives of USDA Agricultural Research Service, USDA NRCS, four land grant universities, US EPA, Iowa Department of Natural Resources, ICA, and the technical service provider community were assembled. This work group produced a guidance document (Koelsch, 2004) addressing CAFO regulatory policy, technical issues relative to siting, design, management, and a review of the existing scientific literature.

The literature review revealed:

- VTS performance data from 33 research citations reporting 101 separate sets of performance data for field scale and simulated field scale conditions (Koelsch, 2004, see Chapter 9 Literature Review). The literature suggests that this technology will settle many contaminants and infiltrate substantial water volume into the soil significantly reducing the concentration and volume of potential runoff. In addition, perennial forage systems, when compared to row crops, reduce runoff and erosion associated from land application site. VTS also provides opportunities for reduced capital and operating costs and less risk of groundwater contamination and catastrophic failures due to limited or no long-term storage of runoff. Primary weaknesses include lack of past VTS application to Large CAFOs and difficulties with meeting a “no discharge” standard.
- Performance of baseline technology (runoff storage and land application) based on CAFO ELG design has been estimated through two modeling efforts (producing four research publications) with no in-field validation of performance. This limited research has shown that the current ELG practice standard performs well in the drier High Plains region, possibly meeting a “no discharge” standard, but regularly produces unplanned releases in higher precipitation climates. Based upon the limited available modeling studies, the baseline technology does not meet a “no discharge” standard in many regions of the United States.

Although the work group was dominated by technical experts, it provided some opportunity for communicating needs and perspectives of regulatory and producer organization. To better understand the perspectives of the different organizations as well as the lessons learned during this process, five individuals representing the regulatory community, regulated livestock community, research community, and public and private technical services community will each present unique perspectives on this process in the following pages.

Second, Iowa State University developed performance models for the baseline and VTS technologies and conducted a peer review of these tools. The peer review group independently assessed the strengths and weaknesses of the performance models and assurances of the models’ ability to identify situations where equal or less pollutant discharge will result from VTS.

Finally, ICA and ISU have collaborated on six on-farm demonstrations of VTS being constructed with producer and public cost share assistance. US EPA is providing grant funds for monitoring of these sites. Demonstrations will begin operation during 2005.

Research Perspectives

John Nienaber, Agricultural Engineer, USDA Agricultural Research Service.

Feedlot runoff has been an important research component from the 1960's when members of the ARS research community initiated the measurement of quantity and quality of runoff from multiple research sites in Nebraska and other locations around the country. Recently, ARS has identified the need for low cost and effective alternatives to total collection and retention of feedlot

Our simplified runoff control facility, constructed in 1997 fulfilled both goal requirements (Woodbury et al,. 2002). During five years of close evaluation, we found no discharge either in surface runoff (part of the grassed field was completely isolated and the only discharge was through a flume) or in deep percolation (we installed ceramic cups to collect soil moisture at 1.5 m depth). Annual harvest has shown that we have utilized more nitrogen than was released to the field in runoff (Woodbury et al., 2003). With this type of performance in hand, we were full participants in the workshops to describe the possibilities of alternative runoff control technology. We felt it was a position of strength since we had successfully designed, constructed and maintained the facility for nearly seven years with close study of the grass field for five years.

This assembly of producers, regulators, environmentalists, designers, educators and researchers was ideal to demonstrate the effectiveness of our design and discuss the potential application of the technology. The series of working sessions has been fruitful in accomplishing those goals toward implementation of the idea and formulation of design parameters. The process of open discussions with all interests being presented has provided insights to problem solutions that could not have been achieved through normal technical information exchange as found in conferences. The forum was reminiscent of the process used in the 1960's when the research community and environmental agencies scheduled this type of discussion semi-annually. It reinforces the need for open communication among all interests.

The unachieved goals that remain are full implementation of the technology to solve the contrasting problems of environmental protection and economic sustainability of a somewhat fragile livestock production industry. It is obvious that a perfect solution is not possible, or is it? We cannot assure complete control of all losses of liquid runoff either by surface or deep percolation and so the regulators are uneasy about granting acceptance of the technology. There is even some reluctance to grant a limited acceptance of the technology. Likewise, any regulations that impact the operation of a facility likely to discharge runoff to an open stream or groundwater are closely and reluctantly conceded to be in need of control. Even minimal controls are regarded as production impositions. Mutual trust of both ends of the spectrum have slowed the full implementation of ideas and solutions.

The final analysis of the simplified runoff control system developed at MARC is an example of an alternative technology that achieves both economic benefits for the producer and environmental benefits for the public.

Regulatory Agency Perspective

Gene Tinker, Animal Feeding Operations Coordinator, Iowa Department of Natural Resources

The role of the Iowa Department of Natural Resources, as the regulatory agency for Iowa's livestock industry, is to protect the natural resources of the state, including surface and ground water. With this role comes the added responsibility to require additional considerations when evaluating unproven methods, as large-scale acceptance of technologies that may not perform adequately can have a substantial detrimental impact on the state's natural resources. In addition, feedlots that don't meet the performance standard will be required to conform to a conventional system, thus resulting in design and construction costs for two systems. It isn't prudent to rush use of such unproven technologies with the associated risks to the state's natural resources and especially the feedlot operators' financial well being.

The new CAFO regulations offer Alternative Technologies as an option, not a requirement, for state regulatory agencies. In an attempt to assist open feedlot operators in the state, IDNR chose to evaluate such alternatives to determine if equivalent performance could be achieved. The CAFO regulations require predictive modeling in conjunction with site monitoring to forecast whether equivalent performance can be met. IDNR provided financial support to Iowa State University to develop the predictive models. IDNR also developed the initial minimum siting criteria document for producers and consulting engineers to use for determination of whether a feedlot has at an appropriate location to consider a Vegetative Treatment System. The siting criteria were modified with input from Iowa State University, NRCS and the Iowa Cattlemen's Association, and subsequently were used as the starting point for the NRCS Guidance Document.

The regulated community has difficulty accepting the differences involved with a treatment system and that of the more standard crop usage rate application system. The treatment system includes risks of nutrient and contaminant accumulation over time, since the effluent is constantly released to the same treatment area at a rate greater than the associated vegetation and microbial community can utilize. The emphasis of treatment has been on only superficial improvement of migratory nutrients, which will provide considerable improvement to many feedlots and their related surface waters. However there should be additional consideration for subsurface effluent travel. Studies have indicated in even the tightest soils some components such as nitrates, chlorides and even phosphorus migrate through macro pores and/or preferential flow paths under no-till conditions. Therefore groundwater monitoring must be conducted to determine if the system is having a detrimental impact. Additionally, the potential for nutrient accumulation may begin to impact the system's ability to fully treat effluent.

It has been noted that this is not new technology, having been discussed thirty years ago. But it has been shelved for thirty years and no progress was made on proving the effectiveness of such systems. It should also be noted that large Iowa feedlots have been out of compliance with environmental regulations for thirty years. Some of these sites could have been used to evaluate this technology to determine usefulness and effectiveness. But the industry chose to do nothing and therefore we now have the task of conducting that evaluation. Until more is known about the effectiveness and proper siting of these systems, each site must be thoroughly evaluated and monitored for effectiveness.

The process for developing the NRCS Guidance Document seemed to go quite smoothly. This has been quite different from how things proceeded within the state. Over zealousness by producers and their support organizations to get a site permitted has caused frustration and unhappiness for all parties within the state. Acceptance of our disaster with the first feedlot probably prompted greater cooperation during development of the NRCS Guidance Document.

The greatest lesson learned within the state is the time-honored lesson of treating others as you would prefer to be treated. All entities involved must respect one another, even if those entities have differing views and goals. We have much rebuilding to do within our state due to previous interactions, and I suspect the producers of the state will ultimately be impacted the most by it.

Producer Community Perspective

Carol Balvanz, Public Policy Director, Iowa Cattlemen's Association

As public policy director for the Iowa Cattlemen's Association, I represent approximately 10,000 open feedlots in Iowa including about 200 of those open lots that qualify as CAFOs The long-accepted technology standard of a total containment basin on all open lot CAFOs has been difficult for Iowa feedlots to meet economically. Iowa receives an average of 34 inches of rainfall annually. Therefore, basins must be built to contain far more precipitation than other areas of cattle feeding country. Iowa feeders are also without resident irrigation equipment to pump out these basins. The costs of compliance, including the increased size of the basin and the cost of dedicated irrigation equipment for the feedlot effluent price traditional NPDES compliance out of reach for most of our 2500 head capacity and smaller feedlots.

In addition, models of the traditional basin technology run with 50 years of Iowa weather data have shown that in Iowa's climate, these basins only effectively manage only 83%-93% of feedlot effluent. The systems do not represent 100% containment in the upper Midwest as they might in the Plains and Southwest.

Iowa cattle producers have known for several years that they need a lower cost alternative to building containment basins on the CAFO-sized feedlots across the state that must meet NPDES standards. In 2000, members of the Iowa Cattlemen's Association teamed up with the at Iowa State University to study the feasibility of using vegetative treatment systems for feedlots over 1,000 head. These systems were working well for some Iowa feedlots below 1,000 head, costing a fraction per head of what basin systems cost. Therefore, we believed, and were encouraged by the ISU researchers, that these systems could be designed to meet the needs of CAFO-sized feedlots if the right siting criteria were present.

We have worked since 2001 to make our case and generate enough interest in non-basin alternative technologies to develop a pilot project of six CAFO Vegetative Treatment System sites in Iowa to test the results. We requested and received assistance from NRCS and EPA described previously to develop VTS technical design parameter and demonstrate in-field performance of VTS.We have understood from the beginning that it would be critical to have buy-in from EPA, NRCS, the engineering community and Iowa Department of Natural Resources (DNR) in order for this to project succeed. So far we have all of those groups at the table, with some providing important funding for the effort. The most critical measure of success for the industry will be if we can meet those standards in a more economical fashion and retain our industry in Iowa.

The ICA has been encouraged by the participation and interest of government and regulatory agencies as well as the academic community. However it is clear that it will be difficult to meet the approval of so many diverse groups. At the current time, our primary obstacle is getting DNR comfortable enough with the parameters and capability of the systems to get permits written that will allow the systems to be built economically. Another issue that has not been addressed is how to measure success or failure of the systems. We know these will not be zero discharge systems. However, basin systems in Iowa are not zero discharge either. DNR has now complicated the performance measurement of these systems by adding protections for shallow groundwater that may be affected by infiltrating effluent. We believe the dilute nature of most feedlot effluent, and the percolation of the effluent through Iowa's soils make this far less of a problem than DNR believes it to be. We need to test this premise.

The Iowa Cattlemen's Association is looking for specific results from this project.
We would like to see -

1) Alternative technologies earn a "stamp of approval" through the pilot project as meeting the environmental performance equivalent to a basin, given appropriate siting criteria.
2) Monitoring results that will allow siting criteria be relaxed somewhat from current standards, especially as related to groundwater standards.
3) The engineering/design component of vegetative treatment systems become less expensive as comfort with the performance of the systems grow.
4) Producers who have chosen to drop feedlot capacity below 1,000 head due to the expense of building a conventional system gain the opportunity to increase capacity, obtain a VTS permit and have their VTS be recognized as "in compliance" by DNR and EPA.

5) This technology made applicable to other areas of the country and recognized as a viable and even preferable alternative to basins.

The process used to develop these tools for VTS has run pretty smoothly on the surface. Many opportunities for review and input by the experts have been provided. The individuals invited to the consortium represent many years of experience with traditional technology, and some participants have been somewhat reluctant to allow VTS alternatives to be applied to CAFOs. The greatest weakness of the process has been the lack of review and communication with producers who have to pay for and manage the technology. Some of the systems we're seeing designed are nearly as expensive as traditional systems because the regulatory agencies lack faith(faith might not be a good choice of words…is "understanding" better?) in the processes of infiltration and vegetative treatment and a layering of both water balance and nutrient management requirements on the VTS.

We fear that this project may simply be creating one or two new "cookie cutter technology standards" that will only be applicable in a very limited number of cases. We had hoped to look at a performance-based measures of VTS. If EPA/DNR expect these systems to meet a zero discharge standard, VTS will not be accepted. We are hopeful that the pilot project will open more constructive dialogue between our producers and agency personnel and provide water quality and air quality solutions for CAFOs.

I think the most important "lessons learned" are yet to be learned. We need to see these systems on the ground and test their capabilities before handcuffing them with so many restrictions that they become too difficult to design and operate. ICA continues to take the practical approach to Vegetative Treatment Areas, knowing that our ISU researchers have confidence these systems can perform very well in Iowa's climate if sited properly. What we need is the recognition that new ideas may move us closer to both improved environmental performance and economic viability if given the chance.

Private Sector TSP Perspective

John A. George, P.E., consulting engineer, Agricultural Engineering Associates

This section is written from the perspective of an agricultural engineer who was in the EPA when the original ELG for CAFOs was written and the first permit language was generated. Since that time, the author has been involved solely as a consultant working with livestock production and research facilities domestically and internationally for three decades. Within this project, the author appears to be the only participant without the mantle of public employment with extensive experience representing producer's interests in facility design, acquiring environmental permits, and managing facilities for environmental compliance.

The reader should understand that the Clean Water Act(CWA) required EPA to survey the applicable environmental protection technologies for each industry in anticipating the definition for each of the Best Available Technology(BAT) economically achievable and it's inherent performance level that would be required in NPDES Permits for all "point sources". Feedlots, many of which constitute the typical "non-point" pollution source, were stipulated to be a "point source" and thus subject to NPDES permit compliance if they discharged and contained over 1,000 animal units. The CWA anticipated that each facility required to have a permit would select from the available and emerging technologies the one(s) most suitable to their situation to meet the permit performance requirements which derived from the ELG definition of BAT. *The BAT based permit limitations set the performance level for discharge parameters that were to be achieved for each industry. Individual facilities within that industry could chose any technology as long as the permit performance limitations were met*.

After the ELG for CAFOs was completed, we developed permit language that required compliance with BAT that was simply stated as "design, build, and maintain retention structures capable of containing the runoff from the 25 year, 24 hour precipitation event for the locale of each CAFO". While the permit language recognized and allowed for the reality that these facilities would be overtopped by both the acute "design storm" and chronic events in many regions of the country, the environmental leadership in this country began representing the CAFO ELG as a "zero discharge" technology, and the presumed performance to be "zero discharge". In response to that *faux pas*, the author along with Kansas State University catalyzed the first EPA funded CAFO performance modeling project in the mid 70's which documented that ELG Permit compliant CAFOs discharge significantly from a variety of environmental conditions in all but the most arid locations in the U.S.

Most attempts at implementing any of the non-point source technologies such as VTS were rebuked as not being "zero discharge" technologies and therefore not permittable for a CAFO. In singling out agriculture and CAFOs as the only industry not allowed to utilize the most efficient technology that they could find to meet the BAT equivalent performance for individual sites, the environmental establishment not only throttled what had been significant on-going research efforts on VTS prior to and during the early 70's, but they essentially cut off all significant funding for any new or additional research, demonstration, and technology development work for the ensuing three decades. At the same time, they created a tunnel-vision focus on prescriptive design requirements for CAFO pollution control systems in lieu of performance standards for CAFOs. This has excluded any recognition of the CWA envisioned "performance based" permit criteria that should have allowed (actually encouraged!) utilization of VTS technologies for appropriately sited, designed, and managed CAFOs for the last three decades.

This project was brought about by the inclusion in the new CAFO rules language presuming to encourage and allow alternative technologies(§412.31(a)(2)). It has placed a potentially impossible burden on individual applicants and designers to prove to the Director independently on each site that the proposed design will function with equivalent environmental protection as the detention ELG. This project sought to bring together some of the best agricultural waste management resources in the country to try to fill this long-standing void and move the technology ahead . It has become obvious within the context of this project that most of the project participants are still much more comfortable with prescribing design and siting requirements in lieu of seeking to facilitate producers and designers having the full range of technologies available to make the best use of site specific resources and management to provide BAT equivalent or better performance. Their reliance upon prescriptive design and management requirements continues to defeat efforts to transition CAFO pollution control to the same enlightened and effective site specific resource and technology utilization paradigm afforded all other NPDES Permit holders since the inception of the CWA. Obviously there is much still left to be accomplished to give CAFOs the opportunity to utilize the most economical and effective technologies possible to elevate environmental protection and enhancement.

USDA Natural Resources Conservation Service Perspective

Daniel E. Meyer, National Agricultural Engineer, Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) has always been a proponent of partnership-based natural resource conservation initiatives. The integrated efforts put forth on the alternative technologies for Concentrated Animal Feeding Operations (CAFO) demonstrated the efficacy of these types of initiatives.

The NRCS is the leading provider of science-based technical assistance and technology transfer to agricultural producers on natural resource conservation and management. Although staffed with technical experts from various natural resource disciplines, NRCS does not develop the science used to support new and innovative technologies; instead, NRCS relies on ARS, the land grant universities, and private industry to research and validate new technologies that can be added to the technical tools that NRCS utilizes. . The ability to leverage existing resources already dedicated to addressing an identified need, greatly enhances the opportunity to provide new technologies in a timely manner. In the case of this initiative, building a partnership of individuals and groups already involved led to incredible cooperation in addressing the issue at an accelerated rate rarely possible under normal technology development planning scenarios.

In response to new environmental regulations introduced by the U.S. Environmental Protection Agency (EPA), producer groups approached NRCS with an identified need for new technology to mitigate the environmental impacts of runoff from open animal feedlots. NRCS agreed to facilitate a partnership of stakeholders and shareholders involved in the issue to address this need. By involving National, Regional, and State regulatory agencies, land grant universities, private sector technical assistance providers, and producer groups, an effective strategy was formulated and carried out that provided for accelerated delivery of new technology. Involving the appropriate stakeholders from the beginning allowed for constructive interaction on the expectations of each group that ensured successful procedures and processes were put in place.

Even though the specific need that identified alternative technologies for CAFOs was somewhat narrow in scope, NRCS recognized the potential application of the final technology to a far wider range of operations—all confined operations that utilized open feedlots. Because this expanded application could be made available to more livestock producers, NRCS in addition to providing a facilitation role to this initiative, provided financial assistance to ensure that critical non-NRCS technical experts could participate to the extent needed, ensuring success within the critical timeframe outlined.

NRCS views this initiative as a success in addressing the needs of agricultural producers in meeting regulatory requirements and in providing new and innovative technology to address natural resource concerns in a timely manner. These successes were achieved primarily because of the partnership approach used to address the issues raised and the dedication of the partnership members in achieving a science-based solution.

Lessons Learned

The experiences associated with this case study of the application of an alternative technology to meet the ELG for a Large CAFO reveals several critical lessons:

<u>Strengths and Weaknesses of Process.</u>

New models needed for meeting burden of proof for alternative technologies. Based upon our experience with VTS application to permitted Large CAFO operations, four fundamental building blocks are required for application of an alternative technology under the CAFO ELG: 1) A review of existing science by a group of technical experts for development of initial design and management based recommendations; 2) development of models that accurately describes the performance of the baseline and the alternative technologies; 3) field test program for evaluating initial CAFO applications of alternative technologies under field conditions; and 4) stakeholders communications network through the entire process.

Stakeholder communications network was the weakest link. During this case study, the communications network was the weakest link. This was due in part to regular communications not being initiated until later in the process and a focus of this discussions on technical and regulatory issues. Lack of understanding of what is important to all stakeholders led to unmet expectations. The producer community's concern about cost of compliance was not adequately addressed by this process.

New role for research community. Agricultural Research Service and land grant university research staff will need to play an expanded role if involved in research and development of alternative technologies for animal feeding operations. The research community must play an active role in achieving acceptance by the environmental regulatory community of an alternative technology's application to CAFOs.

New role for regulatory community. The regulatory community should better define the “yardstick” by which alternative technologies can be measured. If the regulatory community could lead the conversion of Best Available Technology standards defined by the Effluent Limitations Guidelines into a regionally specific and measurable performance based standard, alternative technologies could be more fairly evaluated.

Important contribution by technical expert group. The technical expert work group from the research, technical advisory, and regulatory community developed key products in a timely manner including a literature review, guidance document, and performance model review. The level of "prescriptive" design contained within the guidance document was of concern to some participants. Overall, there is agreement that expert group made an important contribution to the advancement of an alternative technology for CAFOs.

Potential for VTS Application to Large CAFOs.

VTS offers environmental improvements. A significant database from research and field experiences suggests that VTS offers the opportunity for both significant environmental improvement and reduced costs for attaining those improvements. The performance of the baseline technology defined by the ELG is not as well defined as the alternative technology. Past restrictions by CAFO regulations have limited the application of this alternative to Large CAFOs. As a result, the ability of a VTS to achieve environmental improvements equal or better than the baseline technology on a Large CAFO remains an unanswered question.

Practice based environmental standards limit new technologies. Practice based environmental performance standards are proving to be a significant obstacle to the application of VTS on large CAFOs. Characterization of current ELG as representing “No Discharge” has established an inaccurate performance expectation for the baseline technology in many regions of the country. The lack of an accepted measure of performance for the baseline technology makes evaluation of an alternative technologies very difficult. Some would argue that the current ELG continues to limit environmental management to a single solution that does not change with time.

Limited window of opportunity for VTS application to existing CAFOs. With the approaching April 2006 deadline for CAFO rule compliance, a combination of past EPA CAFO regulations allowing only a single technology option and past avoidance of CAFO rule compliance by some sectors of the livestock industry has led to a very narrow window of opportunity for application of alternative technologies for existing large CAFOs. This is leading to considerable frustration among some stakeholders.

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