NOTICE!

ALL DRAWINGS
ARE LOCATED
AT THE END OF
THE DOCUMENT

0000 45379

EG&G ROCKY FLATS

EG&G ROCKY FLATS, INC
ROCKY FLATS PLANT P O BOX 464, GOLDEN COLORADO 80402-0464 • (303) 966-7000

OCT 5

90-RF-6094

Robert M Nelson, Jr
Manager
DOE, RFO

Attn J Kiefer

EVAPORATION ENHANCEMENT FOR THE SOLAR EVAPORATION PONDS

Enclosed is a draft letter (with four enclosures and videotape) to the Colorado Department of Health (CDH) which requests a change to interim status and provides information requested by CDH

Specifically, this letter requests that CDH approve use of floating aerator units in the 207A and 207B Solar Evaporation Ponds to enhance evaporation of water in those ponds

In a telephone conversation with J Kiefer (RFO) and A Schubert (EG&G) on June 29, 1990, Dr F Dowsett (CDH) stated that use of the floating aerator units would not require submittal of a Part A Permit Application Dr Dowsett further stated that CDH required only a letter requesting a change to interim status that includes engineering details on the installation, operational procedures and methods for containing the aerators' spray within the boundaries of the ponds CDH approval of this change is necessary to remove the liquids remaining in the ponds by the October 1991 date agreed to in the Agreement in Principle between D O E and the State of Colorado

If you have any questions or require additional information, please contact Allen Schubert at extension 5251 or Kirk Ticknor at extension 6344 Additionally, please contact us if you wish us to deliver this document to CDH for you.

J.M. Kersh, Associate General Manager
Environmental Restoration & Waste Management

KWT pif

Orig. and 1 cc - R.M. Nelson, Jr

Enclosure:
As Stated

DOCUMENT CLASSIFICATION
REVIEW WAIVER PER
CLASSIFICATION OFFICE

Enclosure 1

90-RF-6094
Page 1 of 2

DRAFT DRAFT DRAFT

Dr Frederick R. Dowsett, Unit Leader
Monitoring and Enforcement
Hazardous Materials and Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Dr Dowsett

The Agreement in Principle between the U S Department of Energy and the State of Colorado dated June 28, 1989, requires the Solar Evaporation Ponds be dried and the remaining sludge be removed by October 1991 However, the current evaporation rate in those ponds will not dry the ponds by that date

In order to meet the October 1991 date for cleanup of the solar ponds, various techniques are being considered to enhance evaporation of the water in the solar ponds One technique is the use of floating aerator units in the 207A and 207B Solar Evaporation Ponds to enhance evaporation Those aerator units will spray pond water four feet into the air to increase the surface area of the water that is in direct contact with the air That will increase the evaporation rate in the ponds

A total of six floating aerator units will be installed (three in the 207A pond and one in each of the 207B ponds). The aerator units are adjustable to create a spray diameter of approximately 40 to 60 feet The aerator units will be adjusted to a spray height of approximately four feet and a flow rate of approximately 1500 gallons per minute The aerators will be automatically shut down when their velocity elements at the anemometers detect a wind speed that exceeds the maximum allowable wind speed for aerator operation The videotape that is included with this request provides a visual demonstration of the performance of an aerator unit

In a telephone conversation on June 29, 1990, you stated that this technique would not require submittal of a Part A Permit Application You further stated that use of the aerator units would require a letter to the Colorado Department of Health (CDH) requesting a change to interim status that includes engineering details on the installation, operational procedures and method for containing the aerator's spray within the boundaries of the ponds.

The enclosures to this letter provide the information you requested on June 29, 1990. Specifically, Enclosure (A) provides a system description, Enclosure (B) provides details on installation, Enclosure (C) provides the operating procedure, and Enclosure (D) provides engineering calculations to determine the maximum allowable wind speed for

operation of the floating aerator units. Based on those calculations, the initial set point for the maximum allowable wind speed will be 20 miles per hour. In addition to the calculations, the acceptability of the maximum allowable wind speed will be verified by test prior to operation Based on the results of that test, the set point for wind trip speed will be adjusted up or down and the operating procedure revised accordingly.

This letter requests that CDH approve the change to interim status for use of the floating aerator units to enhance evaporation in the solar ponds. This request is being made in accordance with the requirements of the Colorado Hazardous Waste Regulations, 6 CCR 1007-3, Section 100 20.

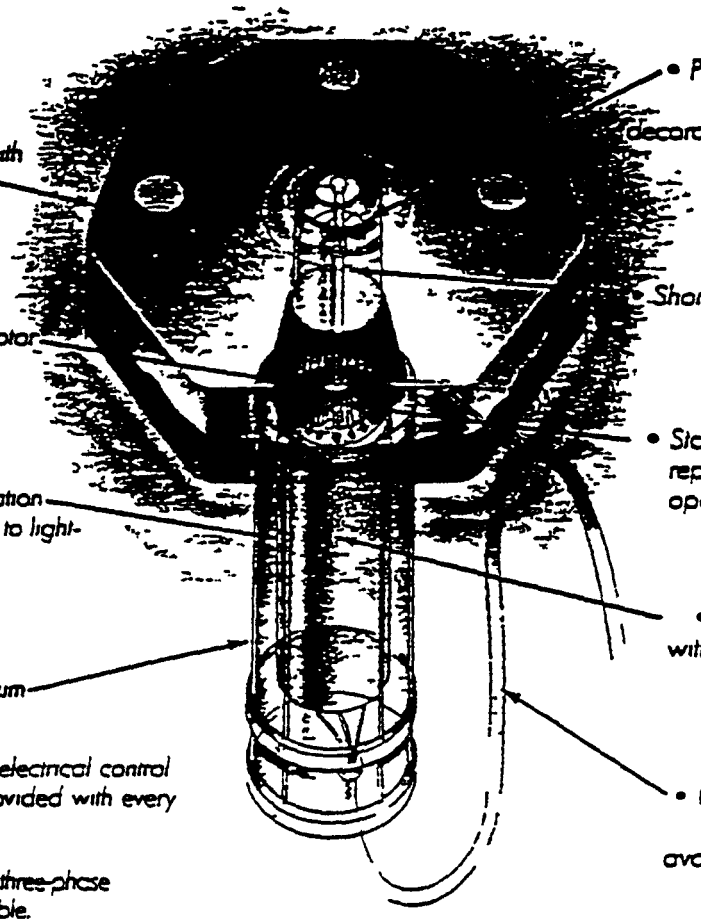
If you have any questions, please call Jim Kiefer of my staff at 966-5924

Enclosures.
As Stated

cc:
J M. Kersh, EG&G Rocky Flats, Inc.
A. L. Schubert, EG&G Rocky Flats, Inc.

AQUA-LATOR: MASTER OF AERATORS!

FEATURES:



- Durable fiberglass float with solid polystyrene interior.
- Continuously lubricated motor bearings.
- Built in double motor insulation makes unit less susceptible to lightning damage.
- All stainless steel or aluminum components.
- Rain tight electrical control station provided with every unit
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- Patented, high efficiency stainless steel propeller/diffuser provides decorative design without volume loss.
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- Oil cooled heavy duty motor with Three Year Warranty on 1hp and larger units
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By introducing oxygen into the aquatic environment and speeding up the process of aerobic decomposition of organic materials aeration attacks the causes of odors and algae. Chemicals which only treat the symptoms introduce the hazards of heavy metals and other toxic materials into your environment

AERATION: THE METHOD OF CHOICE FOR HIGH QUALITY WATER.

LIGHT SETS				
Lenses — Clear red, green blue, amber				
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NIGHT GLOW LIGHT KITS				
	# OF LIGHTS	VOLTAGE	AMP	TRANSFORMER
Set #1	(2) 55 Watt each	12V AC	9	H.D
Set #2	(2) 70 Watt each	24V AC	11	H.D
Set #3	(4)* 70 Watt each	24V AC	2.3	H.D.
*Available only 1, 2 & 5 hp. units.				

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Std.–Includes motor timer contactor photocell H.D transformer, outdoor elec. enclosure	Deluxe–Programmable combination multichannel motor and light timer contactor H.D transformer
*Sequencer options available	

WARNING:

Risk of severe electric shock–
To reduce the risk of electric shock, be certain that it is connected only to a properly grounded, grounding type receptacle

Do not operate where swimmers are present.

Aqua-Master
AERATORS AND PUMPS

A DIVISION OF NIGRELLI SYSTEMS INC
16024 CTH X KIEL WI 53042
PHONE 414) 693 3121 FAX 414) 693 3245

Enclosure B

90-RF-6094
Page 1 of 2

P.E. D. L. Hoyt
EXT: 6063
Date: 5/29/90

MWO # 660877

DESCRIPTION OF WORK FOR INSTALLATION OF FLOATING EVAPORATION UNITS.

Floating aerator units will be installed in the 207 ponds to aid in the evaporation process. The spray should be adjusted to provide fine water droplets, a spray height of approximately 4 feet and a spray diameter of approximately 40 feet or more if possible.

- Assemble floating aerators and attach low height adaptors.

In Pond 207A.

- Attach clips and rope to 3 aerators as shown in Details 2 and 3 All three units will be connected.
- Tie rope to clips and attach clip to at least one anchor (already present around the 207A pond).
- Place aerators in pond while holding remaining rope lines
- Go around pond and sequentially attach clips and rope lines to existing anchors as shown in Drawing # 39176-501. Leave excess rope coiled as shown for later retrieval.
- Adjust and tighten as needed leaving some slack (approximately 1.5' to 2') in lines for variations in water depth.

In Ponds 207BN, 207BC, and 207BS

- Screw in fence post anchors as shown in Detail 1, Drawing # 39176-501.
- Attach clips and rope to aerator as shown in Details 2 and 3.
- Tie rope to one anchor
- Place aerator in pond while holding other 2 rope lines.
- Go around pond and sequentially attach rope lines to anchors as shown in Drawing # 39176-501. Leave excess rope coiled as shown for later retrieval.
- Adjust and tighten as needed leaving some slack (approximately 1.5' to 2') in lines for variations in water depth.

REVIEWED FOR CLASSIFICATION
By [redacted]
Date 5-1-90

HIGH-LEVEL PROCEDURE

Floating Aerator Units

1 1 Before starting the floating spray pumps verify

a. that the Anemometer Switch is operational (turned on)
b that the Anchor Ropes are secure

1.2 To start the spray pump turn the Power Disconnect Switch to the "ON" position, then turn the Control Selector Switch to the "AUTO" position

1 3 Once a spray pump is turned on, verify

a. that the spray is not reaching the pond's berm
b that the spray height is approximately four feet
c. that the spray pump is delivering an even spray

If any of these conditions are not met, shut off the spray pump immediately and notify supervision

1 4 Enter the time the spray pump was started in the Pond Aeration Log Book.

1.5 Every four hours inspect the Pond Aeration System to see that the conditions in Section 1 1 and 1.3 are met. If any condition is not met, shut off the spray pump immediately and notify supervision Enter the inspection time and results in the Pond Aeration Log Book If the Pond Aeration System has automatically shut down, do not attempt to manually override the system Notify supervision immediately

1 6 Shut the Pond Aeration System down by turning the Control Selector Switch to the "OFF" position, then turning the Power Disconnect Switch to the "OFF" position

1 7 Enter the time and reason the spray pumps were shut off in the Pond Aeration Log Book.

Enclosure D

90-RF-6094
Page 1 of 4

STONE & WEBSTER ENGINEERING CORPORATION

5500 SOUTH QUEBEC STREET
ENGLEWOOD, COLORADO 80111

ADDRESS ALL CORRESPONDENCE TO P O BOX 5406 DENVER COLORADO 80217 5406

W U TWX 910 935-0105 TELEPHONE 303 741 7700 FAX 303-741 7670
W U TELEX 45-4401 RCA TELEX 289251 303-741 7671

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RICHMOND VA
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TAMPA
WASHINGTON D C

Ernie Lombardi
Senior Research Specialist
EG&G Rocky Flats Plant
P.O. Box 464
Golden, CO 80402-0464

September 6, 1990

J.O. No. 01336.08
SW/EG&G-049L

SPRAY EVAPORATOR DROPLET DRIFT
SOLAR POND EVAPORATION PROJECT
EG&G ROCKY FLATS SUPPORT SERVICES

You asked that we recommend an initial setting for the wind anemometer that will control the spray evaporators in the solar ponds. Based on the following, we recommend an initial setting of 20 miles per hour, to be adjusted up or down as experience indicates. Nevertheless, regardless of the initial setting that you decide to use, we believe that it is only prudent to turn off a particular spray aerator before working downwind of it in the pond area. In addition, until experience is gained with this setting, the distance downwind that the spray actually travels should be recorded as a function of wind velocity.

The detailed investigation leading up to the foregoing recommendation will be covered in the final report of this project. The final report will also include all of the necessary assumptions, although some of these will be briefly outlined below. For the most part these assumptions are very conservative.

For example, we assumed that the wind velocity measured by the anemometer is the same at the water surface, when the reality is the wind velocity at the water surface will be less. In addition, even though the equation that was developed (see attachment) actually gave wind velocities somewhat in excess of 20 miles per hour, we chose the lower figure because the data used to calibrate the equation went to a maximum velocity of 20 miles per hour.

The only data that we had to develop this equation was the verbal narrative on the videotape made of these sprayers. All of this data is contained in this paragraph. With the 4 foot spray height setting, the diameter of the spray is 35 feet. The manufacturer stated that there is no drift loss at wind velocities of 20 miles/hour (mph) even with gusts to 25-30 mph. At the 5 foot setting, the spray diameter is 55-60 feet. The spray droplet size is slightly smaller than at the 4 foot setting. The spray droplets were described as "large". The reason for this limited information

is due to the fact that these are custom manufactured spray evaporators for the Rocky Flats solar ponds.

When water sprayers are standard off-the-shelf items, the manufacturer's data includes, as a function of operating pressure, the spray droplet size distribution, rate of discharge (volume per unit time), and cone angle. Knowing the size of the spray openings and the number of them, the initial velocities of the spray droplets can be calculated along with their horizontal and vertical components.

Given the limited amount of information available, a simple model was developed to estimate the limiting wind velocity as a function of the average horizontal velocity of the spray droplets (which the simple model permits the calculation of), the height of the spray above the water surface, the vertical distance between the top of the spray and the rim of the pond, and the distance from the centerline of the spray aerator to the nearest part of the pond rim.

In order to calibrate this simple model, data from the following reference was used:

> Concentration of Brines by Spray Evaporation, by G.O.G. Lof, John C. Ward, S. Karaki, and A. Dellah, United States Department of the Interior, January, 1972. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock Number 2400-0728.

Specifically, this data was obtained from Table 17 on page 77 of the above reference. The data was for water sprayers operating at a pressure of 10 psi, where the base of the sprayer was 5 feet above the water surface. This is an additional conservative factor because the spray height is obviously greater than 5 feet. The values used were the maximum radius of the spray in the downwind direction for wind velocities of 0, 5, 10, and 20 mph.

From this data, the ratio of the spray radius at a given wind velocity to the spray radius for no wind was calculated. This ratio was plotted as a function of wind velocity. On the same graph, the uncalibrated form of the limiting wind velocity equation was also plotted and was a fair approximation for the 3/4A50 spray nozzle which has a geometric mean spray droplet diameter of 0.162 cm. Because the largest spray nozzle (the 3/4A120) has a geometric mean spray diameter of 0.335 cm, the equation developed was already conservative even before calibration.

If the wind velocity is less than the initial horizontal component of the spray droplet velocity, the largest drops go further downwind than the small drops. Also, if the wind velocity is greater than the initial horizontal component of the spray droplet velocity, then the small drops go further downwind than the large drops. Because, in general, this latter case is the one of interest here, choosing data from a smaller drop size distribution is the

more conservative estimate.

Consequently, the data from the 1/2A25 spray nozzle with a geometric mean spray droplet diameter of 0.105 cm was actually used to calibrate the equation in order to make the estimate even more conservative.

From a consideration of the height and radius of the spray with no wind, we calulated the following initial horizontal velocities:

At the 4 foot spray height, 12 mph
At the 5 foot spray height, 18 mph

Given the above, we calculated the following limiting wind velocities for each pond based on the freeboard measurements that EG&G personnel made on July 26, 1990 (July 25, 1990, for pond 207C). These are given in the following table for spray heights of 4 and 5 feet:

Pond	Freeboard on 26 Jul 90, feet	Limiting wind velocity, mph	
		4 foot spray height	5 foot spray height
207A	2.44	30	22
207B North	2.39	32	24
207B Center	2.68	34	25
207B South	3.12	35	25
207C	4.27	NA	27

The choice of whether to start with either a 4 or 5 foot setting we leave up to you, but believe there appears to be no real reason for not starting with the 5 foot spray height. If I can be of any further assistance, please call me at 273-6114.

John C. Ward

John C. Ward, Ph.D., P.E., DEE
Supervisor, Environmental Engineering

JCW:JCW

Copies to:
R.V. Morgan
D. Shepherd
R. James

EXAMPLE CALCULATION OF LIMITING WIND VELOCITY

In the following equation, the variables are defined as follows:

- m is the limiting wind velocity in miles per hour
- H is the horizontal carry of the spray droplets downwind of the spray evaporator, feet. H is therefore also the minimum distance between the centerline of the sprayer and the nearest part of the pond rim.
- D is the distance between the top of the spray and the top of the pond rim, feet
- d is the height of the spray above the pond water surface, feet
- v is the overall average velocity of the spray droplets in the horizontal plane when there is no wind, feet/second

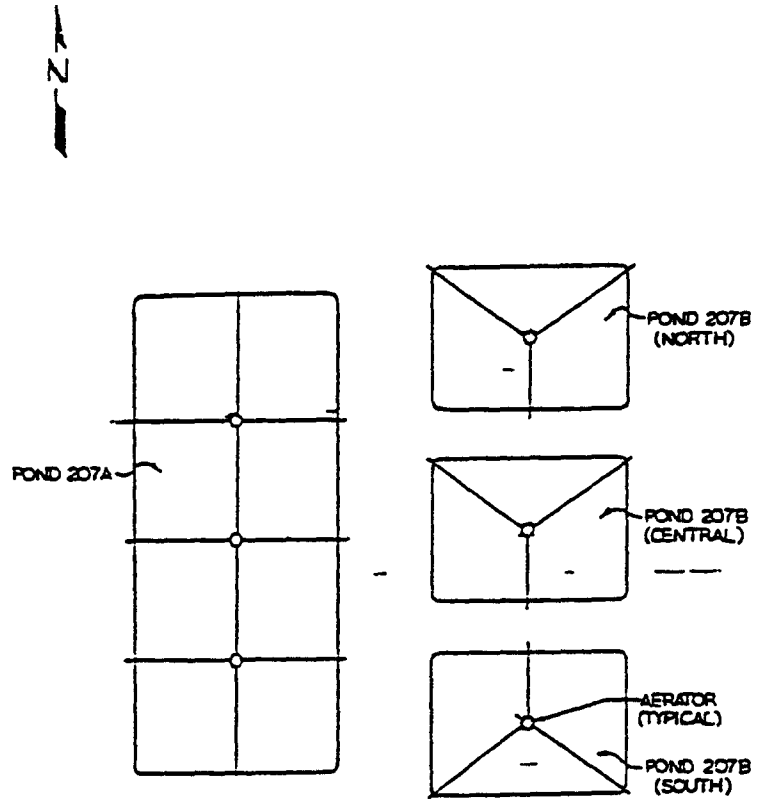
For the 5 foot high spray setting, v is 25.7 feet/second, and for the 4 foot high spray setting, v is 17.5 feet/second. In pond 207A, if 3 spray evaporators are used, then the value of H is 88 feet. In ponds 207B North and 207B Center, H is 93 feet. In pond 207B South H is 90 feet, and it is 81 feet in pond 207C. Only one spray evaporator will be used in each of the last 4 ponds (it is Stone & Webster's understanding that pond 207C will not have a spray aerator).

For the example, we will use the July 26, 1990, observation on pond 207A, namely 2.44 feet of freeboard. We will assume the spray height above the water surface is 5 feet. Therefore, in the following equation,

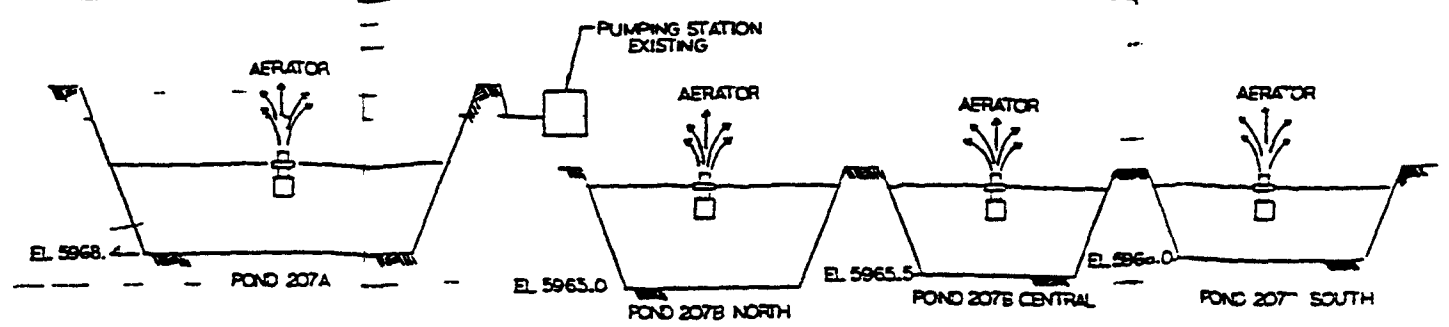
$H := 88 \quad D := 2.56 \quad d := 5 \quad v := 25.7$

$$m := 1.34 \frac{H}{\sqrt{D} + \sqrt{d}} - 0.335\, v$$

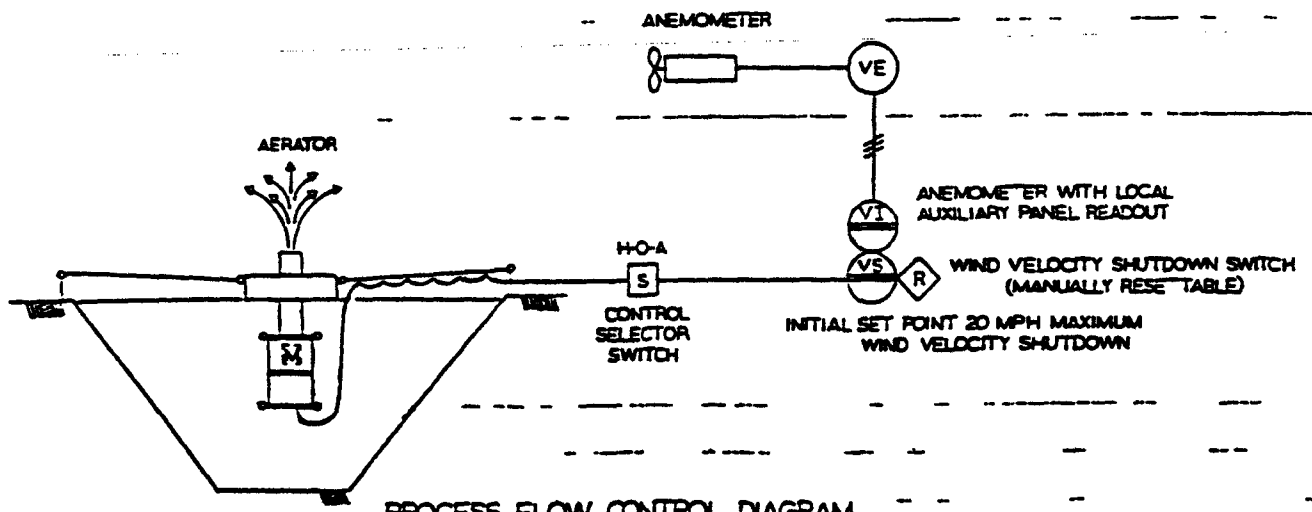
$m = 22.13$



PONDS 207A AND 207B PLAN
NOT TO SCALE



PONDS 207A AND 207B ELEVATIONS
NOT TO SCALE



PROCESS FLOW CONTROL DIAGRAM

LEGEND

H O-A / S — THREE POSITION SELECTOR SWITCH HAND-OFF AUTO SPRING RETURN TO OFF POSITION FROM HAND POSITION AND MAINTAINED IN THE AUTO POSITION

VE — VELOCITY ELEMENT LOCALLY MOUNTED (TRANSFORMS ANEMOMETERS MECHANICAL ENERGY TO AN ELECTRICAL SIGNAL)

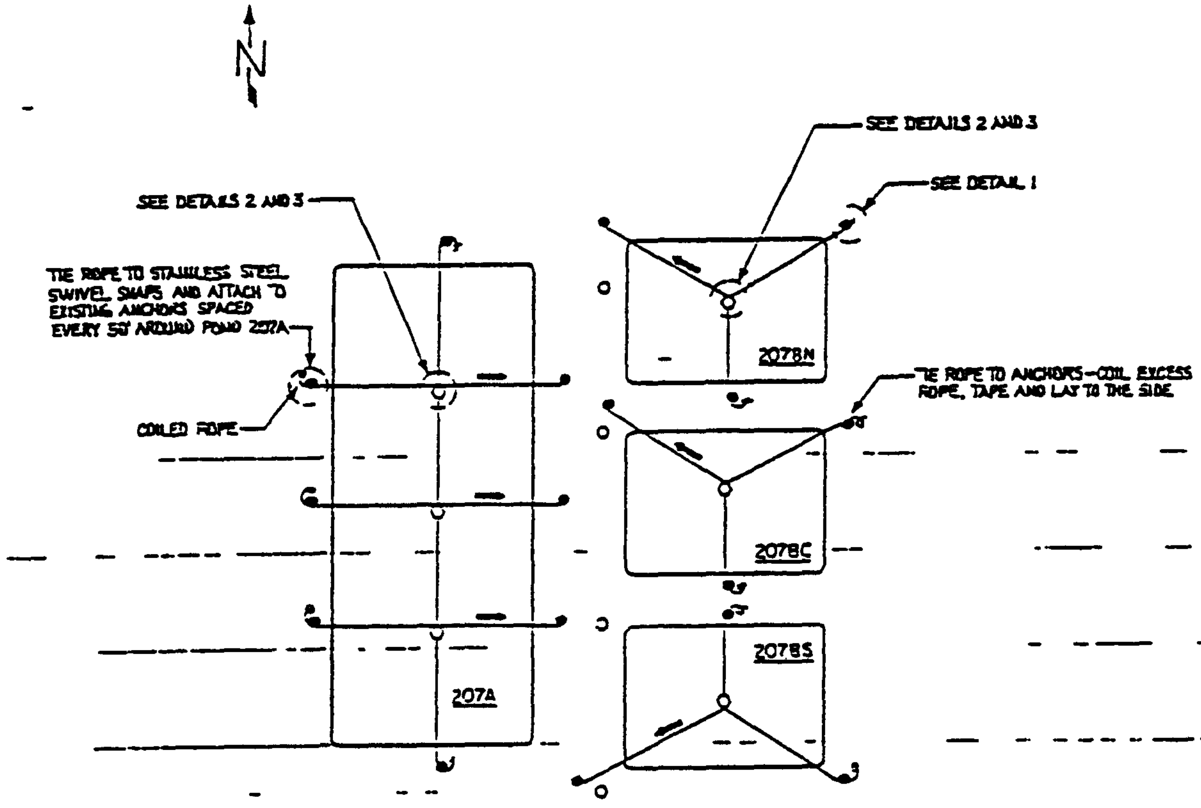
VI — VELOCITY INDICATOR; PANEL MOUNTED

VS — VELOCITY SWITCH; PANEL MOUNTED

R — RESET SWITCH (THIS SWITCH MUST BE MANUALLY OVERIDED TO RESUME OPERATIONS AFTER AUTOMATIC SHUTDOWN)

KEYWORDS:	A | ORIGINAL ISSUE	8 28-90	TS
	DESCRIPTION	DATE	
	DESIGNED: SHAVER	9/27/90	U.S. DEPARTMENT OF ENERGY
	DRAWN: SHAVER	8/28/90	Rocky Flats Plant
	CHECKED: J. KEDDIE	8-28-90	
	APPROVED: R. J. [illegible]	9 28-90	207 PONDS FLOATING EVAPORATING UNITS PROCESS FLOW CONTROL DIAGRAM

NO.	QUAN.	DESCRIPTION
1	9	SCREW-IN FENCE POST ANCHORS McMASTER CARR NO 6015T1
2	5500'	3/8 FIBRILLATED POLYPROPYLENE ROPE McMASTER-CARR NO 3846T24
3	38	STAINLESS STEEL SWIVEL EYE SNAPS McMASTER CARR 3115T42
4	21	STAINLESS STEEL WELDED RINGS, McMASTER CARR 3779T71
5	6	AQUA-MASTER AQUA-LATOR STANDARD HVF 5 HP 460 VOLTS WITH LOW HEIGHT ADAPTORS



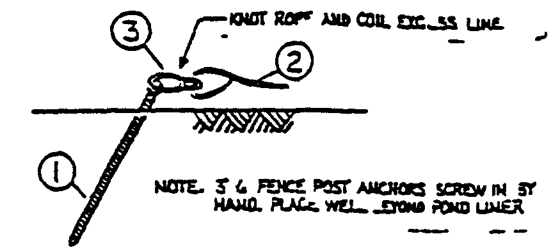
207 PONDS LAYOUT OF FLOATING EVAPORATION UNITS

LEGEND

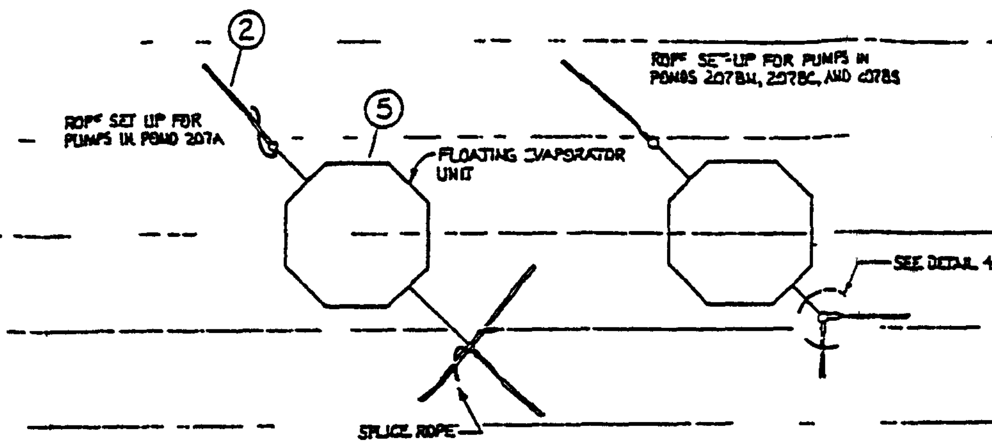
- ● ANCHOR
- ○ POL
- → DIRECTION OF PULL FOR AERATOR MAINTENANCE

DIRECTIONS

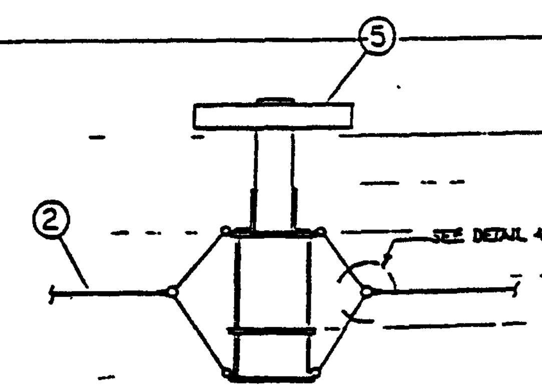
1. LOOSEN ROPE FROM ANCHORS.
2. TIE END OF COILED ROPE TO ANCHORS.
3. PULL ROPE INDICATED WITH ARROWS ALLOWING COILED ROPE TO BE PULLED INTO PONDS UNTIL AERATOR PUMP IS RETRIEVED.
4. FLOATING EVAPORATOR UNITS SPACED 120' N S CENTERED AT 185 E-W ON 207A. CENTERED IN 207B PONDS APPROXIMATELY 130' FROM CORNERS, 95' FROM N-S SIDES.
5. MINIMUM COIL LENGTHS
   POND 207A 175 ON W SIDE
   180' ON N & S SIDES
   PONDS 207B 170' ON N S AND W SIDES



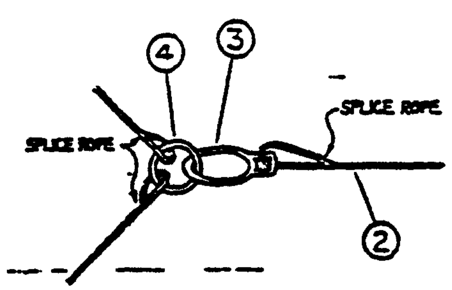
DETAIL 1 - FENCE POST ANCHORS



DETAIL 2 - PLAN VIEW ROPE SET UP



DETAIL 3 - SIDE VIEW OF FLOATING EVAPORATOR UNIT



DETAIL 4 - EVAPORATOR ROPE ATTACHMENT

KEYWORDS: EVAPORATOR, SPRAY, SWISEWER, UNIT, INSTALLATION, 207 PONDS

A | ORIGINAL ISSUE

U.S. DEPARTMENT OF ENERGY

Rocky Flats Plant

207 PONDS
FLOATING EVAPORATOR UNITS
LAYOUT & DETAILS

SCALE NONE

D1 39176-501 | A | 1 of 1