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Title:

Summary of Modifications to the Los Alamos National Laboratory Controlled-Air Incinerator

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Los Alamos
NATIONAL LABORATORY

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1.0 BACKGROUND

The Los Alamos National Laboratory (LANL) Controlled-air Incinerator (CAI) and associated systems were originally a research and development tool used to prove the viability of incineration as a treatment method for various transuranic (TRU) wastes, radioactively contaminated polychlorinated biphenals (PCBs), and low-level mixed (hazardous and radioactive) wastes (LLMW). The original CAI was installed in 1977 and first operated in 1979. Operations ceased in 1987 so that upgrades to the system, identified during the initial phase of operation, could be performed. These upgrades and modifications are nearing completion. Information regarding the original design, operations, and subsequent recommendations were published in Los Alamos National Laboratory reports.[1]

Every effort has been made to cover all changes to the CAI system. However, due to the number of modifications and the time span over which they were made, some modifications may have been omitted. Minor changes may have also never been documented.

2.0 SUMMARY

All modifications done to the CAI system were performed for one of two reasons. The first is replacing equipment due to normal wear. The second is upgrading existing equipment for routine operations. This latter type of modification centers on items such as increased component life, increased corrosion resistance, and improved electronics.

Given these types of changes, CAI system performance will not be degraded compared with the original CAI design. In many instances, enhanced performance is expected.

3.0 BASELINE

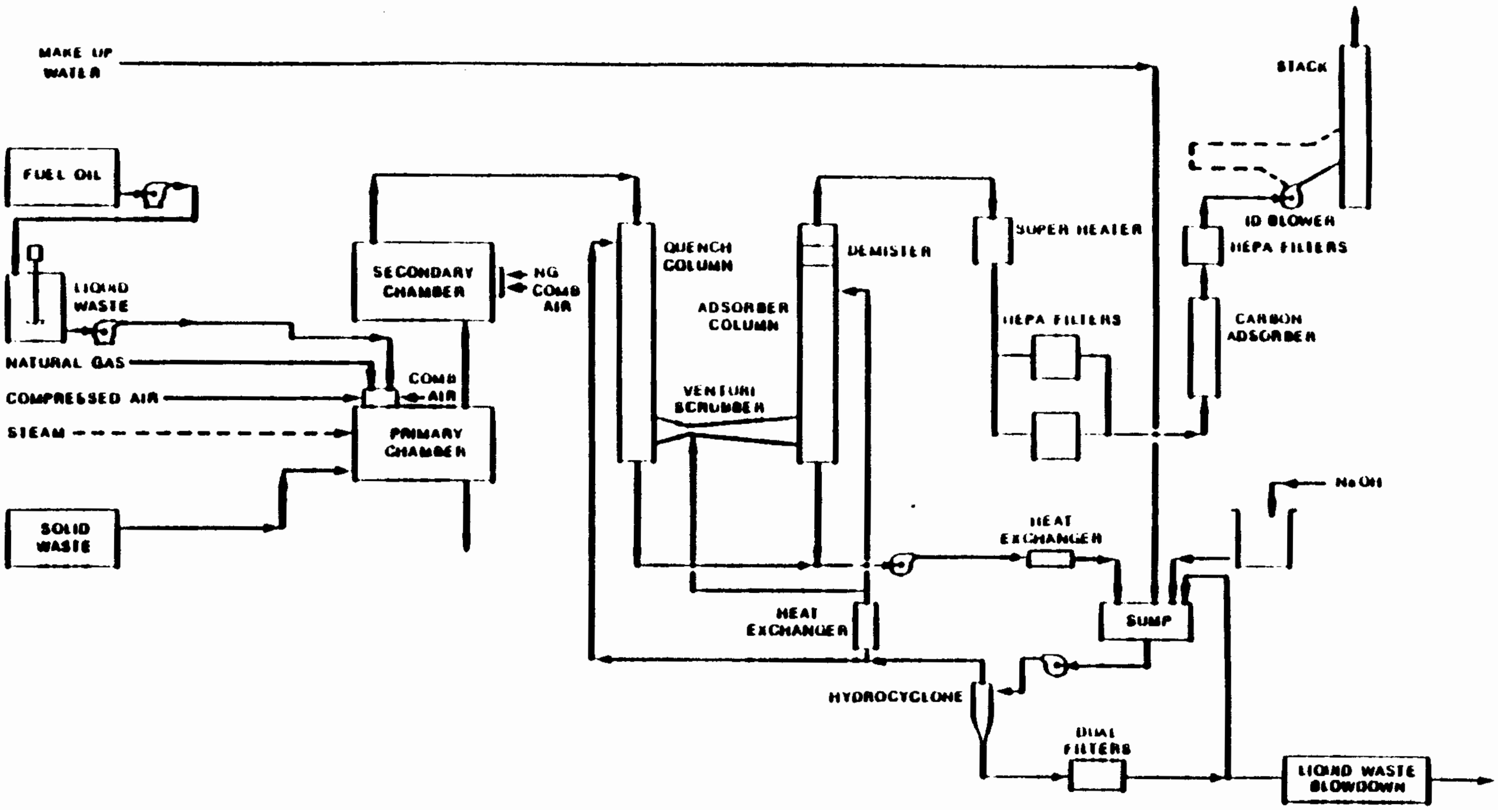
Because many changes have been made to or planed for the incinerator and associated support systems, a baseline is needed to fix the design so that new changes can be documented. This baseline will also prove useful in the event of future modifications.

The baseline selected for this report is the design outlined the current RCRA Operating Permit (Part B). The system layout associated with this baseline is shown in Fig. 1.

4.0 INITIAL MODIFICATIONS

Initial changes to the CAI system have been previously documented[2,3]. These changes were done prior to the issuance of the current RCRA Operating Permit and are therefore inconsequential. Other modifications done to the system prior to the RCRA trial burn[4] are outlined in other documentation[5].

The remainder of this report will address changes planned for or performed on the CAI system baseline described above. The present configuration is outlined in Fig. 2.



INCINERATOR PROCESS DIAGRAM
PREPARED FOR
LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

FIGURE 1.
RCRA Part B Permit

IT Creating a Safer Tomorrow

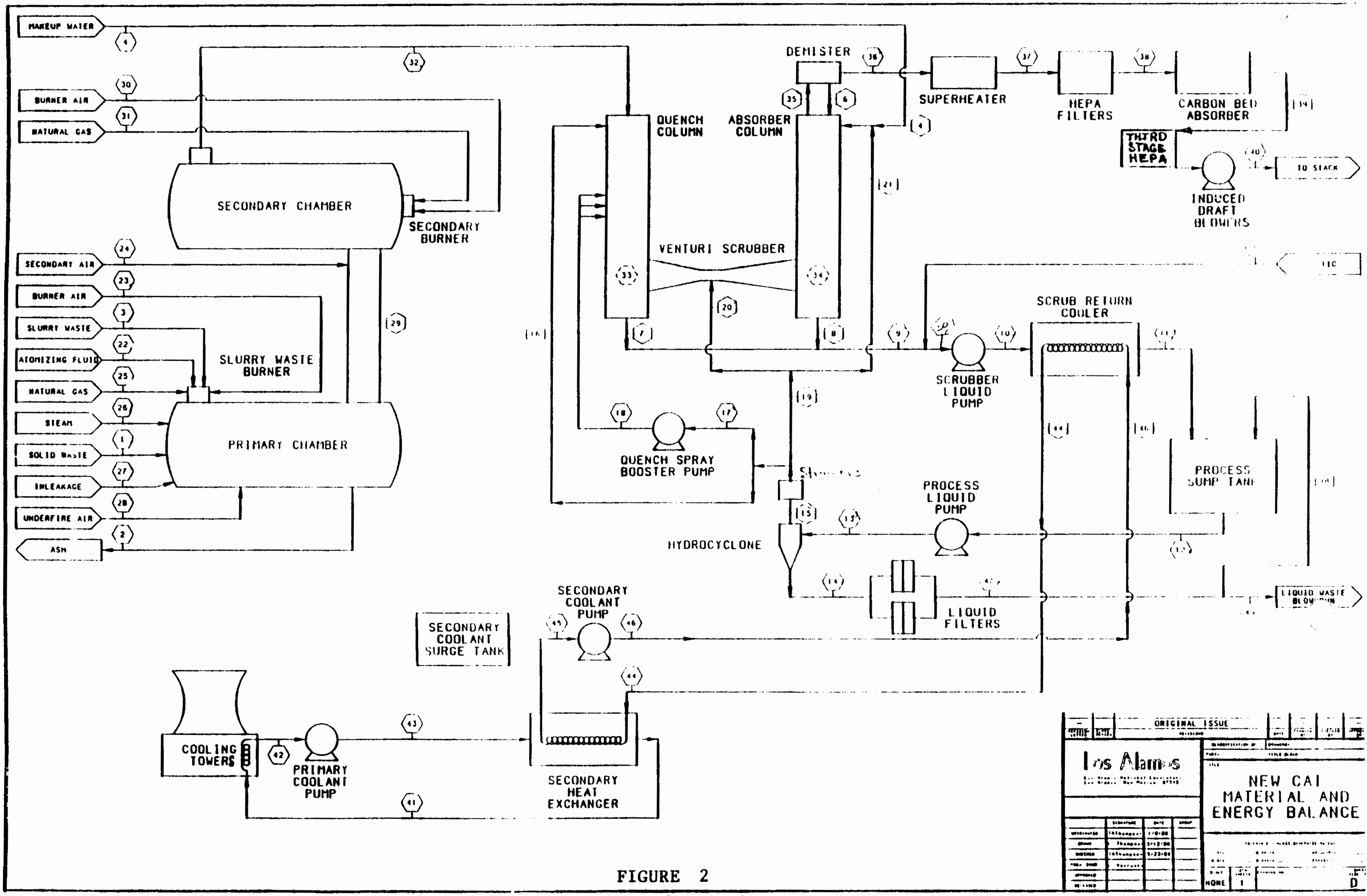


FIGURE 2

Current Configuration

5.0 FEED PREPARATION AND FEED SYSTEMS

The whole feed system has been modified and upgraded. The following summarizes these modifications.

5.1 Multiple Energy Gamma Assay System / Multiple Axis Dual Analysis Measurement System

To keep track of special nuclear materials (SNM) such as plutonium, a multiple energy gamma assay system (MEGAS) was originally employed. The system determined the amount of SNM in waste by analyzing the associated radiation emanating from the waste. The original MEGAS system was inside a glovebox at the beginning of the solid waste feed line. Any waste failing the acceptance criteria would be bagged out, thus generating additional waste. To minimize waste generation, the MEGAS was moved outside of the solid waste feed glovebox.

In addition to this physical move, the MEGAS was upgraded to a multiple axis dual analysis measurement (MADAM) system. The principle of operation of this equipment is similar to that of the MEGAS. The MADAM has modernized analyzer software, computer equipment, and mechanical scanning table. The original Keronix computer was also replaced with an IBM-type PC. The detector hardware and associated electronics design did not change; however, new hardware was obtained. The scanning table was updated with optical encoders and stepping motors. A segmented gamma scanner (SGS) was added to assay low to medium levels of TRU materials. These change will not affect incinerator operations and emissions.

5.2 Waste Package X-ray System

Incoming waste packages are examined by x-ray to prevent introducing unwanted materials into the CAI system and to identify shielding that may prevent detecting radionuclides. This examination will identify wastes containing large noncombustible items, aerosol cans, large containers of potentially flammable materials, and other materials that are not acceptable for incineration in the CAI. As with the MEGAS, the waste package x-ray system was originally in the solid waste feed glovebox. The original system was moved outside of the solid waste feed glovebox. This change will not affect incinerator operations and emissions.

5.3 Feed Staging Glovebox

The original solid waste feed glovebox housed the MEGAS and x-ray systems and also had waste sorting capabilities. The new feed staging glovebox will not contain the MEGAS and x-ray systems and will not be used for waste sorting. The new feed staging glovebox will be used only for staging acceptable, preassayed solid waste boxes before they are introduced into the solid waste feed system.

The original solid waste feed glovebox was constructed of steel and was painted. The new feed staging glovebox is constructed of stainless steel, which is the current Los Alamos standard, and is not painted. Stainless steels are easier to decontaminate because of their smoother finish. The new feed staging glovebox also has a larger capacity than the original solid waste feed glovebox.

These changes will not affect the incinerator performance.

5.4 Feed Storage Glovebox Fire Suppression System

The original fire suppression system for the feed storage glovebox was a limited-flow water type. This system has been replaced with a foam type to minimize contamination and cleanup if used. This change will not affect incinerator performance.

5.5 Ram Feeder Mechanism

The original ram feeder mechanism used to push boxes into the primary (lower) combustion chamber was chain driven. This mechanism has been replaced with a hydraulic cylinder system for simplicity and to minimize parts. This change will not affect incinerator performance and does not increase feed capacity.

The elevator that lifted the boxes from the feed storage glovebox to the level of the primary combustion chamber hearth and the side ram that pushed the boxes in front of the main ram feeder have not been changed.

5.6 Main Ram Glovebox High-Efficiency Particulate Air Filter

An additional high-efficiency particulate air (HEPA) filter has been added to the main ram glovebox to supplement the existing one. The air in-leakage flow rate into the primary combustion chamber can now be measured during solid waste box feeding/incineration and during incineration of liquids.

5.7 Main Ram Glovebox Fire Suppression System

A carbon dioxide fire suppression system was installed on the main ram glovebox to replace the original argon-injection fire suppression system.

5.8 Main Ram Feeder Safety Features

Methods of locking out the main ram feeder are being investigated as an added personnel protection measure because this equipment is automatically controlled.

5.9 Liquid Feed System

Modifications to the liquid feed system include correcting deficiencies with the liquid feed tanks to allow for safe handling of volatile organic materials, the addition of nitrogen pad/de-pad capabilities, and the addition of a second (spare) tubular diaphragm pump. These changes will not affect incinerator performance.

Upgrades to the drum pump-out station hood and other piping changes between the two feed tanks will be pursued.

Additional changes were made to the piping and instrumentation of the liquid feed system. These are discussed in Sections 8.0 and 9.0 below.

6.0 INCINERATOR

No modifications have been made to the incinerator proper. Most of these modifications deal with ash handling and removal and will have no effect on the performance of the incinerator. Some modifications to the combustion air and fuel gas systems are discussed in Sections 8.0 and 9.0 below.

6.1 Gravity Ash Drop Out System / Gravity Ash Removal System

The original CAI system employed a vacuum/pneumatic conveyance system to remove ash from the end of the primary combustion chamber hearth. The system consisted of a blower, a cyclone, and a sintered metal filter. This system worked acceptably in the research environment. Occasionally the system became clogged by large clinkers or other noncombustibles and had to be disassembled and cleaned. This problem could lead to unnecessary worker exposure to radionuclides.

To improve system reliability and to limit possible worker exposure, a new gravity ash removal system (GARS) was designed and will be installed. The system connects to the original gravity ash drop-out system (GADOS), a refractory door on the bottom of the primary chamber. The GARS consists of a hopper with a circulating air shroud and a spool piece with two knife-gate valves to stage ash prior to dumping it into drums through a bag-out ring.

Modifications to the ash removal system are external to the incinerator and will not affect incinerator operation.

6.2 Hearth Sweeper

Previously, the primary (lower) combustion chamber was cleaned and inspected either by manned entry or by observation and manipulation through a glovebox on the end of the chamber. This system was acceptable for the research purposes at the time, but is presently unacceptable because of unnecessary exposure of personnel to radiation. A remotely operated robotics system, the integrated glovebox-operated robotics (IGOR) system, is being installed. This system will have the capability to reach all the hearth in the primary combustion chamber for cleaning; the flue leading to the secondary combustion chamber for inspection; some of the secondary chamber for inspection; and the ash drop-out system for inspection and cleaning. Inspection will be done with a closed-circuit television (CCTV). The operating mechanism on the incinerator door through which the IGOR will enter will be modified. The glovebox on the end of the incinerator will also be modified to house the IGOR system. The IGOR will only be used when the CAI is not operating.

6.3 Liquid Burner Modifications

The high-intensity vortex liquid burner will now be enclosed in a glovebox to provide containment during maintenance, equipment change-out, and cleaning operations associated with the liquid burner. The glovebox will also provide storage space for spare parts. Due to space limitations, a new burner with minor changes will be procured and installed. Besides re-routing the fuel gas pipe and changing a packing gland, the atomizing section of the burner will be shortened 6-10 inches and flame observation ports are being rotated/eliminated/split. The impact of this modification has been discussed with the burner manufacturer. The exact performance of the modified burner will be demonstrated during upcoming trials at the manufacturer.

6.4 Combustion Air Glovebox

Due to the dimensions of the new control valves being installed on the combustion air system, the glovebox face has been removed. This impacts the underfire and secondary combustion air blowers since HEPA-filtered air was supplied through this glovebox. The underfire air blower supplies underfire air, ventilation air to the main ram feeder glovebox, and air to the secondary combustion chamber burner. The secondary combustion air blower supplies secondary combustion air to the plenum between the primary and secondary combustion chambers. Changes associated with this modification are discussed below in Subsection 6.6.

6.5 Combustion Air Blowers

The original CAI system had three combustion air blowers. The underfire and secondary air blowers were in the combustion air glovebox with air supplied through HEPA filters. The liquid burner combustion air blower is on top of the main ram feeder glovebox with a dedicated HEPA filter on the discharge side.

Since the face of the combustion air glovebox is being removed, the underfire and secondary air blowers will be fitted with separate HEPA filters on their suction sides. These two blowers will be replaced with models that have flanged inlets to accommodate HEPAs.

6.6 Combustion Air Check Valve Addition

Check valves are being installed on all combustion air lines to the incinerator. This installation includes the combustion air line to the primary combustion chamber burner, the air line to the secondary combustion chamber burner, and the underfire air line. These valves were added to prevent blowback of radioactively contaminated gases into the combustion air distribution equipment in the event of an overpressurization. The check valves are located at the inlet of the combustion air lines to the incinerator, downstream of the blowers. In addition, all incoming combustion air passes through HEPA filters.

7.0 AIR POLLUTION CONTROL SYSTEM

Most significant changes made to the incinerator system involved the air pollution control system and were completed during the initial round of changes made to the equipment. These changes are detailed in the Kaiser Report[3]. Modifications completed after this engineering analysis include the following.

7.1 Hydrocyclone Overflow Strainers

Strainers were added to the hydrocyclone overflow line. These strainers are constructed of Hastelloy C-276 and have 1/16-inch perforated screens. The strainers were added to exclude large particulates from the recycled scrub solution. They will not affect CAI system performance.

7.2 Super Heater Drain Valve

A drain valve may be added to the off-gas super heater to remove water that may accumulate. Water would be removed during shutdown or maintenance operations.

7.3 Carbon Bed Adsorber

The original carbon bed adsorber is constructed mainly of carbon steel. Water vapor corrosion of carbon steel components in the off-gas system contributed to particulate emissions during trial burns (although this was insignificant when compared to RCRA requirements). Studies have been completed regarding the replacement of the existing adsorber with a unit constructed of a corrosion resistant alloy.

The replacement unit will be a two-pass annular design. The shell will be fabricated of AL-6XN. Internal components will be constructed of Hastelloy C-22. The performance of the replacement unit is functionally equivalent to the original and thus will not impact CAI system performance[6].

7.4 Third Stage HEPA Filter

As with the carbon bed adsorber, the third-stage HEPA filter housing is constructed of carbon steel. It is proposed to replace the existing carbon steel housing with two new housings which will be operated in parallel. These new housings will be constructed of 316L stainless steel. They will also be relocated so that change-out is easier. These changes will reduce particulate emissions due to the elimination of possible water vapor corrosion of carbon steel components.

7.5 Off-gas Ducting

An expanded sampling section spool piece has been added between the sampling trombone and the stack. The spool piece increases the diameter of the off-gas ducting at this point from 12-inches to 20-inches, is approximately 40-inches long, and is constructed of AL-6XN alloy. The increased diameter is required for the addition of the various off-gas monitoring probes discussed under Section 9.0 below.

The off-gas ducting between the carbon bed adsorber and the induced draft fans will be changed when the carbon bed adsorber is upgraded. Changes to this ducting will include upgrading from carbon steel to AL-6XN for corrosion protection (to reduce particulate emissions); rerouting to accommodate the new carbon bed adsorber; relocating the third-stage HEPA filter; and installation of minor additional piping to accommodate the continuous radiation monitor required by the RCRA Operating Permit for hazardous waste operations.

7.6 Off-gas Sampling Trombone

The existing sampling trombone on the air pollution control system is constructed of carbon steel. Because of water vapor corrosion, this piece was replaced with an identical unit made of AL-6XN. This change will reduce particulate emissions by eliminating water vapor corrosion of carbon steel components.

7.7 Flow Straighteners

Three flow straighteners have been added to the off-gas piping to condition the gas stream for analytical sampling equipment. The first of these is downstream of the HEPA filter bank before the alpha/beta monitor. This straightener will have a 10-inch diameter and is constructed of AL-6XN. The second straightener is located between the induced draft fans and the off-gas flow meter. It also has a 10-inch diameter but is constructed of 304 stainless steel. The third straightener has been installed just before the expansion spool piece. It has a 12-inch diameter and is constructed of 304 stainless steel. The last two straighteners were fabricated by Fluidic Techniques, Inc. The first was supplied with the alpha/beta monitor.

7.8 NESHAPS Stack Upgrades

As part of the Laboratory-wide NESHAPS compliance effort, engineering studies are underway to determine whether the existing stack sampling point is appropriate for new monitoring equipment. Modifications may be needed depending upon the outcome of the study.

8.0 PIPING

Many piping changes have been made to the CAI system to increase containment reliability and to minimize maintenance.

8.1 General Piping Replacement

Although general piping replacement was briefly covered in the RCRA engineering description, it is reiterated here. Much of the piping associated with the original CAI system (fiberglass reinforced plastic) was not designed to provide high levels of confidence that containment was being provided and thus has been replaced. Process wetted piping is now constructed of Schedule 40 Hastelloy C-276 for corrosion and heat resistance. All flanges are 150# raised-face types. This change will increase the reliability of the CAI system, offer superior corrosion resistance, and thus provide a high level of confidence that process fluids will be contained.

8.2 Quench Booster Pump Inlet Block Valve

The block valve was added to facilitate maintenance.

8.3 Absorber Tower Makeup Water Line

A check valve has been added to prevent backflow into water lines. There is also some consideration being given to replacing the existing hand valve with a solenoid valve and flow meter to aid in backflushing the demister pad and monitoring water flow into the CAI process.

8.4 Steam Lances and Nozzles

Due to corrosion of the original steam lances and nozzles, they will be replaced with identical equipment. The original steam line supplying the lances has also been upgraded to stainless steel from carbon steel and slightly rerouted to accommodate new strainers.

8.5 Liquid Feed Line

The original liquid feed line was 1/2-inch piping with screwed fittings that leaked regularly. A new line has been installed consisting of 1/2-inch tubing and modified compression-type fittings. Welded joints may also be considered in the future.

8.6 Caustic Addition Line

Caustic was originally added directly to the process sump tank to neutralize acid gases. Because of pH control problems, this addition point was moved upstream of the sump tank before the scrubber liquid return pump. This did not produce the expected results. The addition point will now be moved to the quench tower liquid inlet. This change will result in a more consistent scrub solution pH. In addition the plastic caustic addition line may be replaced with one constructed of stainless steel.

8.7 Blowdown / Scrub Solution Recycle Changes

Minor plumbing changes such as relocating the pH probes will be made to the scrub solution filtering, recycle, and blowdown streams to increase control and improve performance.

8.8 Instrument Air Supply Lines

The existing instrument air supply lines were upgraded to Duraplus plastic piping to maintain the quality of the air supply. Piping runs were also straightened and consolidated. These changes will not affect incinerator performance; however, instrument life should be extended and maintenance reduced.

8.9 Natural Gas and Combustion Air Piping

These piping runs were upgraded to meet standards set by Industrial Risk Insurers (IRI) and to allow for the new control schemes described below in the Section 9.0. These changes will not affect incinerator performance.

8.10 Main Ram Feeder Glovebox Air Supply

The air supply for the main ram feeder glovebox was changed. Originally it was obtained from room air processed through an 8-inch HEPA filter. Air is now supplied by the underfire air blower. A control valve has been added to modulate the flow of air during box feeding. These changes will not affect incinerator performance.

8.11 Replacement of Control Valves

Control valves on the air supply and natural gas supply lines have been replaced with newer, updated control valves. These valves will control the mass flow of fuel and air supplies as outlined in Section 9.0, below. These changes will not affect incinerator performance.

8.12 Process Pump Replacements

All process pumps handling scrub solution were upgraded. New pumps contain Hastelloy wetted parts for corrosion protection. They also are sealless, thus eliminating the water seals and in-leakage associated with the original pumps. These changes slightly increase the required water make-up to the scrub solution system because there is no longer in-leakage. No impact on CAI system performance will be noted.

9.0 INSTRUMENTATION AND CONTROLS

Many modifications have been made to the instrumentation and controls of the CAI system. These changes were required because of the age of many components, wiring problems, and updated control strategies.

9.1 PLC / Logic / Operator Interface

An Allen Bradley 5/15 Programmable Logic Controller (PLC) replaced mechanical relay based logic. This unit will allow more flexible operations, provide more reliable interlock control, aid in data collection, and provide an additional operator interface with the process.

Logic for the PLC is being written to control many of the interlocks associated with the CAI system. Data collection and operator interface will be provided by Allen Bradley Control View Software and an IBM-based PC.

These modifications are designed to enhance CAI process information available to the operator and the reliability of this information.

9.2 Wiring / Instrumentation

The entire CAI system has been rewired to eliminate bad connections and other related problems. Significant attention was given to routing power (high voltage) wiring separately from instrumentation wiring to eliminate induced signals.

Numerous instruments were also upgraded because of their age. Critical instruments are discussed below. Outdated process recorders and controllers have been upgraded with multipoint digital controllers.

These changes are designed to make the CAI process more reliable and controllable and to enhance the quality of recorded data.

9.3 Combustion Gas Monitor

With the removal of the combustion air glovebox face, the probability of combustible gases accumulating there has been eliminated. Therefore, a monitor originally located in this glovebox used to detect the presence of combustible gases, such as natural gas, has been removed. This deletion will not influence incinerator operations. The unit may be relocated to the liquid feed room exhaust ducting.

9.4 Primary Combustion Chamber Burner Control Logic

The primary combustion chamber burner (high-intensity vortex burner) combustion air and fuel gas control logic is being updated to automatically control the fuel-to-air ratios needed for good combustion. These changes include the following:

- The mechanical linkage control of fuel and combustion air has been removed. They are now controlled independently of each other.
- The use of lead-lag logic for fuel-to-air ratio control. This logic will compensate for the sluggish response of the air supply versus the quick response of the fuel supply.
- The liquid feed control system will compensate for changes in the liquid waste supply and can adjust for different combustion air requirements for liquid wastes.
- A control loop will be added that automatically relates liquid waste feed rates to equivalent natural gas feed rates. The control loop will sum and adjust all fuel sources so that the heat release capacity of the burner, the combustion air capacity of the burner, nor the thermal duty of the CAI is exceeded.

Previously many of these adjustments were made manually. These modifications will allow tighter control of the high-intensity vortex burner and thus more efficient combustion. The degree of improvement will be verified in upcoming verification trials.

9.5 Off-gas Pressure Control Valve Control Logic

The induced draft fans continuously pull combustion products through the air pollution control system. This negative draft also provides containment for radioactive constituents. The original CAI system employed a feedback control logic on the pressure control valve located in front of the induced draft fans. During solid waste campaigns, excess air entered the incinerator during box charging resulted in uneven control with significant pressure fluctuations. Using a new feed forward logic, the control valve will essentially anticipate load changes rather than react to them. This control loop will use the following data to manipulate fan speed (see Subsection 9.7, below):

- estimates of total combustion air and products of combustion
- notification of charging each waste box.
- notification of reduction in underfire air
- amount of combustion air being fed to the secondary (upper) combustion chamber

This change in the control of the off-gas pressure control scheme will result in a more constant draft in the secondary combustion chamber.

9.6 Induced Draft Fans Variable Frequency Drives

Variable frequency drives (VFDs) are being added to the induced draft fans. VFDs will allow precise control of the speed (and thus the draft provided) within the process.

9.7 Off-gas Alpha/Beta Monitor

Off-gas from the CAI facility is continuously sampled for radioactive contamination at the exhaust stack where a small stream is drawn across a filter. This filter is removed and counted on a weekly basis.

To provide more real-time data and to comply with RCRA permit requirements, an EG&G Nuclear Instruments continuous alpha/beta monitor (Berthold Model LB 150 D-R) will be installed between the second stage process HEPA filter bank and the carbon bed. Included with the monitor will be a 10-inch diameter by 10-inch long AL-6XN spool piece with flow straighteners, an isokinetic sampling train, and various mass and velocity measurement instrumentation. The monitor will use pseudocoincidence and alpha energy range discrimination to distinguish artificial radioactivity from naturally occurring background radioactivity (such as radon/thoron daughters).

9.8 Off-gas Total Hydrocarbon Monitor

A total hydrocarbon (THC) monitor will be added to the off-gas stream as required by the current RCRA Part B permit. The location for this monitor will be just before the stack. The addition of this monitor will not affect incinerator performance. It will provide additional data for analysis. A Byron Instrument Model 401 analyzer was originally used for similar monitoring but was removed due to reliability problems.

The monitor selected for this application is the Rosemount Analytical Incorporated Model 402 Hydrocarbon Analyzer. The analysis performed by this unit is based on a flame ionization detector with a minimum detection limit as low as 0.15 ppm at 99% confidence level. The sample analyzed is extracted from the flow to the main stack.

9.9 Off-gas NO / NO_X / SO_2 Monitor

An continuous NO/NO_X/SO_2 monitor will be installed to replace the Thermo Electron Model 10 NO_X analyzer that was originally used. The location of the replacement instrument will be just upstream of the stack. The addition of this monitor will not affect incinerator performance and is not required by the current RCRA permit or TSCA approval. It will provide additional data for analysis that could be used in tuning the CAI system. The system selected is the Bomen model 9100 Multicomponent Fourier Transform Infrared (FT-IR) Gas Analyzer with a heated sample extractor. The following are the measurement ranges associated with this analyzer.

SO_2	0 - 30 to 2000 ppm	(adjustable)
HCL	0 - 30 to 200 ppm	(adjustable)
NO	0 - 50 to 1500 ppm	(adjustable)

NO_2	0 - 30 to 500	ppm (adjustable)
CO	0 - 30 to 500	ppm (adjustable)
NH_3	0 - 70 to 125	ppm (adjustable)
HF	0 - 20 to 200	ppm (adjustable)
H_2O	0 - 1 to 30	vol% (adjustable)
CO_2	0 - 1 to 20	vol% (adjustable)

9.10 Off-gas CO / CO_2 / H_2O Monitor

Off-gas will be monitored for CO, CO_2, and H_2O using a Lear Siegler Incorporated model EX 4700A combustion gas analyzer. This monitoring is required under the current RCRA permit and TSCA approval. This insitu analyzer uses a narrow-band, nondispersive infrared (NDIR) adsorption measurement technique and replaces the aging original $CO/CO_2/H_2O$ monitor. Gas measurement ranges are as follows.

CO	0 - up to 5000 ppm v/v wet
CO_2	0 - 20% v/v wet
H_2O	0 - 50%, corresponding to a maximum dew point of 178 °F

Various measurement corrections and compensations are also performed by the unit. Automatic on-stack calibration (zero and span) can be selected at intervals ranging from 1 to 24 hours. The unit will be located just upstream of the stack on the sampling trombone.

9.11 O_2 Monitors

The original Ametek O_2 monitors located on the primary and secondary chamber exhausts have been updated with new Ametek model WDG-HPII Flue Gas Analyzers. These analyzers employ a zirconium oxide electrochemical cell to measure O_2 concentrations ranging from 0.1 to 100%. The new models transport the extracted sample by convection thus eliminating air pumps and check valves which were clogging with ash on the original model. The new model also has an automatic calibration option.

9.12 Neutron Monitors

Neutron monitors may be installed in the CAI process area. They will monitor accumulation of nuclear materials in selected areas of the process in which the possibility of criticality may exist. Because these monitors are located outside of the process, they will have no effect on CAI system performance.

9.13 Backup Power and Switching Equipment

A new uninterruptible power supply (UPS) was installed to replace existing aging battery racks. During a site power loss, this unit will run critical process control systems until power from the backup diesel generator is brought up or line power is restored. New transfer switching equipment has also been added to replace outdated and less reliable equipment. A load bank is also being added to the generator system so that this unit can be kept running under load during operations thus minimizing switch over time if line power is lost. The generator is sized to run only critical process equipment and controls.

9.14 Liquid Feed System

A new Micro Motion gyroscopic/Coriolis massflow meter was installed on the liquid feed line. This flowmeter provides instantaneous mass flow rates of the waste liquid being fed to the high-intensity vortex burner. A variable frequency drive was also added to the liquid feed pump.

9.15 Mass Flowmeter on the Main Ram Glovebox

A venturi flowmeter with mass calculator was added to the main ram glovebox to measure air in-leakage flow into the incinerator during box feed operations and during liquid waste incineration.

9.16 Other Massflow Meters

Flowmeters on lines supplying the quench tower, venturi scrubber, absorber column, filter recycle, and process blowdown were upgraded to Micro Motion gyroscopic/Coriolis massflow meters.

9.17 Scrub Solution pH Control

Process pH meters are being relocated to obtain better control of scrub solution pH. The old locations resulted in inadequate control because of erratic signals.

9.18 Secondary / Tertiary Cooling Loop Breakthrough Detection

An engineering study and independent review determined how best to detect a double breakthrough from the process scrub system through the secondary cooling loop in the CAI system into the primary cooling tower loop. A conductivity meter will monitor the secondary loop water to detect the presence of process scrub solution in the secondary system. The loops are presently protected by pressure differential. This will continue.

9.19 Cooling Tower Blowdown Control

Investigations are being performed to determine how best to control cooling tower blowdown. The results of these investigations may initiate changes. These changes should not affect CAI performance.

9.20 Scrub Solution Blowdown Control

Studies are being conducted to determine how to minimize scrub solution blowdown. These studies may show that changes are warranted to reduce waste generation. These types of changes should not affect incinerator performance but will be evaluated if they are proposed.

9.21 HEPA Filter Differential Pressure Measurement

Individual differential pressure gauges will be added to each HEPA filter in the off-gas stream to detect blinding and breakthroughs. The present system measures the total differential pressure across the primary and secondary HEPA filter banks. This addition will provide information on when HEPA filters must be changed and thus minimize waste generation.

10.0 SUPPORT SYSTEMS

10.1 Caustic Supply

Sodium hydroxide solution used for acid gas neutralization was originally prepared by mixing flaked NaOH with water. Because this operation was labor intensive and exposed operating personnel to chemical hazards, commercially available caustic solutions were selected for use. Originally 20-30% caustic was used. It is planned to use 50% caustic in the future.

The original caustic tank was removed and a larger capacity tank installed with the appropriate hook-ups for caustic filling. A variable-speed tubular diaphragm pump will meter caustic solution for pH control. The old system employed a centrifugal pump and flow control valve.

The type of caustic used (mixed versus premixed), the caustic delivery system, and the caustic storage tank will have no effect on the incineration process. Because of the increased caustic concentration, less caustic solution will be required to neutralize a given quantity of acid gas and thus the need for make-up water to the process will be slightly increased.

10.2 Instrument Air Supply

The original oil-lubricated instrument air compressor has been replaced with an Ingersoll Rand oilless duplex compressor specifically designed for instrument air systems. This change will not affect incinerator performance; however, instrument life should be extended and maintenance reduced.

Molecular sieve dryers were also added to replace the less reliable refrigeration-type dryers.

10.3 Cooling Towers

Critical components in the original cooling towers needed replacement. Cost estimates to repair the original towers were excessively high. Two new cooling towers identical to the originals were purchased as replacements.

Cooling tower blowdown and silica treatment options are now also being considered; these options could result in changes or additions to the cooling tower system. These changes or additions will not affect incinerator performance since they are external to the CAI process.

10.4 Natural Gas Supply

The natural gas supply system was significantly upgraded to meet new code requirements and to allow for more precise control. Line size was increased from 1.25-inches to 1.5-inches. A new gas meter was installed. An earthquake shutoff valve may also be installed.

11.0 BUILDING

Various upgrades were and are being done to the building that houses the CAI (TA-50-37) to meet new requirements and to aid in waste handling operations. None of these modifications will affect the performance of the CAI system.

11.1 Seismic Upgrades

The original CAI facility was not designed to meet current seismic requirements outlined in DOE Order 5480.28, Natural Hazards Mitigation. Engineering studies are being performed to determine building and process equipment upgrades necessary to meet these requirements. When these studies are complete and proposed solutions approved, upgrades will be made. The effect of these upgrades cannot be determined until they are further defined.

11.2 Ash Pit

To accommodate the new GARS, a pit was constructed below the ash drop-out door on the primary (lower) chamber. This change will have no affect on incinerator performance.

11.3 Airlocks

Modifications are being made to comply with DOE Order 6430.1A, General Design Criteria (containment criteria). These modifications include adding personnel and material airlocks and replacing of roll-up doors.

11.4 Fan Expansion Joints

Because existing rubber expansion joints on the building exhaust fans deteriorate and have to be replaced periodically, new stainless steel joints are being installed.

11.5 HVAC

Replacement of the existing evaporative HVAC system with a new mechanical chiller to provide increased cooling in the process area is being pursued. Ventilation control may also be upgraded. A PLC-based data collection system will also relay critical information to the control room. The three exhaust systems affected include the process area (room 112), the high bay (room 114), and the liquid/solid storage bays (rooms 117/118).

11.6 Loading Dock / Liquid Feed Room / Change Room

The existing loading dock at the CAI is being reconfigured and expanded into a nonwaste dock and a laboratory for the MADAM and x-ray systems. A new waste dock will be added to the south side of TA-50-37.

The liquid feed room containment may be upgraded. It may also be upgraded to a Class 1, Division 1 rating.

The existing change rooms may be expanded and upgraded.

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