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1993

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Department of Energy
Field Office, Albuquerque
Los Alamos Area Office
Los Alamos, New Mexico 87544

SEP 2 1993

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Benito J. Garcia, Acting Bureau Chief
Hazardous and Radioactive Waste Bureau
New Mexico Environment Department
525 Camino de los Marquez
Santa Fe, New Mexico 87503

Dear Mr. Garcia:

Enclosed is clarifying information concerning the Packed Bed Reactor/Silent Discharge Plasma (PBR/SDP) experiment. This information is being submitted in response to a Notice of Deficiency (NOD) received from the New Mexico Environment Department (NMED) dated August 4, 1993.

This submittal consists of the following:

- Reprints of maps (Figures 2 and 5) which include legends, dates, and stream channels as requested in item 1 of the NOD;
- Additional information concerning prevailing wind patterns (wind rose) on supplemental sheets; and
- Written response to items 2 and 3 of the NOD.
- Item 4 of the response is additional information on Dr. Coogan's qualifications as requested during a telephone conversation with NMED personnel.

During a telephone conversation between Los Alamos National Laboratory (LANL) and NMED personnel on August 26, 1993, it was agreed that the wind rose diagram would be submitted as a separate sheet rather than printed directly on the maps. This arrangement was necessary because of the difficulty with incorporating the data directly onto the maps combined with the limited amount of time allowed for this response. The meteorological tower from which wind data was collected is located in Technical Area 6 and is indicated on the "RD&D Unit Key" map, Figure 2. The enclosed wind rose diagram represents the average wind pattern for day and night, at 10 meters above ground level for this location. All data was collected during

72

1992. The following information will assist with interpreting the wind rose:

- The direction of each line indicates the wind direction.
- The length of each line is proportional to the frequency at which the wind blows from the indicated direction.
- Different wind speed classes are indicated by line thickness (increased line thickness equals increased wind velocity).
- The number in the center of the wind rose indicates the frequency of calm winds (winds with velocity less than 0.5 m/s (1 mph).

Pending approval of the permit application, LANL plans to test a PBR/SDP unit for destruction of several types of hazardous wastes commonly generated by LANL operations.

If you have any questions or comments concerning this submittal, please contact Jon Mack of my staff at (505) 665-5026.

Sincerely

FOR

Joseph C. Vozella, Chief
Environment, Safety and Health
Branch

LESH:9JM-037

cc w/o attachments:
K. Sisneros,
NMED
1190 St. Francis Dr.
Santa Fe, NM 87502
T. Gunderson, EM-DO, LANL,
MS-J591
K. Hargis, EM-8, LANL,
MS-K490
T. Grieggs, EM-8,
(EM-8:93-2341-1), LANL,
MS-K490
D. Hjeresen, EE-AETO, LANL,
MS-F641

RESPONSE TO TECHNICAL NOTICE OF DEFICIENCY

Los Alamos National Laboratory
Research, Development and Demonstration (RD&D) Permit Application
Packed Bed Reactor/Silent Discharge Plasma (PBR/SDP) Unit

The following information is provided in response to the Technical Notice of Deficiency issued to LANL on August 4, 1993 by the State of New Mexico Environment Department (NMED) for the RD&D permit application dated December 1992 (and revised June 24, 1993 and July 14, 1993). This material is intended to serve as an addendum to the existing permit application.

1. **Site Location Standards [HWMR-7, Part IX; 40 CFR, 270.14(b)(19)(i), (iii), and (v)]**

   LANL must provide Figures 2 and 5 bearing the dates and legends as well as the words "Figure 2 and "Figure 5" printed on each respective map. Figure 5 must also show the surface waters including intermittent streams. Clearly indicate a wind rose on the figures.

   Response: Figure 2 and Figure 5 have been revised as requested. Wind rose information is separately attached.

2. **Design and Operation of the Facility [HWMR-7, Part V; 40 CFR, 264.31]**

   Explain the second sentence from the top of page 14 of the application text: i.e. why "the piping from the scrubber to the Building 128 vent...or back to the waste feed...will be constructed of either PVC or copper." Expound on the preferred choice of the use of PVC to the use of copper and vise versa.

   Response: The effluent exiting the final scrubber in the system is compatible with both copper and PVC piping and will not react with these materials. There is no particular distinction between the use of one type of material over the other. Rather, copper and PVC piping were selected because they are both easy to work with and are readily available. Copper piping has a slight advantage over PVC in that commercial fittings are easily obtained. PVC piping has a slight advantage over copper in that it is lighter and less expensive. Either material may be used in this portion of the system configuration without impacting the experimental results.

3. **General Waste Analysis [HWMR-7, Part IX; 40 CFR, 264.13]**

Demonstrate how carbon monoxide, one of the end products generated by the RD&D treatment will be destroyed or eliminated without posing any danger to human health and the environment.

Response: Carbon monoxide is generated in trace quantities as a product of incomplete combustion. The purpose of the RD&D experiments is to determine, by varying the operating parameters, the optimal system performance capabilities. The objective will be to operate the system to maximize complete combustion of the input waste, and thereby minimize the production of carbon monoxide.

In the closed-loop system configuration, no gas effluents are vented to the atmosphere. Any trace quantities of carbon monoxide will be recycled back into the system, and the carbon monoxide will undergo further combustion to be converted to carbon dioxide.

In the open-loop configuration, no gas effluents are vented inside the building were personnel may be working. Rather gas effluents from the system are vented through a building stack to the outdoors. No personnel inside the building will be exposed to carbon monoxide from the treatment system. Previous experiments have shown that, when operating in steady-state, the system emits less than 20 parts per million (ppm) carbon monoxide. This level may be two or three times higher during brief periods when the system is starting up or shutting down. The OSHA permissible exposure limit is 35 ppm with a ceiling limit of 200 ppm for carbon monoxide. It is important to emphasize that the quantity of effluent generated during the RD&D experiments is relatively small, due to the small size of the research unit.

Provide reaction diagrams that indicate the thermal decomposition of the hazardous wastes during treatment in the combined PBR/SDP unit.

Response: It is not possible to provide reaction diagrams for the decomposition of the hazardous wastes, because the intermediates that are formed during the breakdown process are not known. Identifying these intermediates and the degradation pathways are part of the research objective. Efforts are underway to model the breakdown of certain benchmark organics and predict the chemical intermediates that may be formed in the treatment system, but the degradation mechanism is complex and very dependent on the operating conditions of the system. The actual breakdown process will depend on parameters such as the flow rate of the system, the temperature of the packed bed, and the power supplied to the silent discharge plasma cells. It is the purpose of the research effort to begin to determine what intermediates are formed during the treatment process and to maximize the complete degradation of the input organic material into simple non-hazardous effluent by-products.

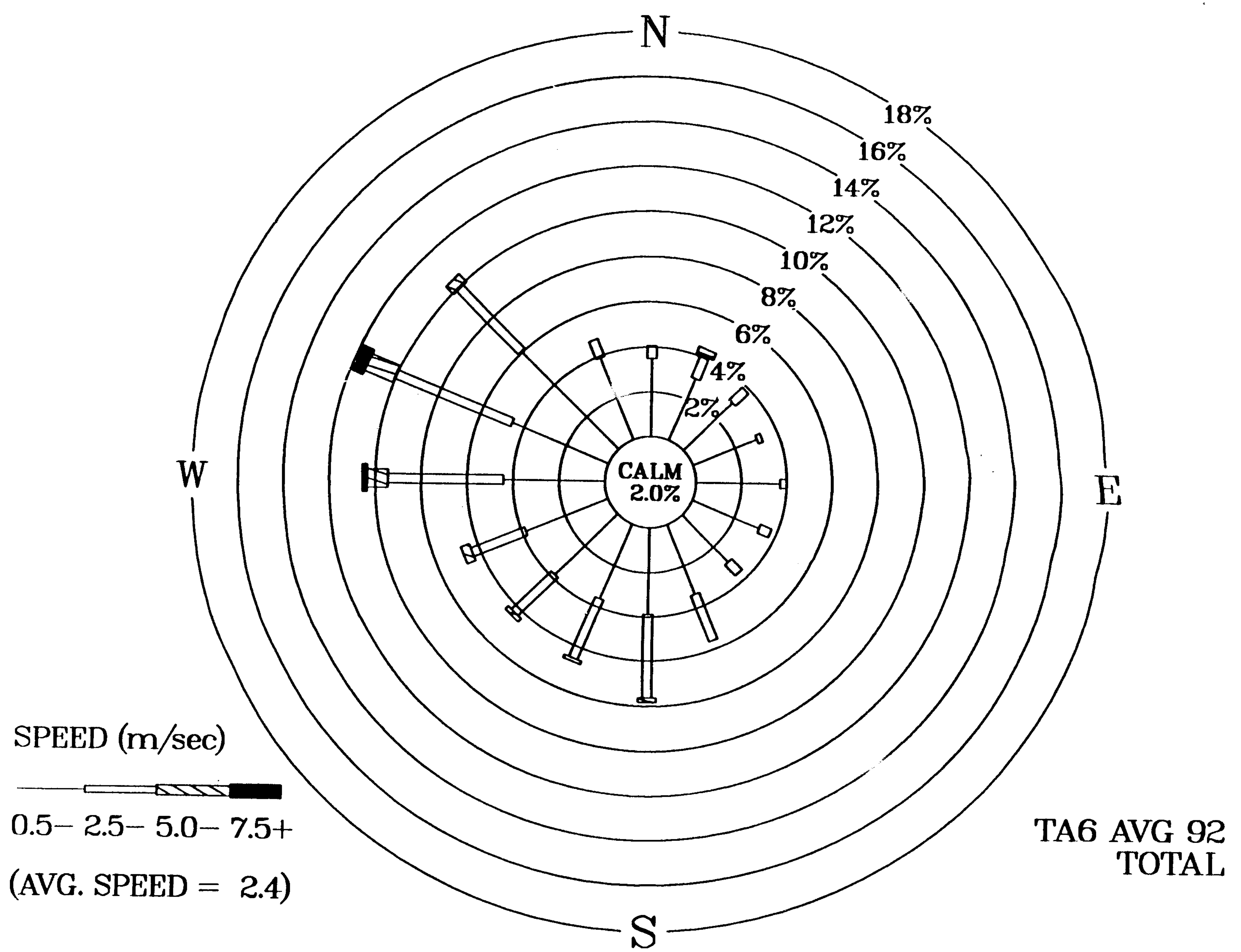
In the packed bed, the organic material is decomposed by the addition of oxygen in a combustion process. The ultimate by-products of combustion are carbon dioxide and water, and possibly acid or salt. The formation of acid or salt depends on whether the input organic material contains other elements (e.g., halogens, etc.). A simplified reaction diagram for the combustion process is:

$$\text{organics} + O_2 \rightarrow CO_2 + H_2O \text{ (+ acid or salt).}$$

However, the combustion process in the packed-bed will not always be complete. Some of the organics will be decomposed into various chemical intermediates (the identity of which cannot be predicted at this time). Trace quantities of the input organics may resist decomposition altogether. The silent discharge plasma unit, which follows the packed bed reactor, is designed to complete the degradation of the remaining organics and their chemical intermediates. Like the packed-bed the precise breakdown mechanism in the discharge plasma cannot be diagrammed, because it is dependent on operating system variables like flow rate and cell power. Degradation of the organics is accomplished by reactions with free-radicals that are produced in the discharge plasma; i.e., the hydroxyl (OH) radical and ozone (O^3). Simplified reaction diagrams of free-radical chemistry are:

$$\text{organics} + OH \rightarrow CO_2 + H_2O \text{ (+ acid or salt)}$$

$$\text{organics} + O^3 \rightarrow CO_2 + H_2O \text{ (+ acid or salt).}$$


N
E
S
W
18%
16%
14%
12%
10%
8%
6%
4%
2%
CALM
2.0%
SPEED (m/sec)
0.5– 2.5– 5.0– 7.5+
(AVG. SPEED = 2.4)
TA6 AVG 92
TOTAL

John J. Coogan, Ph.D.

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Los Alamos National Laboratory
Chemical and Laser Science Div.
CLS-6 MS E525
Los Alamos, NM 87454
(505)665-0186, 667-6080

Fields of Research

Environmental Remediation Techniques, Discharge Plasmas, Kinetic Modeling, Relativistic Electron Beams, Pulse Power and Flash X-ray Systems, Laser Physics, Spectroscopy.

Education

University of Texas, Dallas, TX	Ph.D. Physics	12/89
University of Texas, Austin and Dallas,TX	M.S. Physics	12/88
University of Texas, Dallas,TX	B.S.,*cum laude* Physics	5/85
University of Dallas, Irving,TX	B.A. Philosophy	5/83

Employment History and Experience

Los Alamos National Laboratory — 2/90-present

Staff Member/Physicist. CLS-6 Advanced Laser and Systems Technology. Presently researching applications of pulse power technology to the treatment of mixed and chemical hazardous waste. This includes the use of relativistic electron-beams for aqueous based waste, packed-bed reactors (PBR) for combustible liquids and silent discharge plasmas (SDP) for gaseous based waste. Lead modeling scientist and experimental coordinator for alternative combustion laboratory, PI on research efforts studying mixed waste and off -gas treatment, and on a fundamental study of free radical formation in non-equilibrium plasmas using planar laser induced fluorescence. Mentor for DOE Science and Engineering Research Semester (SERS) and American Chemical Society/LANL SEED students. Member of PBR/SDP team awarded 1992 LANL Distinguished Performance Award.

Postdoctoral Fellow. CLS-7 Pulsed Power Systems. Initiated research program into the ignition and closure of diode plasmas within large area electron beam generators. This work expanded existing perveance models, tested novel emitter materials, designed several unique electron-beam diagnostics and first observed the screening effect in large-area diodes. Programmatic duties for high power KrF lasers for use in Inertial Confined Fusion (ICF) included: developing basic research proposals, optimizing e-beam pumping efficiency, studying vacuum breakdown, and developing and testing composite vacuum/gas barriers. Mentor for DOE SERS student.

University of Texas — 5/85-12/89

Research Assistant, Center for Quantum Electronics under Dr. C. B. Collins. Dissertation : "A Flash X-Ray Source Driven by Stacked Blumleins Producing 500 keV Photons" Involved in feasibility study of the gamma-ray laser. Designed, constructed and characterized a flash x-ray source producing high peak powers at >100 Hz repetition rates used to excite nuclear materials, patent is pending. Also collaborated with the Centre National de la Recherche Scientifique (CNRS), France, in a study of the kinetics of high pressure rare gases using both dielectric controlled discharge and pulsed x-ray excitation. Proficient in the methods of UV, VUV and gamma-ray spectroscopy. Extensive experience with high power thyratrons.

Teaching Assistant and Assistant Research Scientist under Dr. J.W. Keto. Instructed physics students in senior laboratory class covering a variety of experimental techniques and supervised their semester long research projects. Assembled and maintained high-power dye laser for use in time resolved spectroscopy of excited rare gases.

Member of the American Physical Society, the Air and Waste Management Association, and ΣΠΣ
References upon request.