Region VIII EPA - Rocky Flats Trial Burn Plan Comments
March 9, 1987

The following comments are based on EPA Region VIII's present knowledge regarding hazardous waste incinerators (HWIs), as well as EPA's 40 CFR 264 Subpart O, 270.19 and 270.62 incinerator requirements. Comments are also based on yet to be published guidance documents which are presently under national review and development*. These documents will substantially clarify requirements and standards for HWI permitting. It is prudent to provide the following guidance to DOE to assure the best possible engineering management for the plutonium and waste processing proposals presented in their Part B permit application of November, 1986.

1. DOE's Trial Burn Plan for the production unit is comprehensive and well organized. The strongest areas in the plan are the analytical testing, sampling and calibration methodologies and the quality assurance/quality control procedures outlined by DOE's contractor, Roy F. Weston, Inc.

   Also submitted in the Part B permit application, is a trial burn plan for the pilot plant incinerator (see Appendix D-4 of the permit application). The pilot plant is a scaled down version of the "production" unit for which DOE is seeking approval of a trial burn. DOE's expressed intention is to show the two units are equivalent as far as operational characteristics are concerned (see page D-4-1). DOE then plans to use the pilot plant for future research to obtain data for additional and/or new waste streams which DOE would consider as candidates for waste reduction in the "production" unit incinerator.

   It is widely accepted by EPA incinerator experts that no two incinerators (thermo/chemical processes) are exactly the same, even if they are the same size, built by the same company, at the same location and processing the same waste streams. Therefore, should DOE prove this technology an some other incinerator, in some other location, EPA and CDH would require that trial burns be conducted for any on-site units, addressing specific waste streams to be burned.

* <u>Guidance on Trial Burn Reporting and Setting Permit Conditions</u>
Under preparation for EPA by Acurex Corp.

<u>Guidlines For Continuous Monitoring of Carbon Monoxide at Hazardous Waste Incinerators</u>
Under preparation for EPA by Pacific Environmental Services

EPA has published requirements and guidance for permitting Research, Demonstration and Development (RD&D) permits. Should DOE desire a RD&D permit, they should clearly identify this intent. If it is DOE's intent to obtain an operational Part B permit for the pilot unit, DOE should clearly state this.

2. DOE gives a design thermal capacity for the incinerator of 1,500,000 BTU/hr. (see page D-3-4 of the Trial Burn Plans). The plan also gives temperature ranges within which the incinerator will be operated, but this is not enough information for a permit writer to base operating condition decisions on. A correlation between operating temperatures, feed rates, feed BTU rates and optimum and minimum thermal capacity should be calculated and reported in order to allow CDH and EPA to establish, agree to and/or set testing and/or permit operation conditions. These minimum or optimum thermal capacities will remain fairly constant during incinerator operation and would be controlled by several factors. The main influential parameters which effect these thermal capacities would be process temperatures, gas flow rates, and waste feed/fuel blending.

   DOE should submit a minimum or optimum thermal capacity which would indicate the appropriate operation parameters, under all waste feed conditions, for efficient chemical/thermal reaction. Further information requirements regarding the process unit design could be satisfied by submitting a mass/energy balance for the unit (also see comment #26).

3. Fluid bed technology is significantly influenced by gas flow rates. Attrition of the bed material and, therefore, particulate carryover, is influenced by characteristic flow rates of the units. Superficial gas velocity of the incinerator (primary reactor) is approximately 0.6 meters/second (2 ft/s). Gas velocity entering the cyclone separator is 30.5 m/s. The increased velocity of gas flow to the separators is due to restricted volumes in the piping under the relatively stable vacuum provided by the air ejector. The general gas flow rate has been expressed as 680 cu. ft./min. downstream of the afterburner (see page D-3-79 of the plan).

   DOE should supply available calculations for relative retention times in each reactor. Also, a maximum gas flow rate, which influences undesireable rates of bed attrition, should be indicated. DOE should provide information on where and how gas flow will be measured. Gas flow parameters should not be based on measured O_2 concentration alone, but by direct mass flow measurement as well (also see comment #26).

4. As indicated in the plan, the fluid bed media of the primary reaction chamber consists of sodium carbonate and oxidation catalyst [i.e. chromic oxide on alumina oxidation catalyst (Al_2O_3)]. The secondary reaction chamber (catalytic afterburner) consists of a fluid bed media of chromic oxide on alumina oxidation catalyst.

   DOE should identify under what specific conditions the percentage of catalyst is changed in order to address various waste feed streams. If the catalyst concentration is varied for different levels of feed material concentrations, then DOE should present information which would allow CDH and EPA to determine whether or not a specific catalyst permit condition for effective destruction removal efficiency (DRE) is warranted.

   The concentration of catalyst in the trial burn runs should be such that everyday operations will be more conservative toward the destruction of hazardous wastes than the test conditions (if catalyst concentration is truely a major operation parameter). It is noted here that the trial burn plan states bed material is attritioned and/or allutriated. This indicates that standard operating conditions, wherein catalyst is added to the bed material, is a routine operation. If this operation significantly influences the effectiveness of the unit, EPA and CDH would consider setting a standard permit condition based on this parameter.

5. DOE should include a waste feed cutoff system(s) test during the trial burn. Operating parameters during waste feed cutoff conditions should be recorded and reported in the trial burn report. DOE identifies five control parameters for waste feed cutoff (see page D-3-12 of the Trial Burn Plan). Each of these control modes should be tested in order to determine their effectiveness. Should there be a waste feed cutoff based on a change in pressure differential across the HEPA filter bank(s)? Is the pressure dependent waste feed cutoff device, which monitors the secondary reaction chamber, capable of adequately detecting back pressure changes within the HEPA filters?

6. DOE should describe how <u>all</u> unit temperature indicators and controllers will be recorded and tied into the waste feed cutoff systems (i.e. primary, secondary reactors, catalytic combustor and heat exchanger temperatures).

   DOE should also indicate whether or not a high temperature cutoff is needed. One reason for this is the concern for the potential that metal and radioactive materials could be oxidized or entrained in gaseous wastestreams and carried into the various pollution control devices. At the maximum temperatures of operation, 610°C (1136°F), and 650°C (1228°F), there may be a potential for radioactive materials being oxidized. However, within the temperature ranges and flow rates, it is more likely that a potential exists for these radioactive materials to be entrained in gaseous waste streams.

7. Studies have indicated that trace metals emissions can pose a greater health hazard than organic or acid emission currently regulated under RCRA. DOE proposes that total chromium will be tested in the emissions analyses (see page D-3-38 of the Plan). Chromium is an obvious candidate due to bed material.

   DOE should address whether or not there are any other metals of concern in emissions based on solid waste feed streams, and ash particulate entrainment (i.e. beryllium, tritium, cadmium, mercury, silver, arsenic, nickel, lead, etc.).

   The processes involved in the generation of trace element emissions from high temperature incineration are very complex. Metals exposed to hot, oxygen-depleted zones, following burnout of organic matter, can be involved in several potential paths. In responding to this issue, DOE should address each of the following concerns relative to their specific process:

   o Vaporization of metals at sufficiently high temperatures (EPA notes that DOE's process occurs at reletively low temperatures);

   o Melting of metals to form a liquid and removal or entrainment of particles in the inorganic portion of the waste effluents (i.e. gas wastestreams and ash);

   o Reaction with other species (e.g., Cl, F, etc.) to form other compounds which can vaporize, melt, or remain unchanged.

   Depending on the paths, metals may be either discharged with the ash residue or condensed into fine particles. DOE should estimate the particle sizes of these metals and present how they are or are not effectively removed by their air pollution control equipment.

8. The current RCRA Standard for Potentially Organic Hazardous Constituent (POHC) destruction is air emission based. In calculating POHC DRE, DOE will be given credit for unburned/unreacted POHCs in the ash residues. Excessive transfer of waste feed POHCs into ash negates the benefit of the thermal treatment process. Considering the relatively low operation temperatures at which this system will be operated, the potential for this type of carry over into ash is high. With the recent land disposal restrictions, DOE will be required to closely and accurately analyze the ash content for organics, as well as metals and radioactive materials.

   DOE should provide any information which would address the potential for carryover, or particle adsorption and absortion of organics moving into the ash systems.

9. DOE should monitor and record the pressure drops across all the pollution control equipment and ash collection equipment as an indicator of pollution control efficiency. From DOE's flow diagram (page D-3-24), the following pressure indicators should be monitored and recorded:

   primary reaction chamber: PI-2 & PI-3
   primary cyclone: PI-4 & PI-5
   secondary reaction chamber: PI-6 & PI-7
   secondary cyclone: PI-8 & PI-9
   sintered metal filters: PI-9 & PI-10
   catalytic reactor and heat exchanger: PI-10 & PI-11

   DOE should explain why there isn't another pressure sensor between the catalytic reactor and heat exchanger.

10. DOE should report what special procedures are practiced at the facility to prevent inadvertent or unintentional operator error, such as, the manual override of automatic controls while operations are within permitted ranges.

11. DOE's Trial Burn Plans need to identify and justify the locations of the CO continuous emissions monitors (CEMs) more clearly. DOE does refer to EPA's standards for location (see page D-3-33 and figure 10 of the Trial Burn Plan) by restating EPA's reference method 1 for effective location based on stack diameter distance (40 CFR Title 60, Appendix A). However, DOE's description and justification for the CEM sampling locations is incomplete when considering other concerns for obtaining a representative sample.

    The most important factor for accurate CO monitoring is the assurance that a representative sample is collected. To achieve this, there should be minimum stratification of gas-phase pollutants, in the effluent (i.e. concentrations must be uniform across the stack system at the point(s) of sampling). The proposed sampling/monitoring locations in the trial burn plan, 1 and 2 (see figure 9), could be inadequate. It could prove quite costly if DOE, EPA, or CDH determine that stratification testing should have been conducted at sampling locations prior to the trial burn and CO data is considered invalid after the trial burn has already been conducted.

    For sample location 2 (figure 11 was not provided in the Trial Burn Plan), DOE needs to justify why stratification testing data is not collected and/or reported. This is important in sampling/monitoring location 2 due to the fact that room air is introduced up stream from the sampling/monitoring location.

The location of sampling/monitoring at point 1 appears more appropriate for meeting EPA's criteria (from a representative gas stream aspect). A diagram for the location of sampling point one is given and is based on EPA's stack diameter criteria. However, sample point 1 may subject sampling probes to adverse operational conditions as well as adverse stratification effects from "canyon air" (see the process flow diagram on page D-3-24 and Figure 10 of the Trial Burn Plans). The Trial Burn Plan does state that acidic gases are neutralized by the reactor bed materials.

DOE should submit information explaining whether or not there are any acidic gases or adverse temperatures present in the exhaust which would adversly effect sample probes. Also, information should be submitted regarding how the catalytic reactor, "canyon air" and the process heat exchanger, impact CO concentrations and/or gas stream stratification.

12. It is not exactly clear what DOE's intentions for these two sampling points are. DOE should clarify whether or not these sampling points will be redundant sampling/monitoring ports or are included only in the trial burn to determine which monitoring location is better. DOE should also define whether or not normal operation CEMs will extract samples from both locations.

    To further clarify the intended use of these sampling ports, DOE should specify which of the parameters tested for in Table 2 (page D-3-38) will be used as CEM sampling parameters after the trial burn.

13. DOE should supply a more complete list of parameters which will be directly monitored as well as recorded during normal operations. Key operating parameters, as well as continuous emissions monitors (CEMs), tests, calibrations, repairs, and checks on CEMs are subject to reporting requirements for HWIs. These instrument inspections and testings are subject to daily, weekly, monthly, and/or yearly reporting requirements.

14. 40 CFR 264.343(b) requires that an incinerator burning hazardous waste and producing stack emissions of more than 1.8 kilograms per hour (4 pounds per hour) of hydrogen chloride (HCL) must control HCL emissions such that the rate of emission is no greater than the larger of either 1.8 kilograms per hour or 1% of the HCL in stack gas <u>prior to entering any pollution control equipment</u>. DOE should be prepared to address the concern that HCL is being measured <u>after</u> air pollution control equipment in the trial burn. This is due to practical sampling concerns and may be justified by the expected low level of acid gases.

15. During the January 8, 1987, meeting, Nathaniel Miullo of EPA suggested that DOE do one of two things with relation to radioactive materials in the trial burn. Either test an actual amount of plutonium (spiked amount) as a trial burn waste stream, or use only uranium and provide information which would adequately describe the thermo/chemical relationship between plutonium and uranium. If enough correlation can be shown between uranium processing and plutonium processing, then it may be possible to justify allowing the permitted waste feeds to contain limited amounts of plutonium (from depleted sources). However, Mr Miullo strongly urged that actual plutonium be included in the test waste stream in order to determine the specific amount which would be present in the exhaust gases for this system.

On February 24, 1987, during the Data Exchange Meeting, DOE announced that it planned to use plutonium in the trial burn waste feed stream. CDH urged that uranium be used first. If no uranium is indicated by stack emissions tests, then the plutonium tests could be conducted. CDH's approach should be implemented. However, it will impact DOE's proposed trial burn schedule (see page D-4-74 of the Trial Burn Plan). The plutonium related runs of the second and third weeks may need to be delayed so that analytical results from the uranium test runs can be reviewed.

16. Colorado is the first State to have received authorization for mixed wastes and the potential endangerment and/or health risk is of particular concern while dealing with radioactive materials such as plutonium. It is expected, by considering the small amounts of depleted uranium and plutonium which are predicted to be in the waste feed, that the amounts in the emissions will not be detectable.

DOE should provide calculations for the expected amounts of plutonium and uranium which would be emitted from the stack during full load conditions, normal conditions, a HEPA filter failure mode (breakthrough), and an expected exposure rate for various locations down wind of the operation. All calculations and assumptions, including a complete description of dispersion models used, should be presented.

Along these lines, trial burn tests should be conducted during optimum meteorological conditions. DOE should propose what conditions it plans to operate the trial burn under.

17. DOE's plan includes a complicated processing and conveyor system for solid wastes. One of the major permit conditions will set the maximum feed rates.

For liquids, measuring and recording amounts fed into the incinerator should be uncomplicated. DOE specifies the waste feed mixing practices (i.e. table 8 of the Trial Burn Plan). However, DOE has not provided specific analytical results of the liquid mixed wastestream. This places a substantial verification and recording burden upon DOE to assure that a specified BTU level, or BTU range, is met at all times during actual operation.

Unless a specific analytical test on all waste feed streams is performed and results submitted, DOE should explain why knowledge of waste streams, in lieu of analytic data, is sufficient information for issuance of a draft permit. A trial burn, however, can use a surrogate wastestream, as is proposed by DOE.

For solids, DOE proposes that the rotational speed of the screw conveyor, feeding the primary reaction chamber, be dependent upon O_2 level, pressure in the secondary reaction chamber CO level, temperature, and gas velocity. EPA believes that DOE's intent is to indicate waste feed cutoff is dependent upon those factors, and not screw rotational speed.

The primary feed rate indicator for the solids can be based on volumetric, weight, or mass flow measurements. The most accurate method of waste feed monitoring would involve measurements taken prior to the introduction of the solid waste stream to the shredding and conveyer systems [minus the amount removed in the disposal bag and tramp metal drum (see figure 2 on page D-3-8)].

Another method for solid waste feed measurement is based on calculations of the volumetric flow rate of the screw. DOE would need to include a tachometer to measure and record the rpm rate of the screw feeder, and multiply this by the volume fed by one complete revolution of the screw. The tachometer method is desirable due to the fact that it gives a "real time" indication of the solids being introduced into the primary combustion chamber at any given point in the process. This is provided that the tachometer and volumetric calculations are calibrated properly for accurate measurements.

DOE should explore the following types of flow meter technologies and present which option would best suit their specific needs:

SOLIDS	LIQUIDS
Level Indicators: Ultrasonic, Nuclear and Radio Frequency	Rotameter
Stationary Weight Indicators	Orifice Meter
Conveyor Weight Systems	Positive Displacement Meter
Impact and/or Momentum Flow Meters	Coriolis Flow Meter

18. EPA supports DOE's use of surrogate organic waste streams for the trial burn. DOE's justification is based on incinerability criteria for the difficult to destroy, carbon tetrachloride, spiked wastestream. Surrogate waste streams for trial burns is further justified based on recent non-flame thermal decomposition data for several hazardous organic compounds compiled by the University of Dayton (Dellinger, et.al., 1984, 1985, 1986). This data not only gives indications that heat of combustion is an important consideration, but shows that CO emissions may be a good indicator for the efficiency of the overall thermal/chemical removal system.

Formation of products of incomplete combustion, and therefore emissions, may be indicated by high levels of CO. Recording CO concentration levels, during a trial burn, and using a difficult to burn surrogate material, which has experimental data verifying residence times and temperatures for effective destruction and removal efficiency (such as carbon tetrachloride) is a good way to assure other organic compounds will be effectively destroyed (see Tables 9 and 10 of the Trial Burn Plan).

19. CO levels proposed by DOE are not within proposed limits EPA will publish prior to issuance of the permit. DOE has proposed a two tier CO level. Although this is a good approach to assuring undesired shutdown due to upset conditions, the levels which DOE proposes are beyond that which EPA will publish in guidance documents now being developed. EPA's standards indicate that the upper CO limit is not to exceed 100 ppm averaged over 60 minutes and 500 ppm over 10 minutes. DOE's proposed method of measuring these "windows", or time weighted averages, is appropriate due to the desire for avoiding extraneous upset conditions from excessive waste feed shutdowns. However, if the trial burn data show that the unit has capability to operate at lower levels and meet the DRE and other standards, the permitted waste cut-off levels should be lower than the above guideline levels.

DOE has proposed an "upper tier" or upper limit of 1,500 ppm for the duration of the "moving window". This is 1,000 ppm above suggested guideline amounts. Final determination of exact CO limits will be determined by the trial burn results and due consideration must be given to minimization of excessive shutdown conditions. This will assure effective reduction of undesirable emissions (i.e. high concentration "poofs" from upset conditions). However, a CO limit must be set for the trial burn. Unless DOE can provide adequate justification, EPA and CDH will require the use of the 100 and 500 ppm levels.

20. DOE should report the following parameters regarding the continuous emissions monitors:

- o Zero drift over sample time and total test time;
- o Span drift over sample time and total test time;
- o Precision;
- o Linearity;
- o Above listed parameters for each of the double range readouts.

DOE did report some percentage ranges on the flue gas monitors (see page D-3-30 of the Trial Burn Plan), but it is not clear what these ranges are referring to.

21. DOE has not identified whether or not continuous emission monitors for radioactive materials are available. If such technology exists, an in stack application of this technology would be appropriate.

DOE does employ ambient air monitors for radioactive airborne elements at various building locations, as well as throughout the facility. These monitors are not "real time" alarms, but may have some application to monitor stack emissions within building 771.

DOE should present information on whether or not ambient air monitors will be used in the area. A discussion of what localized "real time" radioactive alarm systems are available would also be useful in determining whether or not in stack radioactive monitors will be required.

22. Due to the predicted low levels of radioactive waste feed material there is little concern for a nuclear reaction which would lead to a critical mass event in the reactors. However, since radioactive materials will be handled in various storage and transportation vessels, and/or pollution control devices, as well as the reactor vessels, DOE should discuss whether or not there is any chance of a critical mass occurrence in these units. This submittal should include information regarding design and operational measures DOE has taken to assure this situation won't occur.

23. DOE should explore the possibility and feasibility of installing a parallel, redundant stack system (from before the HEPA filters on), in order to provide an immediate backup should break through of the HEPA filters occur. DOE should compare this option to the protection that the automatic waste feed cutoff technology presently built into the system offers.

The energy balance solves three equations simultaneously: (1) balancing sensible heat, heat of vaporization, and chemical heat with radiation and convection; (2) balancing radiation and convection to the walls, with conduction through the walls; and (3) balancing conduction through the walls, with convection and radiation from the outer shell of the unit to the ambient surroundings.

27. DOE has identified thirteen operation parameters which it expects to be permit operating conditions (see pages D-3-78, and D-3-79, of the Trial Burn Plan). Depending on the outcome of the trial burn, CDH and EPA may want to implement further permit conditions for operation parameters such as maximum draft or pressure in reaction chambers, temperature in the catalytic reactor, minimum oxygen at each reaction chamber exit, reactor bed catalyst feed rates, maximum hydrocarbon concentration at the stack and minimum and/or maximum pressure drop across the catalytic reactor and/or HEPA filters.

DOE should operate the trial burn conditions within various operational ranges for which they wish to be permitted. Unless the specific wastestreams and/or other operational parameters are demonstrated during the trial burn, DOE will not be allowed to change operations for such untested conditions unless a permit modification is sought.

28. Several comments and questions have been raised regarding the effectiveness and historical performance of this particular type of thermo/chemical technology. To EPA's knowledge, fluid bed technology has been effectively used throughout the nation for several years for destruction of industrial and hazardous waste streams. The advantage of this specific fluid bed technology is that it will deal effectively with both liquid and solid waste streams unique to the Rocky Flats Plant. Another positive aspect of fluid bed technology is the ability to adjust flow rates, and increase residence time for more efficient thermo/chemical destruction of organics and ash removal. Also, the thermal inertia of a fluid bed system lends very well to stable operating conditions. Stable operating conditions are desireable for both organic destruction and radioactive material removal.

During several brief discussions EPA staff has had with various representatives of government and industry, we have been unable to identify any other system that is exactly like the one RI has developed (i.e. there are fluid bed reactors that process radioactive wastes and hazardous wastes, but it is uncertain that they are of the nature of RI's reactors. They do not process the same amount and types of waste streams and they do not use the same type of air pollution control equipment).

DOE and RI should define steps it has taken to explore other technology alternatives for management and volume reduction of these wastestreams. The possibility of discovering or developing a less turbulent particle design is conducive to these types of wastestreams. Due to the precedent setting nature of this activity under RCRA, DOE and RI should provide information to identify ongoing, or developmental mixed waste recovery, volume reduction and/or destruction technologies world-wide, while CDH and EPA supports them in development of this fluid bed technology.