

**REVIEW OF TECHNICAL STANDARDS AND
REQUIREMENTS FOR AIR EMISSIONS FOR POULTRY
PROCESSING AND SLAUGHTER WASTE**

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EXECUTIVE SUMMARY

The BC Ministry of Environment is planning to develop Codes of Practice for the slaughter industry and poultry processing industry that will apply province-wide and eventually replace the need for individual air permits as the instrument for regulation of discharges to the environment. Codes of Practice are 'minister's regulations' which are enforceable standards that will streamline the authorization process for both industry and the Ministry. This study was undertaken to document and compare air emission requirements and technical standards applicable to emissions from slaughter and poultry facilities and to provide recommendations for use in developing the Codes of Practice. Of particular interest are air standards for incineration of livestock waste which is the main focus of this study.

The main driver for the development of air standards for incineration are the pending changes to the Canadian Food Inspection Agency (CFIA) feed ban regulation that prohibits specified risk material (SRM) for use in animal feed, pet food and fertilizer chains. The regulatory changes take effect on July 12, 2007 and require industry to apply control or destruction methods to manage SRM waste. Incineration is included as an acceptable destruction method based on a risk assessment analysis conducted by the CFIA. To obtain a permit for destruction of SRM by incineration, the applicant must demonstrate that the device operates in accordance to the criteria defined in the risk assessment and that Provincial air emission standards are met.

A detailed jurisdictional review of incineration and general air emission standards and technical requirements was conducted to gather relevant information applicable to BC for use in developing the Codes of Practice. The review covered British Columbia, some Canadian and US jurisdictions, and the European Union and UK. Limited guidance was identified in Canadian jurisdictions with the exception of Alberta where a Code of Practice has been developed for small incinerators. The Code was not developed specifically for animal by-product waste but does contain some useful general guidance.

In the US, Texas, Nebraska, and Missouri were identified with established "Permit by Rule" regulatory programs for small incinerators. Permit by Rule programs are similar in concept to Codes of Practice in that a set of standard requirements are established for an entire sector eliminating the need for individual air permits for facilities meeting the minimum criteria. The programs target small dual chamber incinerators, < 90 kg/hr (200 lb/hr), and specify minimum operating temperatures as well as particulate matter and opacity limits.

The European Union and UK have the most advanced air standard programs in place for incineration of animal by-product waste due to the high incidence of BSE and the need to destroy SRM waste in a manner that eliminates further spread of the disease. Best Available Technique (BAT) guidance for incineration of wastes from slaughterhouses and animal by-product industries were developed by the European Commission to provide guidance to member states. Emission limits are specified for a list of criteria air contaminants and toxics which are suitable for large-scale centralized incinerators equipped with wet scrubbers and fabric filter controls.

Recommendations for incineration standards for livestock waste in BC were developed considering the relatively small-scale industry operating in the Province. The recommendations are described in detail in Section 5 and cover operational requirements, monitoring and reporting, and emission limits.

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GLOSSARY AND ABBREVIATIONS

ABPR	Animal By-Products Regulation
APCD	Air Pollution Control Districts
AQMD	Air Quality Management Districts
BACT	Best Available Control Technology
BAT	Best Available Techniques
BSE	Bovine spongiform encephalopathy
CCME	Canadian Council of Ministers of the Environment
CFIA	Canadian Food Inspection Agency
CISWI	Commercial and Industrial Solid Waste Incineration
EMA	Environmental Management Act
FCAA	Federal Clean Air Act
IAF	Investment Agriculture Foundation
IPPC	Integrated Pollution Prevention Control
ISO	International Standards Organisation
NAAQS	Ambient Air Quality Standards
NDEQ	Nebraska Department of Environmental Quality
NSPS	New Source Performance Standards
ODADA	Ontario's Dead Animal Disposal Act
OMAF	Ontario Ministry of Agriculture and Food
PBR	Permit by Rule
SHTC	Swan Hills Treatment Centre
SRM	Specified Risk Material
TCEQ	Texas Commission on Environmental Quality
WDR	Waste Discharge Regulation

1 INTRODUCTION

The BC Ministry of Environment is planning to develop Codes of Practice for a number of sectors that will apply province-wide and eventually replace the need for individual air permits as the instrument for regulation of discharges to the environment. Codes of Practice are 'minister's regulations' which are enforceable standards that will streamline the authorization process for both industry and the Ministry. This study was undertaken to document and compare air emission requirements and technical standards applicable to emissions from slaughter and poultry facilities for use in developing the following Codes of Practice for BC:

- Slaughter Industry Code of Practice
- Poultry Processing Industry Code of Practice

These industries are both prescribed industries that can be regulated under a Code of Practice as defined in Schedule 2 of the Waste Discharge Regulation (WDR) under the Environmental Management Act. Discharges associated with Schedule 2 activities are generally lower risk than Schedule 1 activities that typically have complex discharges with potential for significant impacts requiring site specific authorization. The WDR defines the slaughter industry as "establishments engaged in processing more than 1500 tonnes of red meats per year, but does not include establishments included in the definition of rendering industry". The poultry processing industry is described in the WDR as "establishments that process more than 130 tonnes live weight of poultry per year, but does not include establishments included in the definition rendering industry". A recent draft publication by the Ministry of Environment, "Guidelines for Provincial Waste Disposal Authorization Requirements for the Slaughter Industries and Poultry Processing Industries (November 2006)" indicates that authorizations are required for the incineration of waste from all poultry processing or slaughter operations in the province regardless of size.

Currently, the Environmental Management Act requires an authorization for each of the following waste management activities at slaughter and poultry facilities: composting, incineration/gasification, land application, landfill and waste water treatment. Under the Code of Practise approach, a facility would submit one application/registration under the Code for its prescribed industry and demonstrate it meets all documented Code requirements. This approach is intended to provide certainty to industry, streamline the authorization process for the Ministry and industry, and shift to a more results-based focus.

Of particular interest are air standards for incineration of livestock waste which is the main focus of this study with additional consideration of other air impacts associated with both new and existing operations accepting this type of waste. The focus on incineration is driven by the BSE issue and pending enhancements to Canada's ruminant feed ban as regulated by the Canadian Food Inspection Agency (CFIA). The new regulations which take effect on July 12, 2007 prohibit specified risk material (SRM) for use in animal feed, pet food and fertilizer chains and require control or destruction of SRM waste with incineration included as an acceptable destruction method. A review of incineration and general air emission standards and technical requirements relevant to the slaughter industry was conducted for British Columbia, some Canadian and US jurisdictions, and the European Union and UK.

2 STUDY APPROACH AND SOURCES OF INFORMATION

2.1 GENERAL APPROACH

The study reviewed the air standards applied in BC, Alberta, Saskatchewan, Manitoba, and Ontario in Canada. Alberta is focused on due to the size of the slaughter industry and the development of policy and standards for the industry. In the United States, nearby jurisdictions with slaughter and poultry industries similar in size to BC were reviewed including Washington, Idaho, Oregon, Montana, and California. Texas was added due to the high volume of cattle slaughter and poultry production industries and their experience with a BSE case. Nebraska and Missouri were identified as having programs in place equivalent to Codes of Practice for incineration and were added to the review. The European Union and UK were reviewed due to their advanced development of incineration standards driven by the high incidence of BSE.

The main steps in this review were:

- Identification and gathering of information for each jurisdiction pertaining to permitting and regulation of air emissions;
- Review of the available information and compilation of answers to a specific list of questions posed by the BC Ministry of Environment;
- Preparation of an overview of the technical standards/requirements for each of the jurisdictions reviewed

A standard set of questions, prepared by the BC Ministry of Environment, was used to guide the focus and scope of the review. For air emissions from slaughterhouses and poultry processing facilities incinerating and managing slaughter waste:

1. Is there other Code of Practices for incineration, specific to the slaughter industry, in other jurisdictions?
2. What are the most common parameters, numerical standards and monitoring protocols used by other jurisdictions when incinerating this waste?
3. How are odour management issues addressed by slaughterhouses and poultry processors?
4. Are emission controls needed (i.e. scrubbers, precipitators and/or cyclones)?
5. What are common dust management strategies that would be suitable for slaughterhouses and poultry processors?
6. Are there common triggers for when to require modelling?
7. How should this waste be managed prior to incineration?
8. Are the requirements in Alberta Environment's Code of Practice for Small Incinerators sufficient for incinerating this type of waste?
9. Would the Best Available Techniques for incineration of wastes from slaughterhouses and animal by-products industries specified in the European Commission's Reference Document on Best Available Techniques in Slaughterhouses and Animal By-Products Industries, May 2005 by the Integrated Pollution Prevention and Control, be technically possible and viable in BC?

Other considerations

Amendments to CFIA regulations include incineration as an acceptable method for waste management. CFIA permitting requirements and operational standards will be reviewed due to their influence on slaughter waste incineration practices in Canada.

2.2 SOURCES OF INFORMATION

The primary sources of information used in the review were as follows:

- Canada:
 - Canada Food Inspection Agency Ruminant Feed Ban Regulation
- British Columbia:
 - Regulatory information contained in the Environmental Management Act, Waste Discharge Regulation, contact with regional offices
 - Investment Agriculture Foundation (IAF) reports for incineration and gasification pilot tests performed in BC for slaughterhouse waste
 - air permit provided by the BC MOE for a poultry processing facility including pathological incinerator
- GVRD
 - Air permits for a slaughterhouse and a poultry processing facility provided by the GVRD
 - Direct contact with staff of the GVRD
- Alberta
 - Regulatory information from Alberta Environment
 - Direct contact with staff of Alberta Environment
 - Review of air permits for slaughter and poultry facilities
 - First-hand knowledge of the study team
- Saskatchewan, Manitoba, Ontario
 - Regulatory information from public sources and direct contact with responsible agency staff
- US Jurisdictions (US EPA, Washington, Idaho, Montana, Oregon, California)
 - Primarily from information available in rules, regulations and regulatory guidance available from regional and state air agencies on their web sites.
 - Contact with staff of the Washington State Department of Ecology, Washington Southwest Clean Air Agency, Idaho Department of Environmental Quality,

Montana Department of Environmental Quality, Oregon Department of Environmental Quality

- Additional research to locate other states with Codes of Practice or equivalent registration programs for livestock waste incineration: Texas, Nebraska, Missouri
- European Union, United Kingdom
 - Information available from rules, regulations and regulatory guidance available from national environmental agencies in these countries on their web sites
 - European Commission's Reference Document on Best Available Techniques in Slaughterhouses and Animal By-Products Industries, May 2005
 - First-hand knowledge of the study team

Contact was made with staff at the regulatory agencies in Canada and the United States surveyed in this study. The names and contact information for these individuals are provided in Section 7.

3 OVERVIEW COMPARISON OF AIR EMISSION REQUIREMENTS FOR JURISDICTIONS REVIEWED

The nine questions outlined in section 2.1 were prepared by the BC MOE as a guide for this review. Answers to these questions are summarized in Appendix A covering the major jurisdictions reviewed: Canada, USA, European Union and the UK. The completeness of the answers was contingent on the availability of air permits, permitting guidance documents, and rules and regulations via regulatory agency web sites. Interviews were conducted with regulatory agency representatives via telephone and email. Information was collected from these sources for jurisdictions in North America, with the challenge in US jurisdictions being the complexity and interrelationships of state and federal requirements. For some jurisdictions insufficient information was available from the agency contacts and the available literature to answer some of the questions and this is made clear in the summary tables.

Drawing on the summary tables, the main observations and findings from comparison of the air standard requirements and approaches in the surveyed jurisdictions are highlighted in this section. A detailed discussion of the jurisdiction review is provided in Section 4 with a summary of the key findings relevant to Code of Practice development included in Section 5.

In North America, incineration standards for livestock waste are not as well developed as the requirements in Europe and the UK. The development of advanced incineration programs and regulations in Europe is clearly driven by the higher incidences of BSE relative to North America:

Table 3-1 Number of Reported Cases of BSE in Farmed Cattle (1989 – 2006)

Country	BSE
UK	181,493
Ireland	1,584
Portugal	996
France	831
Spain	654
Switzerland	464
Germany	404
Canada	10
US	2

Note: totals include domestic and imported cases
Source: World Organisation for Animal Health

In the Canadian jurisdictions reviewed, Alberta was found to have the most established regulatory requirements for incineration and the slaughter/poultry industry in general. A Small Incinerator Code of Practice was established in September 2005 with temperature requirements sufficient to inactivate pathogens including prions in livestock waste (870°C, dual chamber units). Other provinces with less significant slaughter and poultry sectors had limited information available.

The review of neighbouring US jurisdictions yielded limited information mainly due to the small scale slaughter and poultry industries. Expanding the search to states with larger slaughter industries revealed useful information in the form of incineration Permit by Rule

programs similar in concept to a Code of Practice. The states of Texas, Nebraska, and Missouri were identified as having established Permit by Rule programs.

The European Union and the UK have advanced regulatory programs and facilities in place capable of incinerating livestock waste on a large scale with effective operational requirements to ensure destruction of infectious agents while limiting adverse effects on air quality.

4 DISCUSSION OF REGULATORY REQUIREMENTS FOR AIR EMISSION SOURCES BY JURISDICTION

4.1 CANADA

Federal standards directly applicable to the slaughter and poultry sectors tend to focus on liquid effluent discharges. The Fisheries Act regulates liquid effluents from the industry under the Meat and Poultry Products Plant Liquid Effluent Regulations. From an air quality perspective, there are no CEPA regulations directly applicable to the industry. Federal and Provincial standards for incineration do exist; however, they are applicable to hazardous waste and biomedical waste incineration.

The Canadian Council of Ministers of the Environment (CCME) National Guidelines for Hazardous Waste Incinerator Facilities (1992) include a requirement for a minimum temperature of 1100°C for hazardous waste incineration. These guidelines are currently under revision and new requirements may be included in the updated document. The CCME Guidelines for Municipal Waste Incineration (1989) are out of print but still provide some useful guidance on incinerator operation and emission limits. They are similar to the hazardous waste guidelines and focus on emissions of dioxins/furans and metals, which are not an issue if only animal waste is incinerated. It should be noted that Ontario considers municipal waste incineration the appropriate category for animal waste.

There are also a number of national ambient air quality standards developed by Environment and Health Canada and the CCME. Substances of interest for incineration include carbon monoxide, sulphur and nitrogen oxides and particulate matter (PM). The CCME developed PM_{2.5} and Ozone standards in 2000 that have been widely adopted in Canada which are used for assessing airshed quality as they are based on long term averages (98th percentile annual average over 3 years). They are not intended for directly setting individual incinerator emissions, but are a useful tool in assessing long term impacts of development and can be used as an indication if more stringent criteria are needed (eg. if airshed quality deteriorates).

4.1.1 Canadian Food Inspection Agency (CFIA)

Bovine spongiform encephalopathy (BSE), commonly known as mad cow disease, is a fatal neurodegenerative disease of cattle with no effective treatment or vaccine. BSE is associated with an abnormal prion that accumulates in the brain, spinal cord and dorsal root ganglia and is spread through the ingestion of prion-contaminated meat and bone meal. The CFIA administers and enforces the following regulations in Canada to safeguard against the spread of BSE in Canada:

- Health of Animals Act and Regulations: control disease and toxic substances that may affect animals or may be transmitted to persons;
- Feeds Act and Regulations: control and regulate substances manufactured, sold or imported for consumption by livestock;
- Fertilizers Act and Regulations: regulates fertilizers including agricultural fertilizers, specialty fertilizers, fertilizer-pesticide combinations and supplements;

- Meat Inspection Act and Regulations: designed to protect Canadians from health hazards which may be present in meat products processed in federally inspected facilities.

A feed ban was implemented as a precautionary measure in 1997 prohibiting the feeding of ruminant animals with most mammalian proteins. The first case of BSE in North America was detected in Alberta in May 2003 which prompted the CFIA to amend the Food and Drug Regulations and the Health of Animals Regulations to remove Specified Risk Material (SRM) from cattle slaughtered for human consumption. SRM are tissues that harbour the agent that may transmit the disease in BSE infected cattle. Specifically, these tissues include:

- From cattle of all ages: distal ileum (portion of small intestine)
- From cattle 30 months and older: skull, brain, trigeminal ganglia (nerves attached to the brain), eyes, tonsils, spinal cord, dorsal root ganglia (nerves attached to the spinal cord). Research has shown that these tissues do not contain the infective agent in cattle younger than 30 months.

The BSE case in Alberta prompted a review of the Canadian BSE situation by an international panel of animal health experts. The panel made four recommendations: improved cattle identification, increased BSE surveillance testing, complete removal of SRM from the human food chain and complete removal of SRM from the animal feed chain. The first three recommendations were adopted with the animal feed issue evaluated further. To address this final recommendation, the CFIA is now proposing further amendments to the feed ban regulations prohibiting the use of bovine SRM and bovine deadstock (including animals not raised for food purposes) in any animal feed, pet food and fertilizers. The amendments are published in the Canada Gazette¹ and will take effect on July 12, 2007.

The new requirements will necessitate the finding of suitable alternative disposal options for all SRM. Included in the amended regulations are recognized options and approved methods for the destruction and control of SRM each of which will require a CFIA issued permit specifying the manner and conditions of destruction or control. The CFIA is also interested in the issue of carcass disposal in general, specifically with respect to building capacity to respond to other challenges such as emergency disposal of carcasses in a disease outbreak. The following currently acceptable methods for destruction and control of SRM waste have been evaluated by the CFIA:

Table 4-1 CFIA Destruction and Control Methods for SRM Waste

Destruction	Control
Incineration	Permanent containment (controlled landfill)
Gasification followed by incineration	Intermediate treatment (composting)
Cement kiln	
Alkaline Hydrolysis	
Thermal Hydrolysis	

The above methods of destruction have been assessed by a CFIA science branch risk assessment to present negligible to very low risk of transmission of BSE to domestic

¹ Regulations Amending Certain Regulations Administered and Enforced by the Canadian Food Inspection Agency: <http://canadagazette.gc.ca/partII/2006/20060712/html/sor147-e.html>

ruminants. Of particular interest to this study is the destruction of SRM waste by incineration. A risk assessment for controlled incineration (including cement kilns) produced the following conclusions:

Release Assessment (likelihood that the BSE agent will be released into the environment):

- Negligible (10^{-7} – 10^{-5} probability range)
- reduces infectivity by a factor of 10^5 including a correction for incinerator failure
- temperature must be maintained at 850°C at all times during incineration and as long as unburned material is in the combustion chamber (requires at least one auxiliary burner)
- minimum 2 second residence time

Exposure Assessment (likelihood that cattle and other domestic ruminants will be exposed and develop disease):

- Low (10^{-4} – 10^{-3} probability range) for incineration with land spreading of ash
- Negligible for cement kilns because higher operating temperatures result in complete breakdown of organic material

Consequence Assessment (expected magnitude of resulting consequences):

- Moderate to High (10^{-2} – 1 probability range)

Overall Risk Estimate:

- Negligible

The upcoming amendments to the feed ban regulations have created a greater interest in incineration as a potential destruction method for SRM waste in BC and Canada. The CFIA regulations do not explicitly specify incinerator operating requirements, however, it must be demonstrated that the definition of incineration used in the risk assessment is met or that equivalency is demonstrated. Section 6.4(7) of the amended regulation states: “The Minister shall not issue a permit for the destruction of specified risk material unless the destruction is to be by incineration, or another method, that will ensure that the specified risk material and anything in which it is incorporated will not be used as food for humans and will not, or will not be likely to, result in the spread within Canada of Bovine Spongiform Encephalopathy.” It also must be demonstrated that applicable Provincial emission limits and standards are met. The process for submission of an application for a CFIA permit for incineration is briefly outlined as follows:

- Submit a proposal overview to the local CFIA district office
- Initial review will determine if additional data is required to be submitted or if the methodology is unlikely to be deemed acceptable
- Full submission including standard operating procedures, site plot, demonstration of compliance with provincial environmental/agricultural and/or public health regulations
- CFIA risk assessment

The CFIA inspector who will be responsible for conducting the site inspection will review the application for completeness. Upon review of a completed permit application with all supporting documentation, the CFIA inspector will schedule a site visit. The parameters observed in the site inspection and review of the application for a permit will be assessed against those used in the risk assessment by the CFIA technical expert in Ottawa.

4.1.2 Controlled Incineration in Canada

A recent CFIA study reviewed industrial treatment options for SRM waste in Canada including controlled incineration. The observation was made that incineration has been curtailed in many provinces due to increased regulatory controls including compliance and inspection requirements and costs. The report summarized the most common types of incinerators for all waste streams operating in Canada but stated the total quantity of these devices is not readily available:

- Fixed-facility starved air incinerators are believed to be the most common incinerator type in Canada. Operating temperatures are typically in the range of 800°C – 1000°C. These are batch mode devices operating in two stages devices starting with starved air followed by complete combustion. This category includes on-farm units, incinerators at waste treatment plants, crematoria, veterinary colleges.
- Rotary kiln incinerators rotate the waste in a cylindrical container while mixing with air achieving burn temperatures in the range of 800°C – 1600°C.
- Fluidized bed incinerators contain inert granular material that expands and acts as a fluid when gases are injected.
- Liquid injection incinerators use nozzles to reduce the waste stream into small droplets prior to mixing with air achieving burn temperatures of 640°C - 1600°C.

Operating temperatures in Canadian incinerators depend largely on the design of the device. The majority of incinerators are designed to achieve an initial temperature of between 800°C and 1000°C. There is no guarantee that incinerators in use would operate at a required temperature for reasons such as design, lack of maintenance, variable waste streams, etc. Burn time is variable and dependant on a number of factors including the type of waste.

Currently, no commercial cement kiln plants operating in Canada incinerate SRM waste, however, Lafarge and other cement companies have expressed interest in obtaining contracts for this practice. It is probable that pre-processing of animal waste would be necessary if cement kiln disposal was used. Cement kilns could use animal meal as a fuel source and require a consistent fuel character and quality if it was to be used. This would require construction of a rendering-type facility dedicated to processing SRM for cement kiln fuel production.

4.2 BRITISH COLUMBIA

4.2.1 General Overview

The poultry processing and slaughter industries generally utilize waste management strategies that result in animal waste products (offal, carcasses, feathers, bones etc.) being directed to rendering operations or to landfill. There are currently no facilities operating

under permit from the Ministry of Environment which authorize the discharge of air contaminants from the incineration of animal waste products associated with the poultry processing and slaughter industries. However, there is one facility operating in Chilliwack (Fraser Valley Duck and Goose Ltd.) operating a pathological incinerator under permit to dispose of mortalities. There may be some small poultry processing and slaughtering operations that incinerate limited quantities of animal waste products, however many of these operations remain unknown to regulators unless complaints are received.

There are also a number of pet crematoria that utilize small incinerators (some under permit) to dispose of material similar to animal waste products associated with the poultry processing and slaughter industries. Although the size of these units would preclude their use for poultry processing and slaughter facilities except for the very smallest operations, they may provide some guidance with regard to the establishment of emission limits for the poultry processing and slaughter industries. A larger capacity animal crematorium operated by the Animal Health Centre (Ministry of Agriculture and Lands) is located in Abbotsford.

Recently, a couple of pilot-scale test burns were conducted in the province (Kamloops and Williams Lake) to evaluate the effectiveness of enhanced incineration and gasification technologies as a means of disposing of solid animal waste products from a slaughtering operation. The results of these tests were largely inconclusive.

Human crematoria air emission standards were not included in the scope of this study and therefore not reviewed in detail. The Cremation, Interment and Funeral Services Regulation includes a requirement in Section (3)(b) for documentation from a professional engineer certifying that a test of the operation demonstrates operation in accordance with manufacturer's specifications, local bylaws and the laws of the Province. Beyond this general requirement, no emission limits are specified.

4.2.2 Legislation

The Environmental Management Act (EMA) and Waste Discharge Regulation (WDR) are the legislative instruments regulating the discharge of waste to the environment. In essence, the EMA and WDR establish 'prescribed' industries, trades, businesses, operations and activities as those requiring some sort of authorization to discharge waste (permits, approvals, code of practice etc.) and exempt certain operations (and 'non-prescribed' activities etc.) from the requirement to obtain an authorization. However, in no case is a person allowed to introduce waste into the environment in such a manner or quantity to cause pollution.

Establishments in the slaughter industry and poultry processing industry which process more than 1500 tonnes of red meat per year and 130 tonnes of live weight poultry respectively have been identified in the WDR as candidates for governance by a code of practice. However, until a code of practice has been developed the discharge of waste from these operations requires a permit or other authorization. For clarity, a recent draft publication by the Ministry of Environment, "Guidelines for Provincial Waste Disposal Authorization Requirements for the Slaughter Industries and Poultry Processing Industries(November 2006)" indicates that authorizations are required for the incineration of waste from all poultry processing or slaughter operations in the province regardless of size.

The Ministry of Environment has developed guidelines, criteria and objectives in order to assist both regulators and dischargers with the assessment of pollution control equipment as well as facility design. However, there are no specific guidelines, criteria or objectives for

the emissions to the air from incinerators used for the disposal of animal waste products from the poultry processing or slaughter industries. Two somewhat dated documents, "The Pollution Control Objectives for Food-processing, Agriculturally Oriented, and Other Miscellaneous Industries" (1975) and "The Emission Criteria for Municipal Solid Waste Incinerators"(1991) may provide initial guidance for the development of criteria for the emissions from animal waste product incinerators.

"The Pollution Control Objectives for the Food-processing, Agriculturally Oriented and Other Miscellaneous Industries" specifies that the particulate emissions from all operations in the food-processing and miscellaneous industries are to be no greater than 229 mg/m³ and that no objectionable odour is to be present beyond the plant boundary. Emission levels for lead, zinc, sulphur dioxide, nitrogen oxides and hydrocarbons are also specified.

"The Emission Criteria for Municipal Solid Waste Incinerators" is slightly more current. Although slaughtering and poultry processing waste are usually considered to be an 'industrial waste' and not part of the municipal waste stream, these emission criteria are probably the most applicable guidance for animal waste product incineration and have been referenced in the past by provincial regulators as part of the assessment in the issuance of authorizations for some commercial pet and animal crematoria. This document specifies criteria for both large incinerators (> 400 kg/hr) and small incinerators (< 400 kg/hr). The criteria specified for small incinerators includes a particulate limit of 180 mg/m³ (@ 11% O₂), carbon monoxide limit of 55 mg/m³ (@ 11% O₂) and an opacity limit of 10%. The criteria for large incinerators are more restrictive for both particulate (20 mg/m³ @ 11% O₂) and opacity (5%) and also include emission limits for additional parameters. Both large and small incinerators are required to operate at a minimum temperature of 1000°C and maintain a residence time of one second. There are additional operating and design elements specified including control of odourous and fugitive emissions.

The "Agricultural Waste Control Regulation" includes a "Code of Agricultural Practice for Waste Management" that also allows for the disposal of farm-based mortalities by incineration providing the emissions from the incinerator do not exceed a concentration of 180 mg/m³ for particulate matter and 20% opacity.

4.2.3 Experience With Small Incinerators

4.2.3.1 Commercial Pet Crematoria

The WDR specifically excludes the emissions from commercial pet crematoria from requiring discharge authorizations. However, prior to the adoption of the WDR in 2004, waste discharge authorizations were required for these emissions and an estimated two dozen permits were issued across the province. Most of these permits have now been canceled but a few are still in force.

Typically these incinerators are small 2-chamber units utilizing auxiliary fuel (natural gas or propane) with feed rates ranging from 14 to 45 kg/hour. Most of the units operating in the province were supplied by either Burn Easy or Therm-Tec. Therm-Tec (and perhaps Burn Easy) also manufactures larger capacity units for different applications.

Several permits were reviewed to determine typical discharge requirements. All permits except for one specified requirements for particulate (ranging from 60mg/m³ to 180 mg/m³ [@ 11% O₂]), opacity (10 %) and minimum afterburner temperature (ranging from 760 °C to 1000 °C). A few permits also specified limits for CO emissions (55 mg/m³ @ 11% O₂). One

permit did not specify any emission limit for particulate but rather an opacity standard (10%) and a minimum afterburner temperature (1000 °C).

Stack testing has not been extensive however limited testing on these units indicate particulate emissions in the range of 45 mg/m³ to 51 mg/m³ (@ 11% O₂) and CO emissions around 50 mg/m³ (@ 11% O₂). It is assumed that most testing was conducted under optimal conditions and that higher particulate emissions and opacities (>10%) will occur from time to time if the units become overloaded or temperature controllers are not set correctly.

The permits also included requirements to satisfactorily manage fugitive particulate and odour emissions. Inadequate control of fugitive emissions could result in the cessation of the operation and/or trigger the installation of suitable control devices.

4.2.3.2 Pilot Scale Incinerators

In 2005, Thompson Rivers University conducted an assessment of enhanced incineration and gasification technologies for the disposal of slaughterhouse waste for the Investment Agriculture Foundation of British Columbia.

The enhanced incineration trial was conducted at Rodear Meats near Williams Lake utilizing a customized Burn Easy carcass incinerator with a diesel fuel-fired afterburner. Unfortunately the unit had not been optimized prior to the test and several system failures occurred which resulted in inconclusive findings. The test demonstrated the challenges in maintaining the correct operating parameters required for high performance incineration. Proper control and monitoring of the incineration process is critical to prevent out of compliance air emissions for opacity and particulate matter as occurred during the trial. One of the recommendations from the report acknowledges the challenges facing a small scale operator and suggests that while the principle of dealing with waste locally is sustainable, a few cooperatively managed high performance incinerators located in optimal airsheds might meet the needs for air quality compliance and local use.

The gasification trial was conducted in Kamloops utilizing a commercially available gasifier (manufactured in Kamloops) which had been designed to recover energy from waste plastic. This trial also experienced some equipment failures and did not dispose of a large volume of waste. The economic feasibility of gasification is identified as a concern. Operational costs can be significant due to the need for qualified and motivated operators. The report also recommends considering one or more centrally located gasifier facilities operated in a cooperative agreement between slaughterhouse and packing plant operators.

4.2.3.3 Non-Pet Crematoria

A permit was issued in 1986 to Fraser Valley Duck and Goose Ltd. to authorize the discharge from a pathological incinerator used to dispose of mortalities. This permit predated the "Emission Criteria for Municipal Solid Waste Incinerators". However, the emission limits (for particulate) are consistent with the less restrictive "Pollution Control Objectives for Food-Processing, Agriculturally Oriented, and Other Miscellaneous Industries". The permit specifies an emission limit of 230 mg/m³ for particulate and also requires that a minimum operating temperature of 615°C be maintained in the secondary burning zone. The permit contains an odour control clause that may result in the requirement to install additional control works or to curtail the operation.

The incinerator is a small natural gas fired unit manufactured by Cyclone International and is adequately sized to dispose of an estimated 30 birds (90 kg) per day. The relatively low

operating temperature specified for the secondary burning chamber was considered to be adequate in view of the reported longer residence time in the combustion zone.

The Ministry of Agriculture and Lands operates an animal crematorium located at the Animal Health Centre in Abbotsford under permit (issued in 2001) from the Ministry of Environment. This unit is a two chamber gas-fired incinerator which is manufactured by Therm-Tec. While similar in design to commercial pet crematoria discussed in Section 4.2.3.1, it is substantially larger with an authorized feed rate of 250 kg/hour. Furthermore, this feed rate can be increased to 363 kg/hour providing the Regional Waste Manager (MOE) is satisfied that the increased processing rate will not cause pollution.

The permit specifies emission criteria for particulate matter (180 mg/m³), CO (55 mg/m³), NO_x (350 mg/m³) and opacity (10%). The criteria for particulate matter, CO and NO_x are all referenced to 11% O₂. A minimum temperature of 1000°C is specified for the secondary combustion chamber and there is also a prohibition with regard to the burning of plastics, general refuse or infectious agents (Medical Research Council of Canada Risk Group IV). As with commercial pet crematoria, the permit includes standard clauses to control odours and fugitive dust emissions.

A stack emission test conducted in 1995 at a feed rate of 220 kg/ hour indicated that the specified permit limits for particulate matter, CO and NO_x were all achieved. Furthermore, prior to the issuance of the permit, dispersion modeling was undertaken and a determination of the secondary combustion chamber residence time was made (> 1 second).

No information is available with regard to the experience of using farm-based incinerators for the disposal of mortalities in accordance with the "Agricultural Waste Control Regulation".

4.2.4 GVRD

The GVRD generally applies the air quality permitting process to slaughter and poultry facilities only if they generate public complaints about odours. Their approach tends to focus more on controlling wastewater discharges from these types of operations. The two air quality permits that have been issued for this industry in the GVRD were obtained for review:

- Britco Pork Inc., Langley, BC (slaughterhouse)
- Hallmark Poultry Processors Ltd., Vancouver BC (poultry processing and live bird transfer)

The Britco Pork air permit was originally issued in 1992 and amended in 2002 with a facility name change. Two stack air emission sources are identified in the abattoir including:

1. Hair singer (to singe hair for removal), fired with natural gas at a maximum firing rate of 2.0 MMBtu/hr
2. Cleaver Brooks boiler fired with natural gas at a maximum firing rate of 6.0 MMBtu/hr

The conditions in the permit cite good combustion practices and operating procedures for natural gas combustion. Additional requirements for the hair singer are a 10% opacity limit and no odour past the plant boundary such that the Air Quality Director determines that air pollution has occurred.

The Hallmark Poultry air permit was issued in 2004 due to concerns of odour and dust issues from the live bird transfer area. The identified air emission sources and associated controls, limits and monitoring requirements are summarized as follows:

Table 4-2 GVRD Air Permit Requirements for Hallmark Poultry

	Source	Control	Parameter	Limit	Monitoring
1	Bird transfer building	Spray header application system in series with a venturi wet scrubber, cyclonic separator, mesh pad demister. Good operating practices.	PM	15 mg/m ³	Stack testing for PM, NH ₃ , amines. Evaluate odour removal efficiency. Continuously monitor & record wind speed, direction, temperature. Continuously monitor differential pressure of venturi scrubber.
2	Bird infeed area	Baghouse collector & good operating practices	PM	15 mg/m ³	
3	Scalder area	Good operating practices			
4	Offal and feather storage bin area	Good operating practices			
5	Wastewater treatment (DAF) plant	Good operating practices			
	General building	Negative building pressure	Odour		

General requirements include a Professional Engineer's report confirming the implementation of the final recommendations of the Pollution Prevention Plan including the installation and operation of control works and an analysis of the effectiveness of the plan in achieving the objectives of odour abatement. The report will also confirm that a negative building pressure is maintained to eliminate fugitive odours.

4.2.5 BC Summary

Several guidance documents have been issued by the Ministry of Environment regarding incineration criteria but none specific to the incineration of animal waste products associated with the poultry processing and slaughter industries. The "Emission Criteria for Municipal Solid Waste Incinerators" which was issued 15 years ago is considered to be the most applicable of these guidance documents for slaughtering and poultry processing waste applications and has been used in the past by provincial regulators when issuing permits for smaller operations incinerating similar wastes.

BC Environment has developed an Odour Management Strategy that includes development of an odour management plan for facilities where odour may be an issue. An animal processing waste incinerator will most likely be expected to develop an odour management plan that may include equipment and processes such as those described under Operational Requirements in Section 5.

4.3 ALBERTA

Overview

As in BC, the poultry processing and slaughter industries utilize waste management strategies that result in the diversion of animal waste products to rendering operations or to landfill. There are currently no facilities operating under approval or registration from Alberta Environment which use incineration of animal waste products associated with the poultry processing and slaughter industries. One rendering plant (Alberta Processors, Calgary) is constructing an incinerator for control of odourous air streams.

There are three major incineration facilities in Alberta, the Swan Hills Treatment Centre (SHTC), the Beiseker Biomedical Waste Incinerator and the Wainwright Regional Waste to Energy Authority. Wainwright has a capacity of 1.135 tonnes/hour but the Beiseker facility is small, on the order of a few hundred kg/hr (depends on the heat duty of the waste). All could potentially handle SRM, but are not currently doing so. In the case of Wainwright, the approval specifically prohibits treatment of biomedical waste and it is not clear if SRM would fall under that definition in Alberta. The SHTC did incinerate a couple of carcasses shortly after the initial BSE infected animal was discovered, but this was a one-off occurrence and the SHTC is not pursuing this kind of waste.

4.3.1 Legislation

The governing provincial environmental legislation is the Environmental Protection and Enhancement Act, E-12 RSA 2000². The Act has general prohibition against waste discharge other than to an authorized facility (normally an approved landfill). The Director could authorize landspreading certain waste (eg. manure or wastewater treatment biosolids from a slaughterhouse).

The Activities Designation Regulation AR 276/2003 lists activities that require an approval or registration. For facilities that must hold a registration, a specific Code of Practice applies.

Facilities that process ≥ 1500 tonnes/year red meat or ≥ 130 tonnes/year poultry or fish and release wastewater into the environment require an approval. If they are tied into a Municipal WWTP, no approval is required. For facilities that process less than this amount a registration was formerly required (Small Meat Processing Code of Practice) but this was withdrawn in 2003. There are currently two major red meat processing facilities, Lakeside Packers, Brooks and Cargill, High River. Two poultry processing facilities also hold approvals, Lilydale, Lethbridge and Bow City Co-operative, Bow City.

Small Incinerators also must hold a registration. The definition of small incinerator includes facilities that process < 10 tonnes/month and operates at least every second day on average. It also includes certain mobile incinerators and exempts certain others (eg. crematoria, individual residences, camp kitchen waste). There are currently approximately 57 small incinerators registered in Alberta so there is a wealth of regulatory and operating experience with these units. A number of companies that manufacture incinerators operate in Alberta to service this demand.

² http://www.qp.gov.ab.ca/catalogue/catalog_results.cfm?frm_isbn=0779748611&search_by=link

Approvals

Alberta Environment has a standard approval template they use for general clauses, but unique individual clauses (eg. odour related to solid waste landspreading in the Lakeside approval) are developed by the approval coordinator. There are no standard odour or waste management clauses. Air clauses related to meat processing facilities focus on combustion sources (boilers) and particulate control from baghouses with no limits applicable to incineration.

There is no specific restriction on the use of incinerators for waste treatment. The most likely approach in Alberta for a major fixed facility would be referencing the CCME municipal waste incinerator guideline, which was used as the guide for the Wainwright municipal incinerator approval.

Small Incinerator Code of Practice

The scope of the Code of Practice includes mobile incinerators (operate < ½ time at any one location), small incinerators (<10t/mo) but does not include incinerators that service single residences, camp kitchen waste, crematoria and units regulated by the Alberta Energy and Utilities Board.

The mobile incinerator requirements were taken almost wholesale from approvals originally issued for mobile incinerators used primarily for clean-up of hydrocarbon contaminated sites (eg. underground storage tank removal). The small incinerator requirements are separated into units having one or two combustion chambers. Single chamber units are limited to waste having low levels of certain contaminants as listed in Table 4-3.

Table 4-3 Alberta Small Incinerator Single Chamber Waste Contaminant Limits

Substance	mg substance/kg waste (ppmw)
Halogenated Organic Compounds	50
Lead	100
Mercury	2

Double chamber units have emission limits based on the assumption that they might burn more contaminated waste. These limits are listed in Table 4-4. The limits do not apply if they burn waste that meets the parameters listed in Table 4-3.

Table 4-4 Alberta Small Incinerator Double Chamber Emission Limits

Substance	Emission Limit (mg/m ³ unless otherwise stated)
Particulate Matter	50
HCl	75
CO	57
Opacity	20% averaged over 6 consecutive minutes
Dioxins and Furans	80 pg/m ³ TEQ
Mercury	20 ug/m ³

Temperature must also be measured and recorded unless the unit is a batch incinerator that burns < 90 kg/hr. The temperature minimums are 500°C for the primary chamber and 870°C for the secondary. A stack survey is required if the incinerator burns waste that exceeds the parameters in Table 4-3.

4.3.2 Alberta Summary

Alberta has no specific guidance documents for incineration treatment of waste animal parts. Alberta Environment staff suggests that the Code of Practice for Small Incinerators could be applicable to the treatment of animal wastes, if the limits in the Code applied. Larger facilities would most likely require more stringent emission limits, depending on site-specific public input. There are a large number of small incinerators operating in Alberta (not including crematoria, camp kitchen waste and oil & gas related installations) and careful review of the operating and regulatory experience of this industry may provide useful insight.

4.4 SASKATCHEWAN

The Clean Air Regulations provide information required for an incinerator permit which falls under the Commercial Branch of the Air Quality Section of Saskatchewan Environment. The Sanitation Regulations (SK Reg. 420/64) has provisions for slaughterhouse applications to be submitted to the medical health officer of the municipality or local improvement district. The operators must show how offal would be disposed. In addition a slaughterhouse must not be located less than 200 yards from a dwelling, waste disposal ground or 100 feet from a street.

The Canada Wide Standards for particulate matter was adopted by Saskatchewan in 2000 and gives particulate matter Emission Value Limits. These are described further in the jurisdiction of Manitoba in the next section. The Intensive Livestock Operation Regulatory Program has nuisance provisions that relate to odour, dust and smoke, however there are no specific values listed. The Environmental Review Guidelines for Intensive Livestock Operations document does list controlling odours as a particular concern but does not list any specific emission levels.

4.5 MANITOBA

The Manitoba Regulation issued under The Environment Act provides the standards to be met for new incinerators, these are:

- PM < 0.23g/m³ (dry flue gas corrected to 12% CO by volume).
- Smoke opacity < 40% at all times and must not be greater than 20 % for more than 4 min in a given hour (the effective hourly average opacity would be less than 20% with instantaneous opacities not to exceed 40%)

The Manitoba Environment Act identifies odour as a potential component of a pollutant. The Act controls and regulates developments through licensing, where a development includes activities that cause or are likely to cause the emission or discharge of any pollutant into the environment.

Many developments issued licenses prior to 1995 have a clause which addresses odour nuisance through quantitative and numerical limits on ambient odours in the vicinity of these

facilities. These are not necessarily animal processing or incineration facilities, but indicate an effort is being made to recognize odour as an issue of concern in Manitoba. The government has found it difficult to handle odour nuisance in a manner which responded to the needs of local citizens and developments. Specific difficulties include:

- The ability to administer the existing odour limits had proven difficult
- The degree of protection offered by the current odour limits had been questioned and
- Portable, reliable monitoring equipment for sampling in the field was not readily available.

The odour described is not specific to poultry farming or incineration. Odour for poultry farming is covered under the Farm Practices Act but does not provide specific guidance.

The Berscheid Meats Processing Plant and Livestock Slaughtering Plant (The Pas, Manitoba) license does list odour as being a nuisance. The Maple Leaf Hog Slaughter Plant (Brandon, Manitoba) Stage 1 License does not give any specific mention to odour and air. The Stage 2 License (revised) does list odour as being a nuisance. License controls do not typically provide actual guidance for the industry sector but only regulatory conditions.

The OlyWest Pork Processing Facility in Winnipeg is currently going through the process of licensing and must provide an Environmental Assessment Report. This processing facility has a proposed capacity of 9,000 hogs/day. The EA report must provide air related information relating to point, fugitive and area emissions and annual average projections on existing ambient air quality beyond the plant boundaries and compared to the Ambient Air Quality Criterion from Manitoba Conservation, Ontario Ministry of Environment and the CCME.

4.5.1 Emission Limit Values

The following table provides the emission limit values for Manitoba that would be applicable to a poultry or slaughterhouse incineration plant:

Table 4-5 Manitoba Emission Limits Applicable to Livestock Waste Incineration

Name of Contaminant	Criteria Classification	Units of Concentration Measurement	Period of Time Contaminant is Measured	Maximum Acceptable Level Concentration	Maximum Desirable Level Concentration
Odours (note 1)	Guideline	Odour units	two tests not less than 15 minutes apart nor more than 60 minutes apart	Residential Zone 2.0 (note 2) Industrial 7.0 (note 3)	<1.0 (less than the odour threshold)
PM2.5	Canada-Wide Standard	µg/m ³	24 - hour average (note 5)	30	-
PM10	Guideline	µg/m ³	24 - hour average (note 5)	50	-

Source: <http://www.gov.mb.ca/conservation/airquality/airquality/air-quality-criteria/ambientair-table.html>

All measurements of air quality are corrected to a reference temperature of 25°C and to a reference

pressure of 101.3 kilopascals.

An odour unit is defined as the concentration at which an odour panel (typically 6 people) can begin to detect the odour.

note 1: Nuisance odours from environmentally-regulated developments are managed using a strategy based on the prevention/minimization of odour releases and the use of a community based standard to determine the acceptability of the ambient odour in the community. It is intended that the odour unit limits be used only for evaluating potential impacts on a community during the environmental impact assessment of new or modified developments.

note 2: One volume of odorous air diluted with one volume of odour free air.

note 3: One volume of odorous air diluted with six volumes of odour free air.

note 5: The 24-hour average objective for PM_{2.5} is the national CWS for PM_{2.5}.

4.6 ONTARIO

In Ontario there are no specific guidelines for the incineration of animal by-products. If the province were to issue a permit for such an incineration plant, they would follow “Guideline A-7 Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators, 2004” (Personal communication.: Quynh Nguyen, Ontario Ministry of Environment, 2006). The following table details combustion guideline limits for New Municipal Waste Incinerators:

Table 4-6 Ontario: (Table 1); Guidelines for Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators.

TABLE 1		
Parameter	Emission Limit	Comments
particulate matter (PM) ⁽¹⁾	17 mg/Rm ³	calculated as the arithmetic average of three stack tests conducted in accordance with standard methods
cadmium ⁽²⁾	14 µg/Rm ³	calculated as the arithmetic average of three stack tests conducted in accordance with standard methods
lead ⁽²⁾	142 µg/Rm ³	calculated as the arithmetic average of three stack tests conducted in accordance with standard methods
mercury ⁽²⁾	20 µg/Rm ³	calculated as the arithmetic average of three stack tests conducted in accordance with standard methods
dioxins and furans	80 pg/Rm ³ as ITEQ ⁽³⁾	calculated as the arithmetic average of three stack tests conducted in accordance with standard methods
hydrochloric acid (HCl)	18 ppmv (27 mg/Rm ³) or an HCl removal efficiency of not less than 95%	calculated as the arithmetic average of three stack tests conducted in accordance with standard methods, or as the arithmetic average of 24 hours of data from a continuous emission monitoring system
sulphur dioxide (SO ₂) ⁽⁴⁾	21 ppmv (56 mg/Rm ³)	calculated as the arithmetic average of three stack tests conducted in accordance with standard methods, or as the geometric average of 24 hours of data from a continuous emission monitoring system
nitrogen oxides (NO _x) ⁽⁵⁾	110 ppmv	calculated as the arithmetic average of three stack tests conducted in accordance with standard methods, or as the arithmetic average of 24 hours of data from a continuous emission monitoring system
organic matter	100 ppmv undiluted (expressed as equivalent methane)	calculated as a 10 minute average at the outlet of the secondary chamber before dilution with any other gaseous stream, measured by a continuous emission monitoring system

(Rm³ = reference cubic meter: volume of gas at 25°C and 101.3 kPa)

Source: Guideline A-7 Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators, 2004.

In addition, incineration technologies are used to treat anatomical waste of human or animal origin which has come into contact with an individual being treated for or suspected to be infected with one or more of the agents listed in Schedule 5B of the Guideline: "Agents of Other Biomedical Wastes Requiring Special Handling", and for cytotoxic waste. These technologies are required to meet those standards set out in Guideline A-1: "Combustion and Air Pollution Control Requirements for New Municipal and Biomedical Waste Incinerators".

The primary purpose of this guideline is to clearly define biomedical waste and to specify handling and management requirements for this waste stream. The guidelines are enforced by including appropriate conditions on Certificates of Approval for carriers and receivers.

Further to this guideline the general incineration of deadstock on farms is illegal in Ontario. The disposal of deadstock is covered under Ontario's Dead Animal Disposal Act (ODADA). Under the Act, all dead cattle, pigs, sheep, goats and horses are disposed of within 48 hours after death, in one of three approved methods;

1. removal through a licensed deadstock collection service;
2. composting under 60 cm (2 ft) of organic substrate, such as sawdust or straw; or
3. burying under 60 cm (2 ft) of soil and away from all waterways.

The Ontario Ministry of Agriculture and Food (OMAF) have recently received a number of complaints relating to the use of incinerators on swine farms. Because of the current legislation, these farms have been asked to stop using incinerators to dispose of deadstock. Under the ODADA, fines (up to \$2000 for a first offence and up to \$5000 or six months imprisonment for a second offence) can be imposed where individuals continue to use incinerators illegally.

Ontario does recognize that in other jurisdictions in Canada and other parts of the world incineration is a recognized method for disposing of deadstock. Therefore, research is currently being conducted in Ontario to assess incineration as a deadstock disposal option. A Ministry of Attorney Generals' Report of the Meat Regulatory and Inspection Review (2004) stated that incineration of meat production waste is not widely used and there are no large units in operation. The Ministry of Agriculture, Food and Rural Affairs found that air emissions from operators in other provinces are within the air quality standards if incineration were to be more widely used as a disposal method.

4.7 US JURISDICTIONS

4.7.1 US Environmental Protection Agency (EPA)

The US EPA is responsible for setting national standards under the Clean Air Act (CAA) and is required by the CAA to regulate emissions of toxic air pollutants from a list of industrial sources. The agency established the New Source Performance Standards (NSPS) that apply to new, modified and re-constructed stationary sources. The responsibility for issuing

Air Operating Permits for all major stationary sources has been delegated to individual states in most cases.

The EPA issued the following standards and guidelines applicable to incineration under Part 60 of the US EPA Code of Federal Regulations Title 40:

- 40 CFR Part 60 Subparts CCCC and DDDD - New Source Performance Standards (NSPS) for Commercial and Industrial Solid Waste Incinerator(s) (CISWI) constructed after November 30, 1999 and Emissions Guidelines (EG) for CISWI constructed on or before November 30, 1999

Adopted by the US EPA in December 2000, these two sets of standards and guidelines are applied to combustion units for commercial or industrial wastes. CAA defines commercial or industrial waste as solid waste combusted in an enclosed device using controlled flame combustion without energy recovery.

The NSPS and EG reflect maximum achievable control technology (MACT) which is defined as the maximum degree of reduction in emissions of air pollutants that the agency determines is achievable. The EG, although similar to NSPS, are not enforceable until EPA approves a State plan or adopts a federal plan for implementing them becomes effective. Under these guidelines, owners and operators of new or existing CISWI units are required to meet the following emission limits:

Table 4-6 NSPS and EG Emission Limits for New and Existing CISWI Units

Pollutant	Emission Limitations*	
Cadmium	0.004	mg/dscm
Carbon Monoxide	157	ppmv dry
Dioxins/Furans (TEQ basis)	0.41	ng/dscm
Hydrogen Chloride	62	ppmv dry
Lead	0.04	mg/dscm
Mercury	0.47	mg/dscm
Opacity	10	Percent
Oxides of Nitrogen	388	ppmv dry
Particulate Matter	70	mg/dscm
Sulfur Dioxide	20	ppmv dry

* All emission limits (except opacity) are measured at 7 percent oxygen dry basis at standard conditions

- 40 CFR Part 60 Subparts Ec and Ce - New Source Performance Standards for Hospital/Medical/Infectious Waste Incinerator(s) (HMIWI) constructed after June 20, 1996 or modified after March 16, 1998 and Emission Guidelines for existing HMIWI built on or before June 20, 1996.

These two subparts apply to incineration units whose primary purpose is the combustion of hospital waste and/or medical/infectious waste as defined by the Clean Air Act. Similar to the subparts discussed for CISWI, the HMIWI standards and guidelines are based on maximum achievable control technology. The HMIWI source category is divided into three subcategories based on waste burning capacity: small (less than or equal to 200 lb/hr), medium (200 lb/hr to 500 lb/hr), and large (greater than 500 lb/hr). The following tables are the emission limits established for new or modified and existing HMIWI units, respectively:

Table 4-7 NSPS Emission Limits for New or Modified HMIWI Units

Pollutant	HMIWI Emission Limitations*			
	Small (≤ 200 lb/hr)	Medium (200 lb/hr to 500 lb/hr)	Large (> 500 lb/hr)	
Cadmium	0.16	0.04	0.04	mg/dscm
Carbon Monoxide	40	40	40	ppmv dry
Dioxins/Furans (TEQ basis)	2.3	0.6	0.6	ng/dscm
Hydrogen Chloride	15	15	15	ppmv dry
Lead	1.2	0.07	0.07	mg/dscm
Mercury	0.55	0.55	0.55	mg/dscm
Opacity	10	10	10	percent
Oxides of Nitrogen	250	250	250	ppmv dry
Particulate Matter	69	34	34	mg/dscm
Sulfur Dioxide	55	55	55	ppmv dry

* New or modified large HMIWI units are subject to a 5 percent visible emission limit for fugitive emissions generated during ash handling.

Table 4-8 NSPS Emission Limits for Existing HMIWI Units

Pollutant	HMIWI Emission Limitations			
	Small (≤ 200 lb/hr)	Medium (200 lb/hr to 500 lb/hr)	Large (> 500 lb/hr)	
Cadmium	0.16	0.16	0.16	mg/dscm
Carbon Monoxide	40	40	40	ppmv dry
Dioxins/Furans (TEQ basis)	2.3	2.3	2.3	ng/dscm
Hydrogen Chloride	100	100	100	ppmv dry
Lead	1.2	1.2	1.2	mg/dscm
Mercury	0.55	0.55	0.55	mg/dscm
Opacity	10	10	10	percent
Oxides of Nitrogen	250	250	250	ppmv dry
Particulate Matter	115	69	34	mg/dscm
Sulfur Dioxide	55	55	55	ppmv dry

The above categories are not directly applicable to incinerators used for livestock waste. The National Agriculture Compliance Assistance Center of the EPA describes initiatives and regulations for air emissions from the agricultural sector. In response to the need for regulation of other categories of solid waste incineration units, a proposed NSPS Other Solid Waste Incineration Units (OSWI) was developed considering a list of subcategories including (3) Agricultural waste incinerators, and (6) Crematories (including livestock, poultry). Agricultural Waste Incinerators are primarily units burning rice hulls, pressed sugar cane, and other types of biomass. Animal crematories are those used to dispose of animal carcasses at places like veterinary clinics, animal control facilities, universities and research institutions, pet cremation services, and livestock farms such as poultry and swine farms. The EPA determined that the adverse impacts associated with regulation of animal

crematories outweigh the benefits of regulation and these units are not included as a subcategory of OSWI for regulation at this time. Their concern with imposing regulations discouraging small scale on-farm incineration is the increased risk of disease transmission associated with trucking waste off site.

A search of the US EPA's RACT/BACT/LAER Clearinghouse was conducted to locate any BACT determinations for livestock waste incinerators. Categories in the database that were searched include: Emission Control Afterburners & Incinerators, Hospital/Medical/Infectious Waste Incineration, Mixed/Other Waste Combustion/Incineration, Crematoriums. No BACT determinations were found that were specifically applicable to livestock waste incineration.

4.7.2 Washington State

Contact was made with the Washington State Department of Ecology and the Southwest Clean Air Agency to get an overview of livestock incineration activities in the state. A case of BSE was detected in a cow in Washington State in December, 2003. The investigation determined that the cow had been born and raised in Canada prior to the introduction of the feed ban before being exported to the US. In general, Washington does not have significant slaughter or poultry processing activity in its jurisdiction and no incineration of wastes from this industry. Waste animal parts are sent to one or all of the following: rendering facilities (on or off-site), pet food manufacturers, and landfills. Therefore, there is no Code of Practice or equivalent for incineration specific to the slaughter industry. There is however a registration process for small and moderate-sized sources of air pollution applicable to a list of 56 source categories as specified in WAC 173-400-100. One of the listed categories is for "crematoria or animal carcass incinerators". The registration process involves the following steps:

- Information Request: Dept. of Ecology will request information on equipment, processes, and emissions
- Emissions Calculations: Ecology uses the information provided to develop emission estimates, determine applicability of air pollution regulations, and establish the appropriate registration category for the source
- Verification and Notification: Ecology will notify the applicant of registration status and applicable air pollution requirements. The applicant will have the opportunity to review Ecology's determination.
- Site Inspection: Ecology survey or inspect the source to verify information on the registration form and determine compliance. Ecology will send a follow-up letter to the applicant explaining the results of the inspection.

After a source has been registered, ongoing requirements are determined by the source's registration category. Emission thresholds are used to determine the source category aligning the level of regulatory involvement with the sources' impact on air quality as outlined in the following table:

Table 4-9 Washington State Registration Program Thresholds and Requirements

	Exempt (tons/yr)	Periodic (tons/yr)	Annual (tons/yr)
TSP	<1.25	<25	<100
PM ₁₀	<.75	<15	<100
CO	<5	<100	-
NO _x	<2	<40	<100
SO _x	<2	<40	<100
VOC	<2	<40	<100
Lead	<0.005	<.6	-
Air Toxic	<0	<10	
Total Toxics	<0	<25	
Reporting	No regular reporting	Once in 3 years	Yearly
Inspection	No regular reporting	Once in 3 years	Yearly
Annual Fee	\$0	\$400	\$1200 - \$4000

Emission sources requiring an air permit under the jurisdiction of the Department of Ecology are for major sources defined as those emitting more than 100 tons/yr of any pollutant, more than 10 tons/yr of any hazardous air pollutant or more than 25 tons/yr of a combination of hazardous air pollutants.

The regulator contacted at the Southwest Clean Air Agency stated they have not experienced any odour issues as wastes go to rendering facilities or pet food manufacturing facilities.

Poultry processing facilities are located in Western Washington. The main source of odours from these operations is typically the waste water treatment system. Implementation of proper management and maintenance practices is usually sufficient to reduce or eliminate odours.

In general dispersion modeling is triggered by the installation of a new source of air emissions or modification of an existing source. The air pollutants emitted are usually looked at with a screening level model to assure the national ambient air quality standards are not exceeded. Screening modelling of toxic air pollutants also occurs to determine if a toxic air pollutant is emitted at a rate that would require a more thorough evaluation. Existing sources are rarely modeled to determine their impact on the ambient air quality around the plant. A reason to model such a facility would be as part of an enforcement action or to investigate an odour problem.

The US EPA has recently issued a NSPS standard for air curtain incinerators. Although some facilities might consider using this equipment, the district air agencies do not allow air

curtain incinerators to be installed because of odour and smoke issues. Furthermore, process parameters are not easily monitored to determine proper operation of the equipment.

4.7.3 Idaho

The Idaho Department of Environmental Quality (DEQ) has a Permit by Rule (PBR) program similar in concept to a Code of Practice. The PBR program in Idaho is a process by which a facility that emits air pollutants may register in lieu of obtaining a site-specific air quality operating permit. In a PBR, requirements are spelled out in the rule and apply to all members of a particular industry. A PBR exists for dairy farms but none for the slaughter or poultry industry. The dairy farm PBR requires farms above specified threshold numbers of cows to register and implement industry best management practices to control ammonia emissions.

According to a regulator at the DEQ, there are several small slaughter and meat processing facilities for processing small-scale farm livestock and wild game including mobile ranch butchers. None of these operations are permitted and therefore the total count is unknown. The two slaughter facilities that were permitted in Idaho have recently closed but the air permits were provided for review. One of the facilities officially closed a month ago from the time of writing and the other facility was sold to another company before closing. It is possible that this facility could re-open but it seems unlikely as new subdivisions have been built around the facility and more are planned. There are two rendering plants but many of the meat processing facilities have been closed to move to neighboring states, primarily Oregon and Washington.

Fugitive dust, odours, opacity, fuel burning and fuel sulphur content are common facility-wide parameters considered in this industry. Air quality permits for these facilities must satisfy the requirements of the Idaho Administrative Code - Department of Environmental Quality (DEQ) - IDAPA 58.01.01, Rules for the Control of Air Pollution in Idaho. They require the applicant facility to maintain detailed records of all odour complaints received and to take appropriate corrective actions to the complaints if deemed valid. Any plant engaged in the processing of animal matter must employ reasonable measures for the control of odours including wet scrubbers, incinerators, chemicals or other measures as may be approved by the Department.

A modeling analysis is generally required with each permit application for new construction or a modification that result in an increase in emissions of pollutants for sources permitted by DEQ. The department has established modeling thresholds, below which modeling is generally not required.

4.7.4 Montana

The Montana Department of Environmental Quality currently has no air quality permits issued for any slaughterhouses or poultry processing facilities. Montana does have regulations that would be triggered in the case of any type of incineration activity. If a slaughterhouse or poultry plant planned to operate an incinerator, they would require an air quality permit as stated in section 75-2-215 of the "Montana Code Annotated 2005" which covers solid or hazardous waste incineration.

Two air permits were provided for review, one for an animal crematorium and one for a portable air curtain incinerator that was proposed to be used to incinerate carcasses of

diseased wildlife. The permit application was submitted by the Montana Department of Livestock (DOL) to operate a portable refractory walled air curtain incinerator. The primary use of the incinerator is for wood waste disposal. In addition, the incinerator may be used to incinerate animal carcasses, animal waste, and animal byproducts. The emergence of animal diseases into Montana would necessitate the destruction and disposal of animal carcasses. In the permit analysis documentation, a long list of diseased livestock waste that could be potentially incinerated is listed in the permit including BSE. It is noted that research is on-going to verify that infectious agents are effectively destroyed by the air curtain destruction process. Recent communication with a Montana regulator indicated that the air curtain incinerator has become operational but is only being used to burn wood slash.

Air emission limits imposed in the permit include:

- 10% opacity limit averaged over 6 consecutive minutes after the first half hour of operations
- 20% opacity limit averaged over 6 consecutive minutes during start-up within the first half hour of operations
- Particulate Matter limit of 229 mg/m³ (0.10 gr/dscf), corrected to 12% CO₂

For other incinerator permit applications, modeling will be conducted as specified by rule, policy, or determined on a case-by-case basis. However, in general, modeling will not be required for minor sources applying for a new permit or for existing sources applying for a permit alteration, if the facility's proposed allowable emissions are less than thresholds set by the Montana Department of Environmental Quality. If an incinerator is part of a facility, it would require modeling. Otherwise, modeling is required for any source not located in a non-attainment area that has a potential to emit >50 tons of a regulated pollutant. Any permitted source located in a non-attainment area would be subject to modeling on a case-by-case basis if they emit the pollutant for which the area has been designated non-attainment.

The permit that was provided for the animal crematorium was also reviewed. The crematorium is fueled by natural gas and is capable of incinerating a maximum of 100 lb/hr of animal remains. The opacity and particulate matter limits are identical to the requirements for the air curtain incinerator. An operational requirement for a secondary combustion chamber based on a BACT analysis requires a minimum temperature of 816°C (1500°F) for any 1-hour averaging period with no single reading less than 760 °C (1400°F).

4.7.5 Oregon

Under Oregon Revised Statue, agricultural operations (except field burning) are exempt from Air Quality regulations. The Oregon Department of Environmental Quality only permits operations like rendering plants and disposal facilities that are not considered agricultural operations. Incinerator regulations are specified in the Oregon Administrative Rules: http://arcweb.sos.state.or.us/rules/OARs_300/OAR_340/340_230.html. A summary and comparison of the incinerator standards for infectious waste and crematory incinerators are shown in the following table:

Table 4-10 Oregon Incinerator Standards

	Solid and Infectious Waste Incinerators	Crematory Incinerators
PM	34 mg/m ³	183 mg/m ³
HCl	50 ppm	
SO ₂	50 ppm	
CO	100 ppm	
NO _x	200 ppm	
Opacity	10%	20%
Temperature	982°C	982°C
Residence Time	1 s	0.5 s
Monitoring	CEM: SO ₂ , CO, opacity, exit temp.	exit temp.

Concentrations corrected to 7% O₂ dry standard

CEM – continuous emission monitor

4.7.6 California

In the state of California, the primary responsibility for permitting all sources, except mobile sources, rests with the local and regional air pollution control authorities known as Air Pollution Control Districts (APCD) or Air Quality Management Districts (AQMD). A search of the ARB emission inventory facility search site (<http://www.arb.ca.gov/app/emsinv/facinfo/facinfo.php>) was conducted using the SIC codes for slaughterhouses (2011) and poultry plants (2015). The largest facilities are located in the San Joaquin Valley and South Coast Air Quality Management Districts. Representatives from these district offices were contacted via telephone and email. Regulators at the San Joaquin Valley were unwilling to provide information without completion of a formal Public Record Release Request. The paperwork was completed and submitted and we await the receipt of the requested air permit guidance documents. No responses have been received from the South Coast Air Quality Management District. A search of the permitting requirements described on the district web sites suggests that there may be no specific set of standards specific to waste incineration for the slaughter and poultry processing industry.

Any type of incineration used by a facility would have to follow the New Source Review procedure and should reflect the Best Available Control Technology (BACT) for the process. A search of the ARB BACT Clearinghouse database (<http://www.arb.ca.gov/bact/bact.htm>) was conducted with no determinations found in a search of the following categories:

- Infectious Waste Incinerator <300 lb/hr
- Infectious Waste Incinerator >=300 lb/hr
- Non-Infectious Waste Incinerator <300 lb/hr

- Non-Infectious Waste Incinerator ≥ 300 lb/hr to < 750 lb/hr
- Non-Infectious Waste Incinerator ≥ 750 lb/hr
- Crematories

4.7.7 Expanded Search of US Jurisdictions

The review of the US jurisdictions targeted in the proposal determined that Codes of Practice (or equivalents, such as Permit by Rule registrations) for incineration are not common. None of the other jurisdictions have implemented a Code of Practice regulatory model for incineration specific to the slaughter industry. To compensate for this lack of information, an expanded search was conducted to find additional states with Permit by Rule programs that may be applicable to livestock incineration. The states of Texas, Nebraska and Missouri were identified as having established programs of particular interest to this study.

4.7.7.1 Texas

On June 24, 2005, a cow in Texas tested positive for BSE. The BSE positive cow was born and raised in a herd in Texas and was approximately 12 years old. The animal was sampled for BSE at a pet food plant in Texas as part of the USDA's enhanced surveillance program. The animal was disposed of by incineration and did not enter the human food or animal feed chains.

Permit by Rule (PBR 106.241) - Slaughterhouses

Texas regulators employ a Permit by Rule program under the Texas Administrative Code similar in concept to the BC Code of Practice system. Facilities that do not make a significant contribution of air contaminants to the atmosphere qualify for a Permit by Rule. A program specific to slaughterhouses and poultry processing has been implemented in section 106.241³ of the TAC which states:

Any facility where animals or poultry are slaughtered and prepared for human consumption provided that waste products such as blood, offal, and feathers are stored in such a manner as to prevent the creation of a nuisance condition and these waste products are removed from the premises daily or stored under refrigeration until removed are permitted by rule. In addition, areas used to hold animals or poultry for slaughter shall be kept dry and clean to control odors.

An addition to the above requirements, the following general permit by rule requirements must first be met:

- Total actual emissions authorized under permit by rule from the facility shall not exceed 250 tons per year (tpy) of CO or NO_x; or 25 tpy of VOCs or SO₂ or inhalable particulate matter (PM₁₀); or 25 tpy of any other air contaminant except carbon dioxide, water, nitrogen, methane, ethane, hydrogen, and oxygen.
- Any facility or group of facilities, which constitutes a new major stationary source (relating to Nonattainment Review Definitions), or any modification which constitutes a major modification under the new source review requirements of the Federal Clean

³ Air PBR 106.241: <http://www.tceq.state.tx.us/permitting/air/permitbyrule/subchapter-j/slaughterhouses.html>

Air Act (FCAA) must meet the permitting requirements (relating to New Source Review Permits) and cannot qualify for a permit by rule.

- Unless at least one facility at the property had public notice and opportunity for comment under TAC requirements, total actual emissions from all facilities permitted by rule shall not exceed 250 tpy of CO or NO_x; or 25 tpy of VOC or SO₂ or PM₁₀; or 25 tpy of any other air contaminant except carbon dioxide, water, nitrogen, methane, ethane, hydrogen, and oxygen.
- The facility shall comply with all applicable provisions of the FCAA including Federal New Source Performance Standards and Hazardous Air Pollutants, and the new source review requirements of the FCAA.
- There are no permits under the same commission account number that contain a condition or conditions precluding the use of a Permit by Rule.
- The proposed facility or group of facilities shall obtain allowances for NO_x if they are subject to Chapter 101 (relating to Mass Emissions Cap and Trade Program).
- The emissions from the facility shall comply with all rules and regulations of the commission and with the intent of the TCAA, including protection of health and property of the public, and all emissions control equipment shall be maintained in good condition and operated properly during operation of the facility.
- Facilities permitted by rule under this chapter are not exempted from any permits or registrations required by local air pollution control agencies. Any such requirements must be in accordance with TCAA, 382.113 and any other applicable law.

To assist facilities in determining if they qualify for the general requirements of a Permit by Rule, the TCEQ developed a Permit by Rule Applicability checklist (TCEQ-10149) that can be downloaded from their web site: (http://www.tceq.state.tx.us/cgi-bin/comm_exec/forms.pl#Air).

Permit by Rule (PBR 106.494) – Pathological Waste Incinerators

A permit by rule program exists for crematories and noncommercial incinerators used for disposal of pathological waste and animal carcasses under section 106.494 for the TAC. In addition to the general permit by rule requirements mentioned previously, the follow specific requirements must be met:

Design Requirements

- manufacturer's rated capacity (burn rate) shall be 200 pounds per hour (lbs/hr) or less
- incinerator shall be a dual-chamber design
- burners shall be located in each chamber, sized to manufacturer's specifications, and operated as necessary to maintain the minimum temperature requirements of subparagraphs at all times when the unit is burning waste.
- secondary chamber much be designed to maintain a temperature of 871°C (1,600 °F) or more with a gas residence time of 1/2 second or more or;

- incinerators at animal feeding operations that are used to dispose of carcasses generated on-site and are located a minimum of 700 feet from the nearest property line, shall be designed to maintain a secondary chamber temperature of 760°C (1,400°F) or more with a gas residence time of 1/4 second or more
- Alternatively, incinerators may be located in accordance with Table 494, provided the total manufacturer's rated capacity (burn rate) of all units located less than 700 feet from a property line shall not exceed 200 lb/hr. Setback distances shall be measured from the stack exit.

Table 4-11 Texas Incinerator Property Line Setback Distances

Stack Height (feet)	Property Line Distance (feet) For 24-hour Operation	Property Line Distance (feet) For *Daytime-only Operation
8 or less	210	150
>8 and ≤ 12	200	140
>12 and ≤ 16	180	130
>16 and ≤ 20	160	110
> than 20	140	90

*One hour after sunrise to one hour before sunset

Source: Texas Administrative Code 106.494

Operational Requirements

- manufacturer's recommended operating instructions shall be posted at the unit and the unit shall be operated in accordance with these instructions
- opacity of emissions from the incinerator shall not exceed 5.0% averaged over a six-minute period
- Heat shall be provided by the combustion of sweet natural gas, liquid petroleum gas, or Number 2 fuel oil with less than 0.3% sulfur by weight, or by electric power
- Incinerators installed and operated in accordance with the conditions of this section shall not be used to dispose of any medical waste, other than pathological waste and/or carcasses
- Incinerators installed and operated in accordance with the conditions of this section shall also meet the requirements of other sections of the title relating to single, dual, and multiple-chamber incinerators; including testing requirements, monitoring and recordkeeping requirements, and operating requirements

To assist in determining if a pathological waste incinerator qualifies for a Permit by Rule, the Texas Commission on Environmental Quality developed a checklist (TCEQ-20271) that can be downloaded from their web site: (http://www.tceq.state.tx.us/cgi-bin/comm_exec/forms.pl#Air).

Air Quality Standard Permit for Animal Carcass Incinerators

Effective January 16, 2006, Texas released a standard permit for animal carcass incinerators that applies to pet crematories. Some of the requirements are similar to the Permit by Rule conditions for pathological waste incinerators and are summarized as follows:

- Notification requirements in the local newspaper followed by public comment period
- Nameplate with model and serial numbers must be on each incinerator in a visible location
- Incinerators must be located at least 50 feet from the nearest point on the property line and may not exceed four units in total for a maximum burn rate capacity ≤ 400 lb/hr

Design Requirements

- Incinerators must be dual-chamber incinerators with a maximum burn rate capacity of 200 lb/hr
- The incinerators must be designed to maintain a minimum secondary chamber temperature of 871°C ($1,600^{\circ}\text{F}$) with a minimum gas residence time of one-half second.
- The owner or operator shall install and maintain equipment to continuously monitor and record secondary chamber temperature at the exit of the secondary chamber (measured at the base of the stack) whenever the incinerator is operating.
- There must be no obstructions to stack flow, such as rain caps, unless such devices are designed to automatically open when the incinerators are operated. Properly installed and maintained spark arresters are not considered obstructions.
- Incinerators must have a minimum stack height of 20 feet from ground level and the stack must be at least 3 feet above the highest point of the structure housing the incinerator.

Operational Requirements

- Incinerators must be used for the sole purpose of incineration of animal carcasses, in whole or part. The associated packaging material for the carcasses may also be incinerated, but must not be made of plastics that contain chlorine. Incinerators must not be used to incinerate any type of research or laboratory test animals. This standard permit does not authorize the incineration of any other types of waste.
- Incineration of a carcass must be initiated within two hours of receipt, unless stored at or below a temperature of -2°C (29°F). Storage of carcasses shall be in a manner that minimizes the release of odors.
- Each load must be weighed by a scale. The batch load to the primary chamber must not exceed the manufacturer's specifications.
- The manufacturer's recommended operating instructions must be posted at each incinerator and each incinerator must be operated in accordance with these instructions.
- Fuel for the primary and secondary chamber burners is limited to natural gas or propane.
- The exit temperature of the secondary chamber must not fall below 871°C , averaged over a five minute period, while incinerating carcasses. For each operating period,

the exit temperature of the secondary chamber must be at least 871°C (1,600°F) before the first charge of carcasses is loaded. The combustion of the last charge of carcasses for any operating period must be complete before the secondary chamber burners are shutdown.

- Visible emissions must not exceed an opacity of 5.0% averaged over any six-minute period.
- Except in the case of incinerators with continuous opacity or carbon monoxide monitoring, or equivalent monitoring approved by the executive director or designated representative of the TCEQ, operation of the incinerator is limited to one-hour after sunrise to one-hour before sunset.
- On-site handling of ash must be accomplished in a manner that will prevent the ash from becoming airborne.
- Incinerators installed and operated in accordance with the requirements of this permit must meet the applicable requirements of other sections of the title relating to single, dual, and multiple-chamber incinerators; including testing requirements, monitoring and recordkeeping requirements, and operating requirements.

Recordkeeping Requirements

- The standard permit and stack sampling results for air emission testing authorized under the permit
- Records of the weight of carcasses loaded and cycle times
- Records of the secondary chamber temperature
- Types of carcasses, date and time of receipt and incineration, method of handling (frozen or immediate burn)
- Date and times of emergency incinerator shutdown and/or malfunction
- CEMS quality assurance data including calibration checks and adjustments

Incinerators with a Maximum Burn Rate Greater than 100lb/hr

- The concentration of oxygen at the exit of the incinerator must be maintained above 40,000 ppm by volume on a wet basis (4 percent), averaged over a one-hour period.
- The holder of this permit shall install, calibrate, maintain, and operate a CEMS to measure and record the concentrations of O₂ from the exhaust stack.
- Within 60 days of start-up, the CEMS must be scheduled for certification testing following a pretest meeting with the TCEQ regional office

Slaughterhouses in Texas control odour by refrigeration. In the poultry processing industry, odour is a primary concern at rendering facilities. Cookers, presses, centrifuges and heat exchangers are sources of nuisance odours. These sources are kept under negative pressure and the vapors are routed to a 3-series scrubber system. The first scrubber removes solids and the last two reduce odour emissions. Poultry receiving is enclosed, under negative pressure and emissions are routed to a fabric filter baghouse for dust management. Hydrogen sulfide emissions are a recent concern in the poultry processing

industry. It is common for processors to direct their wastewater to an on-site multi-stage pond system for treatment. If this wastewater system is not properly sized or maintained, the pond system may become a source of hydrogen sulfide emissions.

Modelling is conducted to ensure that the facility is in compliance with the EPA's National Ambient Air Quality Standards (NAAQS), TCEQ Effects Screening Levels (ESLs) and TCEQ Rules and Regulations. On the sample permits provided by the TCEQ it was noted that odours are not quantified, however, modeling can predict the level of nuisance odours generated by a certain facility. Modeling is also conducted to determine the ground level concentrations of hazardous materials such as hydrogen sulfide.

4.7.7.2 Nebraska

The Nebraska Department of Environmental Quality (NDEQ) issues permits to stationary sources. The agency has never issued a permit for the incineration of slaughter waste but has issued permits for incinerators used for the disposal of dead animals at veterinaries and livestock feeding operations. The NDEQ has permit by rule programs established for two specific industry categories: Asphalt Plants and Small Animal Incinerators, with more categories under development. To qualify for the Permit by Rule for Small Animal Incinerators, the following requirements must be met:

Incinerator Features

- Boundary/location requirements: attainment area located a minimum of 5 miles from the town of Weeping Water, Nebraska
- Dual chambers each with its own burner: primary charging chamber, secondary chamber (afterburner)
- Design burn capacity < 200 lbs/hr
- Stack outlet ≥ 7 feet above ground
- Secondary chamber $\geq 760^{\circ}\text{C}$, residence time ≥ 0.5 s

Operating Conditions and Limits

- Incineration rate (lb/hr) specified by the manufacturer will never be exceeded
- Incinerator will be properly operated at all times in accordance with manufacturers instructions
- When the weight of the load is estimated, the incinerator will be operated as if the maximum rated amount of material is being incinerated
- When the weight of the load is known, the incinerator will be operated for a period of time equal to the weight of the load divided by the incineration rate (lb/hr) specified by the manufacturer

Incinerator Fuels

- Only the following fuels are permitted: natural gas, liquid petroleum gas, distillate oil (diesel #1 or #2, < 0.05% sulphur by weight)

Material Constraints

- Only the following materials are permitted to be incinerated: deceased animals or deceased animals and medical/infectious waste (not to exceed 10% by weight in a single load)

Air Emission Testing Requirements

Emission testing must be conducted on the unit or a similar unit and submitted with the application. The following parameters must be tested

- % excess O₂
- Total PM (filterable and condensable): < 0.6 lb/MMBtu per hour, < 229 mg/m³ dry standard cubic foot corrected to 7% O₂
- Opacity < 20%

Record Keeping Requirements

Records must be kept for a minimum of 5 years and made available to Department personnel upon request. The following records are required:

- Type and weight of materials incinerated during each charge
- Date and time daily opacity observations are conducted.
- Hours of operation of the main chamber and calculated incineration rate of each charge
- Type of fuel used including sulphur content of distillate fuel
- Routine maintenance records and equipment failures or malfunctions

The agency does not have regulations that directly address odour or waste management. The permitting process usually involves veterinaries and livestock feeding operations and therefore, does not include dealings with slaughter and poultry processing wastes. It may indirectly address odours if these are caused by a regulated pollutant, such as TRS, VOCs.

Dispersion modeling may be required to ensure compliance with the National Ambient Air Quality Standards (NAAQS). The Nebraska Air Quality Regulations provides thresholds for new or modified stationary emission sources that may require modeling (see table below).

Table 4-12 NDEQ Modeling Thresholds

Regulated Pollutant	Threshold ^a (lb/hr)
CO	23
SO ₂	9
NO _x	9
PM ₁₀	3 ^b
Pb	0.1
TRS ^c	> 0

^a Provided in pounds per hour of increased allowable emissions

^b 3 pounds per hour or alternatively, ≥ 15 tons per year

^c TRS emissions as defined in Title 129, Chapter 1

Source: Atmospheric Dispersion Modeling Guidance for Permits – NDEQ

4.7.7.3 Missouri

The Air Pollution Control Program of the Missouri Department of Natural Resources currently has four Permit by Rule notification programs in place including:

- Application for Authority to Construct, Permit by Rule Notification - Crematories and Animal Incinerators, Form--MO 780-1888
- Application for Authority to Construct, Permit by Rule Notification - Livestock Markets and Livestock Operations, Form--MO 780-1886

The Permit by Rule requirements for Crematories and Animal Incinerators are summarized as follows:

- Materials limited to noninfectious human materials and noninfectious animal carcasses
- Maximum burn rate of 200 lb/hr
- Dual-chamber design with burners located in each chamber
- Secondary chamber minimum temperature of 871°C, 0.5 s residence time
- Incinerator operator shall be trained in incinerator operating procedures as developed by the ASME, the manufacturer, or an individual with more than 1 year experience. Minimum training shall include basic combustion control parameters and emergency procedures in the event of a malfunction or operating parameter exceedance.
- Permitted fuels include natural gas, liquid petroleum gas, #2 fuel oil (0.3% sulphur by weight), or electric power
- Opacity limit: 10%
- Odour detection limit of 7 dilutions-to-threshold for 2 separate trails not less than 15 minutes apart within 1 hour

The Permit by Rule requirements for Livestock Markets and Livestock Operations mainly include building cleanliness and ventilation system cleaning requirements to minimize odours. Similar to the animal incinerator requirement, an odour detection of 7 dilutions-to-threshold is specified. No other emission limits or monitoring protocols are specified.

4.8 INTERNATIONAL

4.8.1 European Union

In 1996 the European Commission issued a directive known as IPPC (Integrated Pollution Prevention Control) to all its member states. This gave each member the coverage to implement their own legislation to control and prevent pollution. Under the IPPC Directive the European Commission is responsible for creating a guidance document to aid Member States in regulating industries in accordance with procedures. The relevant document for the slaughterhouse industry is the “Reference Document on Best Available Techniques in the Slaughterhouses and Animal By-Products Industries”. This document provides guidance to help member states implement their own Best Available Techniques (BAT). This technique was recently known as BATNEEC or Best Available Technique Not Entailing Excessive Cost, until the IPPC regime updated the technique to BAT. The main points related to incineration and BAT in this document are related to SRM being disposed of in an approved incinerator. The BATs listed within the document for animal by-product incineration are able to achieve the following emission limits:

Table 4-13 Emission limits for dedicated incineration of animal by-products in either bubbling bed, circulating fluidized bed or rotary kiln incinerators

Releases to air	Performance associated with BAT ⁽³⁾	
	Typical	Monitoring
SO ₂	< 30 ⁽²⁾ mg/m ³	continuous
HCl	<10 ⁽²⁾ mg/m ³	continuous
HF	n/a	
NO _x	< 175 ⁽²⁾ mg/m ³	continuous
CO	< 25 ⁽²⁾ mg/m ³	continuous
VOCs	< 10 ⁽²⁾ mg/m ³	periodic
Dust	< 10 ⁽²⁾ mg/m ³	continuous
Dioxins and furans	< 0.1 ⁽⁴⁾ ng/m ³	periodic
Heavy metals total (Cd, Tl)	<0.05 ⁽⁵⁾ mg/m ³	
Heavy Metals (Hg)	<0.05 ⁽⁵⁾ mg/m ³	
Total Heavy Metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	< 0.5 ⁽⁵⁾ mg/m ³	
NH ₃	< 10 mg/m ³	
Temperature, Residence Time	> 850°C, 3.5 s	
Oxygen (minimum after last injection)	9%	continuous
Pressure, temperature, water vapour Volumetric flow		continuous
Ash (total carbon)	< 1% ⁽⁶⁾	periodic
Ash (total protein) (Aqueous extract)	0.3 – 0.6 mg/100g	periodic

⁽²⁾ Releases control – “95% percentile hourly average over 24 hours”. Measurements at 273 K, 101.3 kPa and 11% O₂ dry gas

⁽³⁾ Actual performance results operating a dry flue gas-cleaning system with bag filters and injected reagents

⁽⁴⁾ Values measured over a sample period of a minimum of 6 hours and a maximum of 8 hours expressed as toxic equivalent in accordance with Annex 1 of the Waste Incineration Directive

⁽⁵⁾ Values measured over a sample period of a over sample period of a minimum of 6 hours and a maximum of 8 hours total organic carbon

⁽⁶⁾ Total organic carbon

Note: protein analysis is not relevant to the dedicated incineration of poultry by-products

In addition to meeting the emission limits, additional BAT requirements include implementation of all of the following practices:

1. enclose buildings used for delivery storage, handling and processing of animal byproducts
2. clean and disinfect delivery vehicles and equipment, after each delivery/use
3. carry carcasses (not drag them)
4. reduce in size animal carcasses and parts of animal carcasses, before incineration
5. restrict feedstock to exactly that tested during trials
6. agree the fat:moisture:ash content of animal meal, with the renderer
7. avoid receipt of material for incineration in PVC packaging
8. either auger feed, or pump parts of carcasses or animal meal to the incinerator
9. incinerate incineration waste water, if there is no suitable WWTP on the site
10. seal the storage, handling and charging of animal by-products to incinerators
11. duct air from the installation and the pre-combustion equipment to combustion chambers
12. alarm and interlock combustion temperatures to charging mechanisms
13. operate continuous incineration
14. operate an ash burnout chamber, where adequate combustion is not otherwise achievable, e.g. immediately downstream from rotary kilns
15. operate automated continuous de-ashing
16. operate a monitoring regime for emissions, including a protocol for monitoring burnout, including biohazard from TSE prions, in ash
17. to achieve emission levels as low as reasonably practicable below those shown in Table 4.13
18. regularly clean and disinfect installations and equipment
19. operate odour arrestment techniques, when the incinerator is not working, when odour prevention is not reasonably practicable and
20. use a carbon filter for odour abatement, when incinerators are not operating and where odour prevention is not reasonably practicable.

Incinerators are equipped with at least one auxiliary burner which is switched on automatically when the temperature of the combustion gases after the last injection of combustion air falls below 850°C. It must be used during plant start-up and shutdown operations to ensure that the temperature of 850°C is maintained at all times during operations. The unburned material remains in the combustion chamber. If waste content contains over 1% halogenated organic substance (chlorine), the temperature is raised to 1100°C (European Regulation Directive 2000/76/EC).

In France, Germany and Switzerland the combustion of meat-and-bone meal is incinerated in cement kilns, (European Commission [EC], 2000). Burning of hazardous industrial wastes

in cement kilns has become a well-accepted method for the treatment of hazardous wastes. In France, the maximum amount of meat-and-bone meal which can be used in a cement kiln is estimated to be approximately 10% of material.

4.8.2 United Kingdom

The UK has successfully adopted BAT to each industry sector. Specific instructions and guidance following BAT within the UK are outlined in this section. The UK has issued BAT reference notes (BREFS) to aid the UK in implementing BAT for each industry sector. The UK has a well governed regulatory system in place to help control emissions utilizing a licensed scheme. The government issues permits (called UK authorizations) to allow industry to operate and the permit has a number of conditions attached. Those industry sectors which are the major polluters for air, land and water have been targeted. The government recognizes that releases to air are a key area of regulatory focus in the UK.

Traditionally air emissions have been regulated in England, Scotland and Wales under various legislation, including, The Factory Acts, The Chimney Acts, The Smoke Control Acts and more recently the 1990 Environmental Protection Act (EPA). The EPA implemented the following:

- Integrated Pollution Control Processes (IPC) for centrally regulated industry
- Local Air Pollution Control Processes (LAPC) for locally regulated industry

These two regimes are currently being replaced by the Pollution Prevention Control Act (PPC). This act implements the new IPPC directive.

Basically the PPC prescribed process are either regulated by central government or at the local level. The centrally regulated processes are also, known as Part A1 processes, Part A2 processes and Part B processes which are smaller process and governed locally. Part A processes are fully environmentally regulated including air. Part B processes are air regulated only. Although the regulation is disseminated through different levels in the UK, all processes share a common goal of achieving BAT.

The UK has adopted a system where specific industry sectors and working tasks groups will work together with the government to write and published codes of practice, process guidance notes (PGN) and BREF's. These documents help both regulatory officials and industry process operators to fully understand the requirements needed to undergo permitting and compliance while using BAT.

The UK has adopted the technical principles described in the document "Reference Document on Best Available Techniques in the Slaughterhouses and Animal By-Products Industries" for their animal by-product incineration plants.

4.8.2.1 Waste Incineration

Waste incineration in the UK is not specific to cattle tissue but covers the more general approach of animal incineration which includes many forms of carcasses. The incinerator plants will also accept animal carcasses from pigs, sheep, and poultry. Incinerators in the UK can be further categorized down to their specific waste usage:

- high-temperature incinerators, used for hazardous waste;
- municipal solid waste incinerators, used for domestic garbage;

- crematoria, used for deceased humans and human remains;
- hospital incinerators (clinical waste), and;
- animal carcass incinerators.

4.8.2.2 Animal By-Products (ABP) Incineration Plants

Incinerator plants that only burn animal carcasses or parts of carcasses are approved under the Animal By-Products Regulation (ABPR) (EC) No. 1774/2002. They are exempt from the more onerous controls of the Waste Incineration Directive. However, plants which burn other ABP's such as former foodstuffs, catering waste, manure, processed products (meat and bone meal, tallow), or other waste not of animal origin are permitted under the Waste Incineration Directive. Incinerator plants that burn waste other than carcasses or parts of carcasses are permitted under the Waste Incineration Directive (2000/76 EC).

The government has made it policy that veterinary officials will also inspect these types of incineration plants to ensure compliance with the other provisions of the ABPR, e.g. record keeping requirements, pest control, transportation and collection of animal by-products.

The emissions which constitute controls from ABP incineration include odour, particulate matter, hydrogen chloride, nitrogen, oxides, sulphur dioxide, carbon, volatile organic compounds (from methane to polycyclic aromatic hydrocarbons), polychlorinated dibenzodioxin and dibenzofuran. The flue gases are the main source of release and potential releases from animal carcass incinerators. The storage of carcasses can emit odour and the handling of ashes can emit particulate matter.

4.8.2.3 Guidance on ABP Incineration Plants

The government has issued specific guidance for animal waste incinerators:

- Guidance note for high-capacity incineration plants (>50 kg/hr)
- Guidance note for low-capacity incineration plants (<50 kg/hr)

The regulations covering low capacity incinerators usually apply to incinerators on farms, knackers' yards and pet crematoria. These incinerators (when operated in accordance with the manufacturer's instructions) have been approved by the government as capable of meeting the requirements of the ABPR. A list of low-capacity incinerators presently operating in the UK is maintained by the Department for Environment, Food and Rural Affairs (defra): http://www.defra.gov.uk/animalh/by%2Dprods/guidance/type_approvals.pdf Low-capacity incinerators may only burn SRM if the incinerator has an afterburner. Not all of the incinerators listed are equipped with afterburners.

4.8.2.4 Air Emission Limits

The air emission limit values are listed under the Waste Incineration Directive. The parameters, criteria and numerical values are listed in Table 4-14 for specific animal carcass incineration. The Waste Incineration Directive further details the parameters into what derogations are feasible, in particular for nitrogen oxides. There are further emission level values for co-incinerators, although not all waste incinerators use co-incinerators.

4.8.2.5 Odour and Dust

Odour and dust are controlled from upon receiving the carcass at the facility. The following points list the common conditions which would be sited on a permit:

- Careful siting of animal carcass storage
- Setting storage time settings for unrefrigerated, refrigerated and frozen carcasses
- Spillage prevention while transport is taking place
- Spillages are vacuumed, dry spillages use wet methods, and dry sweeping is not permitted - high standards of house keeping are encouraged
- All vehicles, containers, trailers, storage areas, loaders and equipment are designed for easy cleaning and disinfected, impervious and kept clean
- Holdings tanks have a resistant finish
- Air from storage areas are under negative pressure and are then used in the combustion process
- High intensity odours are filtered through carbon filters
- De-washing is enclosed and made directly into an enclosed transport skip. Air extraction systems are used with filters when an area is not enclosed

Table 4-14 UK Emission Limit Values and Criteria for Animal Carcass Incineration

General parameters	Daily Average (mg/m³)	Monitoring	Monitoring Frequency
Total Particulate	10	quantitative monitoring and recording	continuous
Gaseous and Vapours organic substances	10	manual extractive test	annual
Hydrogen Chloride	10	manual extractive test	annual
Sulphur Dioxide	50	quantitative monitoring and recording	continuous
Nitrogen Monoxide	200		
Nitric Oxide	400	manual extractive test	annual
Oxygen	Minimum 3% and average 6% by volume	manual extractive test and measure continuously at same location-end of retention zone in secondary chamber	continuously
Dioxins	0.1ng/m ³	manual extractive test	annual
Carbon Monoxide	50	quantitative monitoring and recording	continuous

The secondary chamber temperature is set at a minimum of 850°C at start after the retention zone. The secondary retention time is the minimum of 2 seconds after the last injection of combustion air.

These particular parameters and emission limit values are those referred to in the Sector Guidance Note IPPC SG10; Secretary of states guidance for Animal Carcass Incineration: disposal rate of 50 kilogram's per hour to 1 tonne per hour and capacity of less than 10 tonnes per day. These limits will likely change depending on actual throughput of animal carcasses and exceedance of 10 tonnes per day.

4.8.2.6 Waste Management

The most important process waste related to air includes incineration ash and the air pollution control residues (ash and scrubber sludge). Ash management in particular should be addressed in the Code, but is beyond the scope of this project. For example, certain incinerator ash can be used as a soil amendment in the UK.

4.8.2.7 Emission Controls and Monitoring

The monitoring of emissions to air is described in Table 4-14. Monitoring and descriptions are provided in the secretary of states guidance for A2 animal carcass incineration with capacity of less than 1 tonne per hour. The type and frequency of monitoring may change depending on the animal carcass throughput and the incinerator being used. All emissions, monitoring and frequencies listed are associated with BAT.

The UK government has introduced a monitoring and certification scheme called MCERTS to help improve monitoring procedures. There are a number of technical guidance notes ranging from (monitoring and sampling protocols) available in order to conduct monitoring:

- M1- Sampling requirements for the monitoring of stack emissions to air from industrial installations, Environment Agency, July 2002.
- M2- Monitoring of stack emissions to air, Environment Agency, October 2004.
- M3- Standards for IPC monitoring part 1: standards organisation and the measurements infrastructure, HMIP, August 1995.
- M4- Standards IPC monitoring part 2: standards in support of IPC Monitoring, HMIP Revised 1998.
- Emissions should be free from visible smoke and does not exceed the equivalent of Ringelmann shade 1. Ringelmann shades are shades of grey ranging from 1 to 6. 1 being clear and 6 being black. This is British standard BS 2742:1969.

UK operators use these technical guidance documents as aids for regulatory compliance and good environmental practice which allows the operator to show that BATs are being used.

Stack height calculations and modeling are carried out to ensure adequate dispersion. The exhaust discharge from stacks typically does not achieve velocities greater than 15 m/s during operating conditions so adequate dispersion is achieved. There are no restrictions at the top of stacks, except cones to help increase velocity at the opening. There are specific requirements for stack height calculations detailed in the HMIP Technical Guidance Note; D1, (HMIP, 1993). The operators provide emission inventory data to the government authorities to demonstrate compliance. These include:

- Minimum daily oxygen concentrations
- Time reference for ½ hour averages for particulate matter, sulphur dioxide, carbon monoxide. Daily averages for ½ hour average carbon monoxide and particulate matter.

- Monitoring frequencies are encouraged when processes are first installed and commissioned. Regulation provides some variance on monitoring frequency depending on the level of compliance.
- Regular recording of temperatures, pressure, oxygen, water vapour so reference conditions are determined.

4.8.2.8 Gas Cleaning

Gas cleaning requires the cleaning of acid gas, particulate matter and ductwork in order to meet the emission limits. Fabric filters are commonly used and can provide reliable abatement of particulate matter to below 5 mg/m³. They are not used at temperatures above 250°C due to risk of fires. Wet scrubbing systems can be used together with fabric filters, however, reheating may be needed to prevent dew point and associated problems.

Wet scrubbers are commonly used in this industry sector but are not considered to be BAT for particulate matter on their own. They only represent BAT in combination with filter usage. They give rise to liquid effluent, which, if not recycled into the process, can require treatment and disposal. Plume visibility is likely to increase when wet scrubbers are being used.

4.8.3 UK Summary

Key findings from the review show that the UK has a comprehensive and structured air quality regime. Other European countries did not have as structured regimes which were technically adapted to suit slaughter waste and poultry incineration. This has developed through various directives having been ratified by European member states and the development of specific guidance such as that relating to BAT. There are specific findings for animal by-products. This incineration technique allows slaughter waste and poultry operators to dispose of their by-products through incineration, if they so wish. If a Code of Practice was to be developed then Europe and the UK's practices should be considered seriously, and, either adopted or assessed in more technical detail as to their compatibility to BC.

5 KEY FINDINGS RELEVANT TO CODE OF PRACTICE DEVELOPMENT

The request for proposal outlined nine key questions relating to air emissions from slaughterhouses and poultry processing facilities incinerating and managing slaughter waste. Based on the findings described in the previous sections of the report, these questions have been addressed and are answered in this section.

1. Is there other Code of Practices for incineration, specific to the slaughter industry, in other jurisdictions?

Established Codes of Practice for incineration specific to the slaughter industry are limited in North American jurisdictions. In the Canadian jurisdictions reviewed, Alberta's Code of Practice for Small Incinerators was identified as a potential source of guidance to BC's Code of Practice development for the slaughter and poultry industries. The Alberta Code was not developed directly for the slaughter industry but could be applicable if the limits established in the code were applicable to the contaminants in the exhaust stream. The temperature requirements for dual chamber units are sufficient to destroy pathogens in livestock waste; however, no residence time requirements are specified. It is likely that more stringent limits would be applied for larger scale incineration facilities dedicated to animal by-product waste.

In the US, the states of Texas, Nebraska and Missouri were identified as having Permit by Rule programs in place that may be relevant to incineration of slaughter waste. Permit by Rule programs are similar in concept to Codes of Practice in that they define a set of standard requirements applicable to an entire sector and eliminate the need for individual air permits for facilities meeting all of the defined requirements. The programs identified are generally applicable to animal crematories and in most cases do not meet the more stringent incineration standards recommended by the CFIA and the European Union.

The state of Texas with its significant slaughter industry and experience with BSE has well established regulatory programs for livestock waste incineration air standards. A Permit by Rule for Pathological Waste Incinerators applies to noncommercial incinerators and crematories for both pathological waste streams and animal carcasses. In addition to this program, an Air Quality Standard Permit has been established for animal carcass incineration. Both of these programs specify similar performance and emission requirements. These programs are well documented and include checklists useful for facilities in assessing if they meet the necessary requirements.

The state of Missouri has a Permit by Rule program applicable to both crematories and animal incinerators which has a temperature specification similar to the CFIA requirement; however, the document specifically states that materials are limited to noninfectious animal carcasses.

The European Union and UK have the most advanced air standard programs in place for incineration specific to the slaughter industry. This is driven by the high incidence of BSE and the need to destroy SRM waste in a manner that eliminates further spread of the disease. The European Commission's Best Available Techniques in the Slaughterhouses and Animal By-products Industries contains guidance for air standards useful for member countries in developing standards. The UK has adopted these technical principles in the development of their Sector Guidance Notes for animal carcass incineration.

2. What are the most common parameters, numerical standards and monitoring protocols used by other jurisdictions when incinerating this waste?

Canadian standards for incinerating livestock waste are the responsibility of each Province and are generally based on adopting incineration guidelines used for municipal or hazardous waste. Emission limits are typically limited to opacity, particulate matter, and CO as a minimum. The Code of Practice for Small Incinerators in Alberta specifies limits for particulate matter, opacity, HCl, CO, opacity, dioxins and furans, and mercury. The temperature requirements are 500°C for the primary chamber and 870°C for the secondary chamber and must be monitored and recorded. No residence time requirements are specified. The Code also requires a stack survey be performed if certain types of waste are burned (higher chlorine and metals). This would not apply to animal waste material.

The amendments to the CFIA feed ban regulations that take effect on July 12, 2007 recognize incineration as an effective technique for destruction of SRM waste. A CFIA risk assessment study for controlled incineration determined the overall risk of BSE transmission was negligible. This assessment was based on a minimum temperature of 850°C at all times during incineration with a minimum residence time of 2 seconds. The incinerator requires at least one auxiliary burner. These requirements are not explicitly documented in the CFIA regulations, however, in the application process to the CFIA for an incineration permit operating parameters will be assessed against those used in the risk assessment by a CFIA technical expert to determine if they are at least equivalent prior to issuing a permit.

The review of US jurisdictions mainly uncovered operating parameters and monitoring protocols for small scale carcass incinerators operating at a burn rate < 90 kg/hr. Typical requirements for these devices in Texas, Nebraska, and Missouri include temperatures of ranging from 760-871°C at residence times > 0.5 s. Limits are established for opacity ranging from 5-10%. Nebraska also specifies a limit for PM at 229 mg/m³. A typical requirement is to continuously monitor and record the temperature at the exit of the secondary combustion chamber.

Both Europe and the UK have detailed emission limits values for criteria air contaminants as well as toxics. The governing standards are established in Table 4-13. The UK has adopted their own limits and parameters specific to their animal-by-product incineration plants and these are listed in detail in Table 4-14. The parameters may vary depending on how long the incinerators run together with their hourly throughput. Monitoring is either continuous or annual depending on the listed parameter.

Temperature and residence time are key operational parameters for dual chamber incinerators to ensure destruction of prions and other infectious agents. A summary comparison of the European and pending Canadian CFIA requirements are illustrated in the following table:

Table 5-1 Temperature & Residence Time Comparison

	EU BAT	UK	CFIA
Minimum Temperature	850°C	850°C	850°C
Residence Time	3.5 s	2 s	2 s

3. How are odour management issues addressed by slaughterhouses and poultry processors?

North American regulations for odour management are generally complaint based systems that require the prevention of nuisance releases or no objectionable odours beyond the facility property line. A common requirement is for a facility to document all odour complaints and any required corrective actions. Minimum distance requirements are sometimes specified from nearby dwellings and streets. Slaughterhouses and poultry facilities typically address odour issues by implementing best management practices relating to general cleanliness and waste handling/storage. The Permit by Rule program for Slaughterhouses in Texas specifically targets odour control by the requirement to maintain dry and clean conditions in areas used to hold animals or poultry for slaughter. Animal by-product waste is required to be stored in a manner to prevent nuisance odours and must be removed from the facility daily or stored under refrigeration. Another common odour management technique identified in the review is the practice maintaining negative pressure in animal receiving areas and waste storage areas to eliminate fugitive odours. This requirement is consistent with housekeeping requirements in Alberta approvals for rendering operations where poor housekeeping has generated major odour issues.

In Europe and the UK, odours from animal by-products are specifically addressed from the start of the process when waste is received. Areas used for delivery storage, handling and processing of animal byproducts are enclosed. There are a number of specific guidelines which are detailed within the guidance notes (section 4.8.2.6). These typically involve the combined use of technology (including wet scrubbers, filtration and good combustion during incineration) and good environmental management. One specific area where odour can cause a problem is the storage of waste prior to incineration in waste transfer stations. Typically wet scrubbing systems will be used in combination with negative building pressures in these large storage facilities so laden vehicles can drive through inside the control enclosure.

4. Are emission controls needed (i.e. scrubbers, precipitators and/or cyclones)?

Emission control requirements for small-scale carcass incinerators in use in North America are limited to a secondary combustion chamber (also referred to as an afterburner) for the minimization of opacity and odours. Good combustion practices for maintaining manufacturer specified fuel-air mixtures are essential for preventing out of compliance emissions of combustion products including CO, unburned hydrocarbons, SO_x, NO_x and PM. The manner in which these limits must be met is not specified as the rules are generally performance-based. Rendering operations in Alberta use wet scrubbers for odour control and one incinerator for odour control is under construction. Larger fixed incinerator facilities that operate under an approval use wet scrubbers as these can manage particulate and acid gas (halogen) removal concurrently.

In Europe and the UK, emission controls are identified through Best Available Technique (BAT) guidance in order to have good control over the emissions leaving the incineration stacks and any fugitive emissions that may arise from the facility. The emissions controls also play a vital part in the control of odour and dust. Wet scrubbers are commonly used in combination with fabric filters to meet BAT requirements.

5. What are common dust management strategies that would be suitable for slaughterhouses and poultry processors?

Dust management strategies are often similar to odour control strategies that require best management practices and procedures to minimize fugitive releases from a facility. Waste storage areas should be enclosed and ventilation fans and louvers should be regularly cleaned to prevent build-up of dust. Cleaning out these areas with water rather than blowing them out with air will minimize dust releases. More advanced dust control procedures for waste receiving/storage areas involve the use of fabric filters to control local exhaust air. In Alberta, dust-generating livestock operations are enclosed and specific large volume particulate sources use baghouse controls.

European dust management strategies include good management practices and efficient combustion and efflux velocities so not to result in stack downwash conditions. Dust control inside facilities include the use of negative pressure systems and local exhaust ventilation. The use of water bowsers, wetting down procedures and cleaning are common management techniques.

6. Are there common triggers for when to require modelling?

North American jurisdictions generally require modelling as part of a new permit application or amendment to an existing permit for sources with anticipated significant impacts to the airshed. It is expected most jurisdictions would require as a minimum screening level modelling but likely more sophisticated models for a proposed incineration facility handling livestock waste in quantities beyond quantities handled by smaller on-farm units.

The Alberta Code for Small Incinerators requires no modelling, but all approved facilities have required extensive modelling. Odour modelling was required for perhaps the first time at a rendering plant in Alberta in 2006.

There are common triggers for air quality modeling in the UK before a facility is issued a permit to operate. The triggers are usually based on stack height and emission thresholds. The UK has modelling expertise but not at the same advanced technological level as North America.

7. How should this waste be managed prior to incineration?

Little guidance in this area was identified in North American jurisdictions due to the lack of well developed regulations and guidance for incineration of livestock waste.

In both Europe and the UK, waste is typically managed through the use of management tools such as ISO 14001. These programs are strongly encouraged and a facility will usually have procedures in place to help them gain ISO accreditation. The programs include effective operations and maintenance, response to problems, managing contractors on site, auditing, competence and training, and systems in place for recording accidents, incidents and non-conformance conditions.

Effective waste management is used through the combination of good practice and technology. This involves the full management of pollution abatement systems to land, water and air (dust, odour, incineration, solid and liquid wastes). Animal waste stock rotations are used inside waste transfer stations so the oldest or highest priority material is incinerated first. Carcasses are reduced in size prior to incineration and carried, not dragged. Raw materials used in animal carcass incinerators consist of; carcasses which have been cut to reduce their size ready for incineration, parts of animals such as SRM, gas

treatment reagents (lime), water, activated carbon reagents for dioxin and heavy metal treatment, chemical treated effluent, gas, oil for start up, biocides, magnesium silicon and packaging.

8. Are the requirements in Alberta Environment's Code of Practice for Small Incinerators sufficient for incinerating this type of waste?

Alberta's Code of Practice for Small Incinerators was not developed specifically for animal by-product waste. There are currently approximately 57 small incinerators in Alberta registered under this code but none of these devices are in service for destruction of slaughter or poultry related waste. The temperature requirements specified for a dual chamber unit are consistent with CFIA and European requirements, however, no residence time is specified and the list of substances with specified limits is not as comprehensive as those regulated in European standards. The Code may be applicable for a small quantity of livestock waste but would be inadequate for a larger facility handling significant quantities of this waste stream. It is anticipated that a larger scale facility that treats animal waste (that would require an approval in Alberta) would have considerably more stringent emissions requirements, along the lines of what exists for the Beiseker and Wainwright incinerators. The Alberta Code also has no requirements for waste management at the facility and this has previously been identified as a significant odour issue.

9.. Would the Best Available Techniques for incineration of wastes from slaughterhouses and animal by-products industries specified in the European Commission's Reference Document on Best Available Techniques in Slaughterhouses and Animal By-Products Industries, May 2005 by the Integrated Pollution Prevention and Control, be technically possible and viable in B.C.?

The BAT requirements developed by the European Commission were established based on experience in managing SRM waste generated from the BSE crisis on a large scale. Small on-farm units with limited capacities were not adequate to manage SRM waste from a BSE outbreak of the scale that occurred in Europe. The BAT requirements were developed based on the experience gained by health officials and environmental regulators to control the spread of disease while protecting air quality. The UK has adopted most of the BAT requirements but allows slightly higher emission levels for SO₂, NO_x and CO. The UK chose to adopt a 2 second residence time requirement which is lower than the 3.5 seconds specified in the BAT. The 2 second residence time requirement was referenced in the CFIA risk assessment study for SRM incineration practices in Canada.

The research and information gathered in this study indicates that the BAT requirements establish the most advanced incineration standards available and serve as the ultimate objective to aim for when developing standards for BC. These standards must be considered in context of what is viable in a jurisdiction like BC with a much smaller scale slaughter and poultry industry. The EU BAT requirements effectively require installation of large-scale incinerators as small operations would find it difficult to meet these requirements and maintain economic viability.

Recommendations for Animal Waste Incineration Code of Practice for British Columbia

Incineration standards for livestock waste in BC must be considered in context of the small-scale operations seeking waste management options in the Province. It is assumed that there will be strict segregation of waste and that only animal by-product waste or SRM waste will be incinerated. Any co-mingling with other waste streams is invalidates these

recommendations and in that situation it is recommended that Municipal or Biomedical waste incinerator emissions guidelines be followed.. Incineration equipment must be sized to process approximately 50 – 200 kg/hr of feedstock. Air standards suitable for incinerators operating in this range must occupy the “middle ground” between standards for smaller units and larger equipment burning a mixed waste stream. The review of standards in the jurisdictions reviewed uncovered values suitable for small devices (< 90 kg/hr) in North America and standards for the significantly larger (1000+ kg/hr) centralized facilities in Europe.

Certain design limitations are necessary to meet performance and operation limits. Dual chamber systems are essential to ensure complete destruction of airborne material and elimination of odour and visible emissions. It is probable that incinerators used in BC will fall into two size groups. The smaller facilities process <20kg/hr. These are expected to be batch incinerators charged several times/week, perhaps more than once per day. The second group is in the range of 40-200 kg/hr and will operate at a continuous feed rate. Large charges of feedstock should be avoided so that steady-state operation can be maintained.

Code requirements generally fall into five sections:

- 1) Scope and Definitions
- 2) Operational Requirements
- 3) Emission Requirements
- 4) Monitoring and Reporting
- 5) Applications and Amendments

Of these, recommendations are provided for items 2-4 above. Items 1 & 5 are strictly regulatory and public policy decisions and are outside the scope of this project.

Operational Requirements

This section includes operation of the incineration unit, maintenance, and handling of incoming waste. A number of applicable operational requirements were noted in the US and EU programs. These include:

- Incinerator shall be operated according to manufacturer’s requirements
- Incinerator shall not be loaded at higher than design limitations
- Waste loading into incinerator shall be weighed
- Reduce animal carcass size and parts of animal carcasses before incineration
- Waste stream dedicated to SRM and other animal by-products only
- Either auger feed or pump parts of carcasses or animal meal to the incinerator
- Duct air from the installation and the pre-combustion equipment to combustion chambers

- Place alarms and have interlock combustion temperatures to charging mechanisms, this will prevent material entering the combustion zone if the secondary chamber drops below 850°C

The following are a listing of facility operating requirements to reduce odour and other nuisances.

- There shall be a buffer zone of 250 meters around the site, to reduce the potential impact to any neighboring residents, commercial or industrial facilities
- Enclose buildings used for delivery storage, handling and processing of animal byproducts
- Air from storage areas are placed under negative pressure and then used in the combustion process
- When the incinerator is not operating, building air shall be scrubbed or incinerated to eliminate odourous emissions
- Any cutting of material shall be done inside a waste transfer building which serves a wet scrubbing system and operates under negative pressure
- Implement a spillage prevention strategy while transport is taking place
- Spillages are vacuumed, dry spillages use wet methods, and dry sweeping is not permitted
- All laden vehicles should be driven straight into a waste transfer building for unloading, this building will be placed under negative pressure
- Clean and disinfect delivery vehicles and equipment, after each delivery/use
- Seal the storage, handling and charging of animal by-products to incinerators
- Regularly clean and disinfect installations and equipment

Monitoring

Monitoring includes source emissions (stack test), operational parameters (secondary chamber temperature) and certain operational conditions:

- Stack test for the emission parameters listed in Table 5.2
- Temperature exiting primary chamber and secondary chamber
- Visual and olfactory assessments of emissions should be made regularly while the process is in operation. The time, location and results of these assessments should be recorded by the operator.

Monitoring is an important part of the operations process so problems such as, breakdowns, inefficient combustion, and regulatory emission limits can be determined. It is recommended that the operator monitor emissions, perform tests and inspections of the process and keep records. These should include non-continuous monitoring, inspections

and visual assessments. These assessments should be kept on site for at least 3 years and made available for the regulator to examine upon request.

Initial stack testing may confirm the limits for the above parameters. The absence of a proposed limit does not necessarily indicate that the substance is not released; the emission rate may be insignificant and not warrant limits or controls. Potential additional substances for consideration depending on the sensitivity of the airshed include HCl, VOCs, and dioxins & furans. A recommendation for additional study is to test the releases from an operating unit to confirm emission levels of the substances in Table 5-2 and to test for the presence of additional compounds. To ensure emissions are in compliance with the proposed limits and the release of additional substances are minimized or prevented, it is essential that the following practices are maintained:

- Strict control of the feedstock by allowing animal waste only (no municipal waste, plastics, PVC, etc.)
- Follow the manufacturers recommended procedures for operation and maintenance

A commissioned device need not be tested on a regular basis provided waste feed stock does not significantly change.

Table 5-2 provides recommended emission limits for small animal waste incinerators for BC and comparison to emission limits referenced in other jurisdictions. Generally other jurisdiction referenced were for larger units or units that potentially burned a much wider range of substances. As only animal waste is considered here, it was deemed acceptable to limit the emission parameters to those indicators of high efficiency combustions.

Particulate matter and opacity emission limits, combined with primary and secondary temperature monitoring and strict following of unit capacity limitations are anticipated to provide an acceptable level of confidence that the incinerator is operating effectively.

Regulatory experience in Alberta suggests that animal waste storage has the potential to generate significant odour issues. This aspect of the facility operation warrants considerable attention.

Evaluation of available technologies for the capacity and material considered would be a useful extension of this project. It is not clear that units designed for animal waste at the low throughputs required in BC are in fact available on the Canadian market. It is also unknown if small capacity units can handle animal waste with any degree of effectiveness.

Table 5-2 Proposed Emission Limits and Emission Limits from other Jurisdictions

Parameter	Proposed Limit (mg/m ³)	BC Guidelines for Municipal Waste Incinerators (mg/m ³)		BC Guidelines for Biomedical Waste Incinerators (mg/m ³)	Alberta Small Incinerator Code (mg/m ³)	CCME Guidelines for Municipal Waste (mg/m ³)	CCME Guidelines for Biomedical Waste (mg/m ³)		UK (mg/m ³)
		<400 kg/h	>400 kg/h				<200 kg/h	>200 kg/h	
Total Particulate	20	180	20	20	20	20	50	20	10
Sulphur Dioxide	50	0.450 (1-h average) 0.160 (24-h average)	250	180	-	-	-	-	50
Oxides of Nitrogen	200	0.400 (1-h average) 0.200 (24-h average)	350	380	-	-	-	-	400
Carbon Monoxide	50	55 (4-hr rolling average)	55 (4-hr rolling average)	55 (4-hr rolling average)	57	57		57	50
Opacity	10% averaged over 6 consecutive minutes	10%	5%	-	-	-	-	-	-
Dioxins and Furans	-	-	0.5 ng/m ³ TEQ	0.5 ng/m ³ TEQ	0.5 ng/m ³ TEQ	0.5 ng/m ³ TEQ	-	0.5 ng/m ³ TEQ	0.1 ng/m ³ TEQ
HCl	-	0.100 (0.5-h average) 0.040 (24-h average)	70	50 or 90% removal (8-hr rolling average)	75	75	75	75	10

Parameter	Proposed Limit (mg/m ³)	BC Guidelines for Municipal Waste Incinerators (mg/m ³)		BC Guidelines for Biomedical Waste Incinerators (mg/m ³)	Alberta Small Incinerator Code (mg/m ³)	CCME Guidelines for Municipal Waste (mg/m ³)	CCME Guidelines for Biomedical Waste (mg/m ³)	
		<400 kg/h	>400 kg/h				<200 kg/h	>200 kg/h
Total Particulate	50	180	20	20	50	20	50	20
Sulphur Dioxide	-	0.450 (1-h average) 0.160 (24-h average)	250	180	-	-	-	-
Oxides of Nitrogen	-	0.400 (1-h average) 0.200 (24-h average)	350	380	-	-	-	-
Carbon Monoxide	-	55	55	55	57	57		57

		(4-hr rolling average)	(4-hr rolling average)	(4-hr rolling average)				
Opacity	20% averaged over 6 consecutive minutes	10%	5%	-	-	-	-	-
Dioxins and Furans	-	-	0.5 ng/m ³ TEQ	0.5 ng/m ³ TEQ	0.5 ng/m ³ TEQ	0.5 ng/m ³ TEQ	-	0.5 ng/m ³ TEQ
HCl	-	0.100 (0.5-h average) 0.040 (24-h average)	70	50 or 90% removal (8-hr rolling average)	75	75	75	75

Reference conditions: 11% O₂, 25°C, 101.3 kPa

Table 5-3 Proposed Emission Limits and Emission Limits from other Jurisdictions

Parameter	US EPA - NSPS and EG Emission Limits for New and Existing CISWI (mg/m ³)	US EPA - NSPS and EG Emission Limits for New or Modified HMIWI (mg/m ³)			US EPA - NSPS and EG Emission Limits for Existing HMIWI (mg/m ³)		
		≤ 200 lb/h (approx. 91 kg/h)	200 lb/h to 500 lb/h (91 kg/h to 227 kg/h)	> 500 lb/h (approx. 227 kg/h)	≤ 200 lb/h (approx. 91 kg/h)	200 lb/h to 500 lb/h (91 kg/h to 227 kg/h)	> 500 lb/h (approx. 227 kg/h)
Total Particulate	70	69	34	34	69	34	34
Sulphur Dioxide	20 ppmv dry	55 ppmv dry	55 ppmv dry	55 ppmv dry	55 ppmv dry	55 ppmv dry	55 ppmv dry
Oxides of Nitrogen	388 ppm dry	250 ppmv dry	250 ppmv dry	250 ppmv dry	250 ppmv dry	250 ppmv dry	250 ppmv dry
Carbon Monoxide	157 ppmv dry	40 ppmv dry	40 ppmv dry	40 ppmv dry	40 ppmv dry	40 ppmv dry	40 ppmv dry
Opacity	10%	10%	10%	10%	10%	10%	10%
Dioxins and Furans	0.41 ng/m ³ TEQ	2.3 ng/m ³ TEQ	0.6 ng/m ³ TEQ	0.6 ng/m ³ TEQ	2.3 ng/m ³ TEQ	2.3 ng/m ³ TEQ	2.3 ng/m ³ TEQ
HCl	62 ppmv dry	15 ppmv dry	15 ppmv dry	15 ppmv dry	15 ppmv dry	15 ppmv dry	15 ppmv dry

Reference conditions: 7% O2 dry basis at standard conditions

NSPS - New Source Performance Standards

EG - Emissions Guidelines

CISWI - Commercial and Industrial Solid Waste Incinerator(s)

HMIWI - Hospital/Medical/Infectious Waste Incinerator(s)

Table 5-4 Proposed Emission Limits and Emission Limits from other Jurisdictions

Parameter	Oregon Administrative Rules - Incinerator Standards* (mg/m ³)	Texas Commission on Environmental Quality Permit by Rule Requirements* (mg/m ³)	UK** (mg/m ³)	EEC** (mg/m ³)
		$\leq 200 \text{ lb/h}$ (<i>approx. 91 kg/h</i>)		
Total Particulate	34	25 tons/yr (limit for PM ₁₀)	10	<10
Sulphur Dioxide	50 ppm	25 tons/yr	50	<30
Oxides of Nitrogen	200 ppm	250 tons/yr	400	<175
Carbon Monoxide	100 ppm	250 tons/yr	50	<25
Opacity	10%	5% averaged over a 6-minute period	-	-
Dioxins and Furans	-	-	0.1 ng/m ³ TEQ	0.1 ng/m ³ TEQ
HCl	50 ppm	50 ppm	10	<10

* Reference conditions: 7% O₂ dry basis at standard conditions

** Reference conditions: 11% O₂, 25°C, 101.3 kPa

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7 AGENCY CONTACTS

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**APPENDIX A SUMMARY TABLES OF JURISDICTION REVIEW -
ANSWERS TO KEY QUESTIONS**

Table A-7-1 Canadian Jurisdiction Review Summary

	<i>Name of Jurisdiction --></i>	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario
1	Is there a Code of Practice for incineration specific to the slaughter industry?	Currently in scoping phase for Codes of Practice development for Slaughter Industry and Poultry Processing Industry	Small Incinerator Code of Practice is not directly specific to the slaughter industry, but could be used for animal incineration	No	No	Guideline A-7 Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators but is not specific to the slaughter industry.
2	What are the most common parameters, numerical standards and monitoring protocols used when incinerating this waste?	BC "Emission Criteria for Municipal Solid Waste Incinerators" likely most applicable and have been applied in the past for some pet crematoriums.	No specific limits for animal waste incineration. Limits were developed for oily soil treatment. These are listed in the Small Incinerator Code of Practice and are cited in section 4.3.1	There are no specific standards available only the Canada Wide Standards which are listed in section 4.5.2. The Intensive live stock operations program does list odour, dust and nuisance but is not specific to incineration.	There are no specific standards available but there are standards including those set by the Manitoba Incineration Regulation and the Canadian Wide Standards which are listed in 4.5.2. The Ambient Air Quality Criterion from Manitoba Conservation, Ontario Ministry of Environment and the Canadian Council of the Ministers of the Environment.	There are no specific standards available but the air emissions for Guideline A-7 Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators are listed in section 4.6 and Table 4-6. Also, Guideline A-1: "Combustion and Air Pollution Control Requirements for New Municipal and Biomedical Waste Incinerators".
3	How are odour management issues addressed by slaughterhouses and poultry processors?	In the event of complaints, the facility may be required to install additional control works or curtail the operation.	Licensing conditions and technology .	Probably through licensing and technology – no specific examples.	Probably through licensing and technology – no examples to date.	Probably through licensing and technology. Biological filters are being considered as an option to control odours from poultry processing plants.
4	Are emission controls needed (i.e. scrubbers, precipitators and/or cyclones)?	Control devices for removal of acid gases and/or particulates required in BC Emission Criteria for Municipal Solid Waste Incinerators.	Yes. Wet scrubber for odourous sources (rendering operation). Generally baghouses used for particulate control.	No specific requirements, but expect some controls required for major incineration facility.	Control necessary to meet the ambient guidelines required, so dependent on size of the source.	Yes, if incineration is brought in as a viable option for disposal.
5	What are the dust management strategies for poultry processors and slaughterhouses?	Some guidance in "Management of Dust in Broiler Operations", BC Ministry of Agriculture	All operations enclosed and specific large volume particulate sources (eg. Dryers, storage silos) use baghouses.	No specific management techniques but will be likely done through licensing and management controls. The Intensive livestock operations program will give advice.	No specific management techniques have been located but likely will be managed through licensing and management controls.	No specific management techniques have been located but likely will be managed through licensing and management controls.

	<i>Name of Jurisdiction --></i>	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario
6	Are there common triggers for when to require modeling?	Screening level modelling used in low-risk permit applications. Higher risk sources require more refined models decided on a case-by-case basis.	Modelling done for large, approved facilities, but not for registrations (eg. Small Incinerators)	Generally modelling is not required in SK.	No, modelling plan normally required to determine if modelling necessary. Anticipate that modelling would be required for incinerator.	No, but modeling can be used.
7	How is the waste managed prior to incineration?	Incineration used only on a trial basis except for Fraser Valley Goose and Duck which may provide some guidance.	Incineration not used, but rendering plants must keep waste inside a building equipped with air scrubbers for odour control.	No specific details available.	No specific details available.	Not applicable to this province
8	Are the requirements in Alberta Environment's Code of Practice for Small Incinerators sufficient for incinerating this type of waste?		Temperature/time requirements for two-chamber units meet the pathogen control requirements. Particulate and opacity limits for municipal and hazardous waste incinerators more restrictive than the small incinerator CoP.			

Table A-7-2 US Jurisdiction Review Summary

	<i>Name of Jurisdiction --></i>	Washington	Idaho	Montana	Oregon	California
1	Is there a Code of Practice for incineration specific to the slaughter industry?	No (Department of Ecology and Southwest Clean Air Agency). Dept of Ecology has a registration process for crematoria or animal carcass incinerators.	No. A Permit by Rule program exists for dairy farms, however, nothing applicable to the slaughter industry.	No.	No.	San Joaquin Valley and South Coast Air Quality Management District have largest slaughter industry. Review of regulatory requirements posted on web sites did not yield any information on incineration standards. Contacts at these agencies did not provide information.
2	What are the most common parameters, numerical standards and monitoring protocols used when incinerating this waste?	Washington does not have significant slaughter or poultry processing activity in its jurisdiction and no incineration of wastes from this industry.	Idaho does not have incinerators of this type.	Montana has standards for animal crematoria but none in place for incineration.	Oregon has standards in place for: 1. Solid and Infectious Waste Incinerators 2. Crematory Incinerators (see Table 4-9)	
3	How are odour management issues addressed by slaughterhouses and poultry processors?	No odour complaints or issues as wastes go to rendering facilities or pet food manufacturing facilities. (Southwest Clean Air Agency)	Idaho Administrative Code requires odour controls for animal processing facilities including wet scrubbers, incinerators, chemicals, or other measures.	Montana currently has no air quality permits issued for any slaughterhouses or poultry processing facilities.	Oregon Department of Environmental Quality only permits operations like rendering plants and disposal facilities that are not considered "agricultural operations".	
4	Are emission controls needed (i.e. scrubbers, precipitators and/or cyclones)?	Slaughterhouse with integral rendering: venturi scrubber, spray chamber scrubber, packed bed scrubber, wet cyclone filter, bag filter.	Slaughterhouse with integral rendering: cyclone scrubber, spray tower, venturi scrubber, packed-bed scrubber, spray-chamber wet scrubber.	No specific details available.	No specific details available.	
5	What are the dust management strategies for poultry processors and slaughterhouses?	Fugitive dust control plans, dust bag filters	General fugitive dust management requirements in IDAPA 58.01.01.650 and 651	No specific management techniques provided or located.	No specific details available.	
6	Are there common triggers for when to require modelling?	Modelling is triggered by the installation of a new source of air emissions or modification to an existing source.	A modelling analysis is generally required with each permit application for new construction or a modification that result in an increase in emissions.	For incinerator permit applications, modeling will be conducted as specified by rule, policy, or determined on a case-by-case basis.	Agricultural operations (except field burning) are exempt from air quality regulations. Oregon requires air permits for operations like rendering plants and disposal facilities that are not considered agricultural operations.	
7	How is the waste managed prior to incineration?	No incineration used.				

Table A-7-3 Summary of Expanded US Jurisdiction Review

	<i>Name of Jurisdiction --></i>	Texas	Nebraska	Missouri
1	Is there a Code of Practice for incineration specific to the slaughter industry?	1. Permit by Rule program for Pathological Waste (includes animal carcasses) 2. Air Quality Standard Permit for Animal Carcass Incinerators (pet crematories) 3. Permit by Rule for Slaughterhouses	Permit by Rule program for Small Animal Incinerators	1. Permit by Rule program for Crematories and Animal Incinerators 2. Permit by Rule program for Livestock Markets and Livestock Operations
2	What are the most common parameters, numerical standards and monitoring protocols used when incinerating this waste?	871C, 0.5 s residence time Dual chamber design (afterburner) 200 lb/hr maximum burn rate 5% Opacity limit	760C, 0.5 s residence time Dual chamber design (afterburner) 200 lb/hr maximum burn rate 10% Opacity limit 229 mg/m ³ PM limit (dry standard, 7% O ₂)	871C, 0.5 s residence time Dual chamber design (afterburner) 200 lb/hr maximum burn rate 10% Opacity limit
3	How are odour management issues addressed by slaughterhouses and poultry processors?	Slaughterhouses control odour by refrigeration. Poultry processing facilities are maintained at negative pressure with vapours routed to scrubbers.	There are no regulations that directly address odours. Nebraska's permitting process may indirectly address odours if they are caused by a regulated pollutant, i.e., TRS, VOCs, etc.	
4	Are emission controls needed (i.e. scrubbers, precipitators and/or cyclones)?	Afterburner and good combustion practices.	Afterburner and good combustion practices.	Afterburner and good combustion practices.
5	What are the dust management strategies for poultry processors and slaughterhouses?	Poultry receiving area is enclosed and maintained under negative pressure with baghouse controls for dust management.		
6	Are there common triggers for when to require modelling?	The standard permit for waste management does not require modelling by the applicant facility because the Texas Commission on Environmental Quality reviews 'worst case' scenarios and comes up with distance limitations. If an applicant needs to apply for a case-by-case review, the agency would model the specific scenario. Non-compliance with the permit tends to be what generates complaints from neighbours (i.e. smoke and odour issues).	Dispersion modelling triggered if defined emission rate thresholds are met.	
7	How is the waste managed prior to incineration?	No specific details available.		

Table A-7-4 European Union & UK Jurisdiction Review Summary

	<i>Name of Jurisdiction --></i>	European Union	UK
1	Is there a Code of Practice for incineration specific to the slaughter industry?	Best Available Techniques (BAT) in Slaughterhouses and Animal By-Products Industries. Refer to section 4.8.1	1. Integrated Pollution Control Processes (IPC) for centrally regulated Industry. 2. Local Air Pollution Control Processes (LAPC) for locally regulated industry. Refer to sections: 4.8.2 4.8.2.1 4.8.2.2 4.8.2.4 4.8.2.8
2	What are the most common parameters, numerical standards and monitoring protocols used when incinerating this waste?	These are listed in the Waste Incineration Directive and Best Available Techniques (BAT) in Slaughterhouses and Animal By-Products Industries. Refer to section 4.8.1 and Table 4-13	These are listed in the two Guidance documents: 1. Integrated Pollution Control Processes (IPC) for centrally regulated Industry. 2. Local Air Pollution Control Processes (LAPC) for locally regulated industry. Refer to sections: 4.8.2.5 4.8.2.6 and Table 4-14
3	How are odour management issues addressed by slaughterhouses and poultry processors?	These are addressed through the use of both technology, scrubbers, filtration and good environmental management and practice.	These are addressed through the use of both technology, scrubbers, filtration and good environmental management and practice. Refer to section 4.8.2.9
4	Are emission controls needed (i.e. scrubbers, precipitators and/or cyclones)?	Wet scrubber + fabric filter	Wet scrubber + fabric filter
5	What are the dust management strategies for poultry processors and slaughterhouses?	These are listed in the Waste Incineration Directive and Best Available Techniques (BAT) in Slaughterhouses and Animal By-Products Industries. Dust is managed through good practice and technology, such as efficient combustion, enclosures, use of negative pressures and filtration.	These are listed in the two Guidance documents: 1. Integrated Pollution Control Processes (IPC) for centrally regulated Industry. 2. Local Air Pollution Control Processes (LAPC) for locally regulated industry. Refer to sections: 4.8.2.5 4.8.2.6
6	Are there common triggers for when to require modelling?	yes	yes for stack height calculations and dispersion modelling.
7	How is the waste managed prior to incineration?	These are listed in the Waste Incineration Directive and Best Available Techniques (BAT) in Slaughterhouses and Animal By-Products Industries. The waste is managed through a combination of good practice and the efficient technology. This involves full management of any by-products with pollution abatement techniques to, land, air and water.	These are listed in the two Guidance documents: 1. Integrated Pollution Control Processes (IPC) for centrally regulated Industry. 2. Local Air Pollution Control Processes (LAPC) for locally regulated industry. Refer to section 4.8.2.6

	<i>Name of Jurisdiction --></i>	European Union	UK
9	Would the Best Available Techniques for incineration of wastes from slaughterhouses and animal by-products industries specified in the European Commission's Reference Document on Best Available Techniques in Slaughterhouses and Animal By-Products Industries, May 2005 by the Integrated Pollution Prevention and Control, be technically possible and viable in B.C.?	Technically possible based on current technology but challenging to meet requirements and maintain economic viability.	