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ENGINEERING EVALUATION / FACT SHEET

BACKGROUND INFORMATION

Application No.:	R13-2860
Plant ID No.:	057-00051
Applicant:	Smith Funeral Home, Inc.
Facility Name:	Keyser
Location:	Mineral, Raleigh County
NAICS Code:	812210
Application Type:	Construction
Received Date:	September 28, 2010
Engineer Assigned:	Edward S. Andrews, P.E.
Fee Amount:	$1000.00
Date Received:	September 28, 2010
Complete Date:	November 1, 2010
Due Date:	January 30, 2011
Applicant Ad Date:	October 5, 2010
Newspaper:	*News-Tribune*
UTM's:	Easting: 674.1 km Northing: 4367.4 km Zone: 17
Description:	Construction and operation of one crematory. The unit will be dedicated for human remains.

DESCRIPTION OF PROCESS

Power-Pak II (Human Crematory)

The IE43-PPII Power-Pak II crematory is designed to complete a typical human cremation in 2 to 3 hours. This time does not include preheating the secondary chamber or the cool-down period before the removal of the remains (½ hour). The crematory has a maximum burn rate of 150 pounds per hour and a nominal burn rate of 100 pounds per hour of remains and the associated container, based on the entire cremation period. The crematory is a multiple chamber design and is fired with natural gas as an auxiliary fuel. It is designed to be manually loaded in batches with maximum load capacity of 300 pounds. The Power-Pak II can handle loads up to 750 pounds. Matthews International Cremation Division, Industrial Equipment & Engineering, Co., the crematory manufacturer, has prescribed specific operating procedures for cremating remains over 400 pounds up to 750 pounds in the Power-Pak II.

The remains are typically loaded into the primary chamber and then the secondary chamber is preheated to 1400-1800^{0}F by 30 minutes using the secondary chamber burner (afterburner). Then, the primary or cremation burner is ignited to begin the cremation cycle. Actual cycle time varies per load size from 30 minutes to 6 hours. A cool-down period of 30 minutes or more is recommended at the end of the cremation cycle before removing the cremated remains and loading the next set of remains.

The secondary chamber has one Eclipse Therm-Jet burner rated at a maximum of 1.5 MM Btu/hr, and is normally set to 1.2 MM Btu/hr. The secondary chamber temperature is monitored by a digital controller which adjusts the after burner gas input to maintain the desired temperature set-point. The crematory operates best with a minimum secondary chamber temperature of 1400-1600^{0}F.

The primary chamber has one Eclipse Therm-Jet burner rated at a maximum of 1.5 MM Btu/hr and is normally set to 0.45 MM Btu/hr. The primary chamber temperature ranges from 500^{0}F at the beginning of the first cremation of the day to 1600^{0}F or more during successive cremations

SITE INSPECTION

On October 19, 2010, Stephanie Hammonds, member of the DAQ's Permitting Section; Gene Coccari, member of the Small Business Assistance Section of the DAQ; and this writer met with Mr. Brain Smith, President of Smith Funeral Home at the applicant's Keyser location. The purpose of this meeting was to conduct an inspection of the proposed site. Mr. Sonny Rhodes, Mayor of the City of Keyser, was present during this site inspection.

Smith Funeral Home is located at 85 South Main Street in Keyser ,WV. The applicant plans on locating the crematory in a new structure adjacent to the funeral home on Cliff Street. This new structure is being built right next to another structure that is also owned by the applicant. The layout of proposed located of crematory in the new structure can be seen in Figure #1 at the end of this evaluation.

One concern about this proposed location is actual stack height and the height of the adjacent structures. The applicant has verified the actual stack height from Matthews, crematory manufacturer, which turned out be 29.67 feet above the finish floor of the basement. At this height, the stack would not have cleared the roof line of the 4 bay garage w/apartments. Thus, this garage apartment structure could influence how the emissions from the crematory would be dispersed(mixing effect) into the atmosphere. As result of this concern, the applicant proposed to a new location of the unit/exhaust stack, which is noted in Figure #1, that increased the distance from the garage/apartment structure by over 40 feet from the original proposed location.

During this inspection, no emission source or crematory was found at the site. However, the applicant was in the process of constructing the new structure at the time of the inspection.

ESTIMATE OF EMISSIONS BY REVIEWING ENGINEER

The applicant presented potential emissions based on emission factors published in AP-42, Chapter 2.1 "Refuse Combustion". These factors were developed from sources combusting garbage and other non-hazardous solids, commonly called municipal solid waste. This writer does not believe the emission factors for these municipal solid waste incinerators are representative of human cremations. Therefore, this writer developed factors based from actual emission estimates from Power-Pak II crematories incinerating human remains and their associated containers.

The tests were conducted by Air Testing & Consulting, Inc. Baldwin Fairchild's IE43-PPII (Power-Pak II) on May 5, 2005 and December 9,2004. Air Testing & Consulting measured particulate matter, carbon monoxide, hydrogen chloride, oxides of nitrogen sulfur dioxide and volatile organic compounds on December 9, 2004. The Orange County Florida, Environment Protection Division requested PM, CO and visible emissions be measured from their Power-Pak II unit on May 5, 2005. Results of third test was obtain from the agency's files. The third set of results was used in Permit Applications R13-2583 and R13-2653. Presented in the following tables are the results of these tests and the incineration rate that the crematory unit was operating at during the test.

Table #1 - Tests Results for Power-Pak II			
Pollutant	Test Data[1] (lb/hr)	TestData[2]	Test Data[3]
		Lb/hr	lb/hr
Average Incineration Rate of the test(lb/hr)	82	150	111
Particulate Matter ($PM/PM_{10}/PM_{2.5}$)	0.095	0.227	0.156
Sulfur Dioxide (SO_2)	0.154	NM	NM
Oxides of Nitrogen (NO_x)	1.000	NM	NM
Carbon Monoxide (CO)	0.005	0.007	0.027
Volatile Organic Compounds (VOCs)	0.005	MN	NM
Hydrogen chloride (HCL)	0.080	NM	NM

1 - Results of testing conducted on 12/9/2004
2 - Results of testing conducted on 5/5/2005
3 - Results of testing conducted on 3/11/1999

These results were an average of three one-hour runs for each test. All of these results were corrected to a standard Oxygen content of 7%. VOC emissions were assumed to be propane. To review these results with regards to the maximum incineration rate, the measured results were corrected to the maximum incineration rate of 150 lb/hr, which is present in the following Table #2.

Table #2 - Tests Results for Power-Pak II Corrected to 150 lb/hr Incineration Rate			
Pollutant	Test Data[1] (lb/hr)	TestData[2]	Test Data[3]
		Lb/hr	lb/hr
Incineration Correction Ratio	1.83	1	1.35
Particulate Matter ($PM/PM_{10}/PM_{2.5}$)	0.17	0.227	0.211
Sulfur Dioxide (SO_2)	0.28	NM	NM
Oxides of Nitrogen (NO_x)	1.83	NM	NM
Carbon Monoxide (CO)	0.0091	0.007	0.036
Volatile Organic Compounds (VOCs)	0.0091	MN	NM
Hydrogen chloride (HCL)	0.15	NM	NM

NM - Not Measured
1 - Results of testing conducted on 12/9/2004
2 - Results of testing conducted on 5/5/2005
3 - Results of testing conducted on 3/11/1999

Reviewing the above corrected result, the arithmetic mean corrected PM rate was determined to be 0.20 lb/hr with a standard deviation of 0.027 lb/hr. Again using the corrected results, arithmetic mean for CO was 0.017 lb/hr with a standard deviation of 0.016 lb/hr. Using the annual schedule operation of 3,120 hours per year and the corrected data, this writer estimated that this proposed crematory to emit as presented in the following table.

Table #3 -Potential to Emit for Power-Pak II		
Pollutant	Hourly Rate	Annual Emissions
	lb/hr	Tons per year
Particulate Matter ($PM/PM_{10}/PM_{2.5}$)	0.23	0.36
Sulfur Dioxide (SO_2)	0.28	0.44
Oxides of Nitrogen (NO_x)	1.83	2.85
Carbon Monoxide (CO)	0.04	0.06
Volatile Organic Compounds (VOCs)	0.01	0.02
Hydrogen chloride (HCL)	0.15	0.23

The applicant proposed to construct only one emission source. Therefore, the facility's potential is the same at the crematory's potential to emit.

REGULATORY APPLICABILITY

The following state regulations apply.

45CSR6 - To Prevent and Control Air Pollution From Combustion of Refuse

The purpose of this rule is to prevent and control air pollution from combustion of refuse. The permittee has proposed install and operate one human crematory. This rule defines incineration as the destruction of combustible refuse by burning in a furnace designed for that purpose. The proposed crematory is designed to destroy human remains and associated containers through incineration. Thus, it meets this definition.

Per section 4.1, these crematories must meet the particulate matter limit by weight. The human crematory will have an allowable particulate matter emission rate of 0.41 pounds per hour (based on maximum design-incineration rate of 150 lb/hr). This allowable rate is higher than the estimate hourly potential of 0.23 lb/hr. Thus, the unit should be more than capable of meeting this PM standard.

The crematory is subject to the 20% opacity (visible emission) limitation in section 4.3 of this rule. The opacity and the allowable limits should be met since the crematory is equipped with a secondary chamber, which is designed to reduce the particulate matter entrained in the exhaust stream into products of complete combustion. The retention time of this crematory was calculated to be 1.9 seconds. The times were verified by using the measured flow rate in the provided test reports. These retention times for the power pak II crematory were determined to be 2.4, 1.8, and 2.1 seconds. Thus, this particular crematory should be capable of meeting the applicable limitations of this rule.

45CSR13 - Permits for Construction, Modification, Relocation and Operation of Stationary sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, and Procedures for Evaluation

The potential-to-emit from the proposed crematories are below 6 pounds per hour and 10 tons per year for all of the criteria pollutants, which is less than the permit trigger level as defined in 45CSR§13-2.24.b. However, Rule 6 requires all incinerators be required to obtain a construction or modification permit regardless of size. Smith Funeral Home, Inc. has proposed to install a crematory, which is subject to Rule 6. Therefore, the facility is required to obtain a permit as required in 45CSR§6-6.1. and 45CSR§13-2.24.a. The facility has met the applicable requirements of this rule by publishing a Class I Legal Advertisement in the *News-Tribune* on October 5, 2010, paid the $1,000.00 application fee, and submitted a complete permit application.

As a result of this construction, Smith Funeral Home's Keyser facility will not be classified as a major source of hazardous air pollutants or Title V. In addition, the emission unit is not subject to New Source Performance Standard. Thus, the facility is not subject to Title V and will not be required to obtain a operating permit under 45CSR30. Therefore, Smith Funeral Home will be classified as a "9B - Crematory Incinerator" source as defined in 45CSR22.

TOXICITY OF NON-CRITERIA REGULATED POLLUTANTS

Only trace amounts of non-criteria regulated pollutants will be emitted from this facility. These are acetaldehyde, arsenic, antimony, beryllium, cadmium, chromium, copper, formaldehyde, hydrogen chloride, lead, and mercury. Only the metals, (i.e. cadmium, chromium, mercury, etc.) and hydrogen chloride would be not controlled by the afterburner (secondary chamber).

Under EPA's IRIS program, hydrogen chloride (hydrochloric acid) has undergone a complete evaluation and determination for evidence of human carcinogenic potential. Reference concentration for chronic inhalation exposure to HCl was determined to be 0.02 mg/cu.m. In general, the reference concentration is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Mercury

The inhalation Reference Concentration (RfC) is analogous to the oral RfD and is likewise based on the assumption that thresholds exist for certain toxic effects such as cellular necrosis. The inhalation RfC considers toxic effects for both the respiratory system (portal-of-entry) and for effects peripheral to the respiratory system (extrarespiratory effects). It is expressed in units of mg/cu.m. In general, the RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The Rfc for mercury is 0.0003 mg/cu. m. The critical effect of mercury exposure can be hand tremor, increases in memory disturbance; slight subjective and objective evidence of autonomic dysfunction.

Basis — Based on inadequate human and animal data. Epidemiologic studies failed to show a correlation between exposure to elemental mercury vapor and carcinogenicity; the findings in these studies were confounded by possible or known concurrent exposures to other chemicals, including human carcinogens, as well as lifestyle factors (e.g., smoking). Findings from genotoxicity tests are severely limited and provide equivocal evidence that mercury adversely affects the number or structure of chromosomes in human somatic cells.

All HAPs have other non-carcinogenic chronic and acute effects. These adverse health affects may be associated with a wide range of ambient concentrations and exposure times and are influenced by source-specific characteristics such as emission rates and local meteorological conditions. Health impacts are also dependent on multiple factors that affect variability in humans such as genetics, age, health status (e.g., the presence of pre-existing disease) and lifestyle. As stated previously, *there are no federal or state ambient air quality standards for these specific chemicals*. The file contains summaries of the IRIS database information on hydrogen chloride and mercury. For a complete discussion of the known health effects, refer to the IRIS database located at *www.epa.gov/iris*.

AIR QUALITY IMPACT ANALYSIS

This writer deemed that an air dispersion modeling study or analysis was not necessary, because the proposed construction does not meet the the definition of a "major source" as defined in 45CSR14.

MONITORING OF OPERATIONS

For the purposes of ensuring compliance with the proposed emissions limits and applicable rules, the facility should be required to monitor and keep records of the following:

- Weight of each charge/batch per crematory.
- Temperature of the secondary chamber on a continuous basis for each crematory.
- Hours of operation of each crematory to include the date and time of each start-up and shut-down for each crematory.
- Quarterly check to determine if visible emissions are being emitted.

Proper operation of a crematory or any other incinerator begins with not over loading the unit. Overloading an incinerator beyond the manufacturer's rated capacity usually results in incomplete incineration and/or excess emissions.

Monitoring the secondary chamber temperature is an indicator that the temperature in the secondary chamber is sufficient to ensure complete combustion of products of incomplete combustion such as particulate matter, carbon monoxide, and volatile organic compounds. During both test demonstrations, the temperature in the secondary chamber was measured and recorded. These temperatures were interpreted to be about 1600^0F from the circular recorder chart, which were included in the test reports.

In addition, the calculated the retention time in the secondary chamber based on 1600^0F for the crematory. Based on these calculations, one should conclude that the crematory manufacturer would intend to operate the crematory with the minimum temperature of the secondary chamber at 1600^0F.

Given that the proposed emission rates are based on these test results while operating the secondary chamber at 1600^0F and the retention time of the exhaust gases were based on 1600^0F, the permit should set the temperature of the secondary chamber at no less than 1600^0F while the crematory is incinerating remains.

Smith Funeral has proposed an annual operational limit of 3,120 hours per year for the crematory. This annual operation schedule coincides with the annual emission limits

respectively. Stipulating such a limit will need to be monitored by recording the start and end times for each cremation charge. These limitation and recordkeeping requirements have been established as permit conditions.

OTHER PERMIT CONDITIONS

To minimize the emission impact that the crematory might cause in the local residential neighborhood, the Division feels it is reasonable to prohibit the operation of the crematories during times of the day when the meteorological conditions usually prevent good dispersion of the emissions into the atmosphere. 45CSR§6-1.1.b. requires operators engaged in any form of incineration to give careful consideration of the effects of the resultant emissions on the air quality of the local area. Furthermore, this subdivision notes that the location, time of burning, types of material being burned, and meteorological conditions must be taken into consideration before operating any incinerator. Thus, the DAQ believes it is appropriate to limit the potential adverse effects from night time temperature inversions which could cause the local air quality to become temporarily unhealthy as a result of operating the crematory during such an event.

Limiting the type of material used to contain the human remains is a key factor in emissions. Other state and local air regulatory agencies have imposed restrictions limiting the amount of chlorinated plastics in the container, or to only allow certain types of containers to be used in the cremation process. Limiting or restricting the type of container would limit the amount of hydrogen chloride to be emitted from the crematory. Florida restricts the chlorinated plastic content in the container to 0.5 percent by weight. The City of Indianapolis limits the containers being made of cardboard or pine. Under 45CSR§6-1.1.b.and 45CSR§§13-5.11 and 14.1., the DAQ may impose any reasonable condition as a permit condition in an effort to minimize air pollutant discharges to prevent a statutory air pollution from occurring.

RECOMMENDATION TO DIRECTOR

The information provided in the permit application and the conditions set forth in the permit indicates the Smith Funeral Home's natural gas fired crematory should meet all applicable state rules and federal regulations when operated. Therefore, this writer recommends that the Smith Funeral Home, Inc. should be granted a Rule 13 Construction permit for their proposed human and animal crematories at the Keyser facility.

Edward S. Andrews, P.E.
Engineer

December 27, 2010
Date

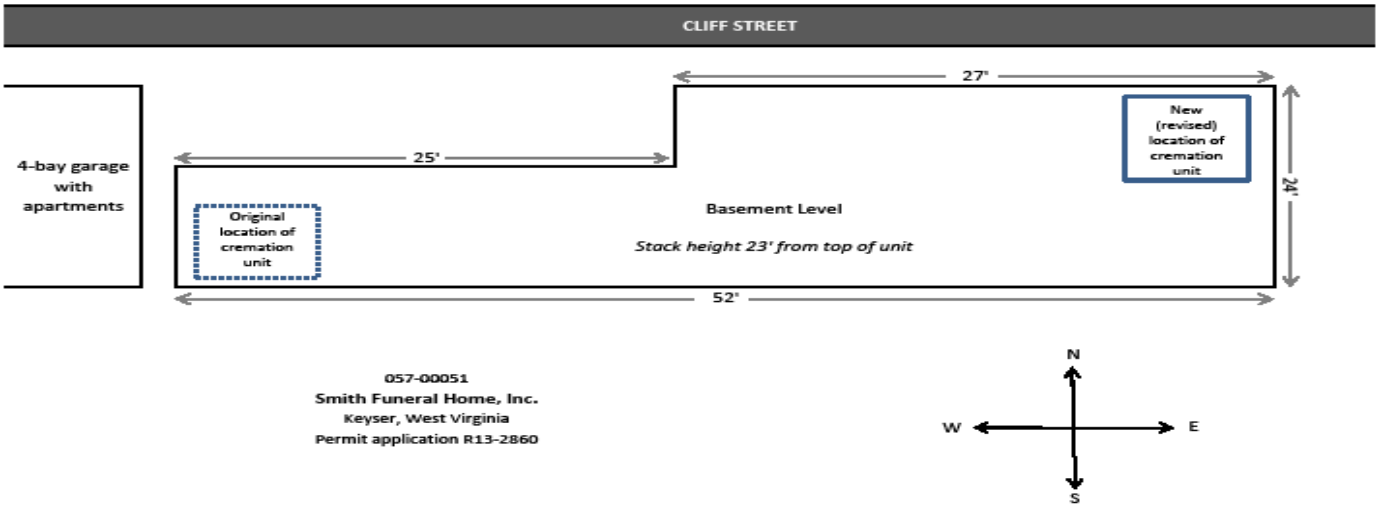

Figure #1
Drawing Not to Scale