

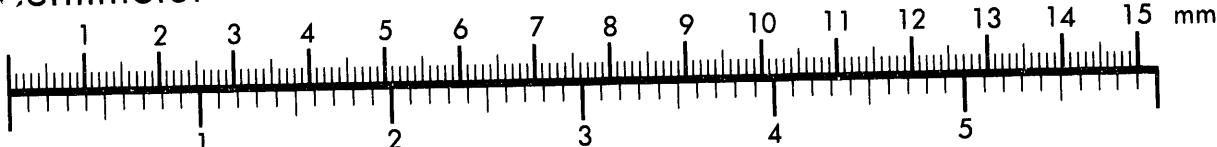


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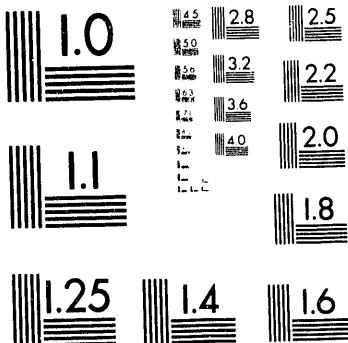
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UV DISINFECTION PILOT PLANT STUDY AT THE SAVANNAH RIVER SITE (U)

by

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**UV Disinfection Pilot Plant Study at the
Savannah River Site**

by

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An ultraviolet light disinfection system pilot plant was operated at the Savannah River Site Central Shops sanitary wastewater treatment package plant July 14, 1992 through August 13, 1992. The purpose was to determine the effectiveness of ultraviolet light disinfection on the effluent from the small package-type wastewater treatment plants currently used on-site. This pilot plant consisted of a rack of UV lights suspended in a stainless steel channel through which a sidestream of effluent from the treatment plant clarifier was pumped. Fecal coliform analyses were performed on the influent to and effluent from the pilot unit to verify the disinfection process. UV disinfection was highly effective in reducing fecal coliform colonies within NPDES permit limitations even under process upset conditions. The average fecal coliform reduction exceeded 99.7% using ultraviolet light disinfection under normal operating conditions at the package treatment plants.

Discussion

Background

The new SRS sitewide NPDES permit is expected to contain limits on total residual chlorine (TRC) discharges for all Site sanitary wastewater treatment plants. SRS wastewater treatment plants currently disinfect wastewater by the addition of sodium hypochlorite. A project entitled "Environmental Modifications for Production Facilities", proposed new chlorination and dechlorination systems for all sanitary wastewater treatment package plants to meet NPDES TRC limits.

Previous alternative studies performed considered various forms of chlorination/dechlorination, bromination, hydrogen

peroxide addition, and ozonation; however UV disinfection was not considered due to its status as "innovative technology." Since completion of these studies, UV disinfection has become "standard technology" and is in use in over 100 wastewater treatment plants within the United States.

UV disinfection systems have many advantages:

1. UV eliminates the handling of hazardous chemicals by operations personnel.
2. UV eliminates the risk of a fish kill by an accidental chlorine discharge due to a failure of the dechlorination system.
3. Use of UV eliminates problems with aquatic toxicity due to chlorination or dechlorination chemicals.
4. UV systems are cost effective vs. chemical chlorination and dechlorination facilities.

Although UV systems have many advantages, there were still concerns regarding their effectiveness on the effluent from small, package wastewater plants. Although many UV disinfection units are in service, most are in use on large (> 700 gpm) municipal wastewater plants. Very little data was available on the effectiveness of UV on very small systems (< 50 gpm). To determine the effectiveness of UV on package plant effluent, a pilot plant UV unit was set up to disinfect a sidestream from the Central Shops (C/S) sanitary wastewater treatment package plant.

Configuration

A pilot UV system was leased from Trojan Industries, Inc. (Figure 1) to perform the study. This plant was designed to treat 104 gpm at 65% UV transmittance with no redundancies built into the system. Effluent was pumped from the C/S wastewater treatment plant clarifier (Figure 2) trough into the influent flowbox of the UV system at 12 gpm with a 55% UV transmittance. Although the pilot plant was rated for a much greater capacity than needed, the scope of this study was to determine the treatability and not the design parameters. UV disinfection is not able to treat highly colored effluents or effluents with high solids regardless of the design parameters.

Procedure

The pilot study began 7/14/92 and ended 8/13/92. Grab samples were pulled from the pilot plant effluent discharge stream, influent flowbox, treatment plant clarifier, and influent pump suction area within the clarifier effluent trough. These samples were analyzed for fecal coliform bacteria by use of the membrane filtration method. At least one influent sample was grabbed for each effluent grab sample (Figure 3). Results from effluent samples in which the accompanying influent sample had a low fecal coliform count (<300 colonies/100 ml) were not included in the final data compilations (Table 1).

Results

A total of 17 valid data points were collected during the month-long study. All but two of these data points indicated a nearly complete fecal coliform kill (<10 colonies/100 ml). The NPDES permit limit for fecal coliform bacteria is typically 200 colonies/100 ml as a monthly average and 400 colonies/100 ml as a daily maximum. One of the two data points that fell outside of this range resulted in a fecal coliform concentration of 230 colonies/100 ml (Figure 4). This sample was grabbed during a simulated process upset which caused the sample to contain a very high solids concentration. A piece of rising sludge (sludge which "pops up" from the clarifier bottom due to denitrification) was caught in the UV pump inlet just prior to grabbing a sample. The concentration of solids flowing through the pilot plant at the time the sample was grabbed was estimated to be >50 mg/L. This sample was analyzed to determine the effectiveness of the UV system during abnormal operating conditions. Although UV disinfection was not adequate for the sample to meet the monthly average limit, it was adequate for the sample to be well below the daily maximum limit for fecal coliform concentration.

The other sample that had a fecal coliform concentration greater than 10 colonies/100 ml was the final sample grabbed. It had a fecal coliform concentration of 22 colonies/100 ml. This sample was the first indication of a decrease in the UV transmittance due to fouling of the quartz sleeves which house the UV lamps. Fouling occurs due to a natural build-up of organic compounds, and was a serious concern since soda ash (Na_2CO_3) is added to the mixed liquor for alkalinity adjustment in the package plant. The pilot unit had been operating for 1 month before a slight rise in the fecal coliform concentration due to fouling was observed.

Conclusions

1. Average fecal coliform reduction exceeded 99.7% using ultraviolet light disinfection under normal operating conditions at the package treatment plants.
2. Fecal coliform reduction by ultraviolet light disinfection meets the limits specified by the SRS NPDES permit under normal operating conditions at the package treatment plants.
3. Fecal coliform reduction is acceptable (lower than NPDES daily maximum allowable concentrations) under process upset conditions at the package treatment plants.

ULTRAVIOLET DISINFECTION PILOT STUDY

CHANNEL/LAMP SPECIFICATIONS

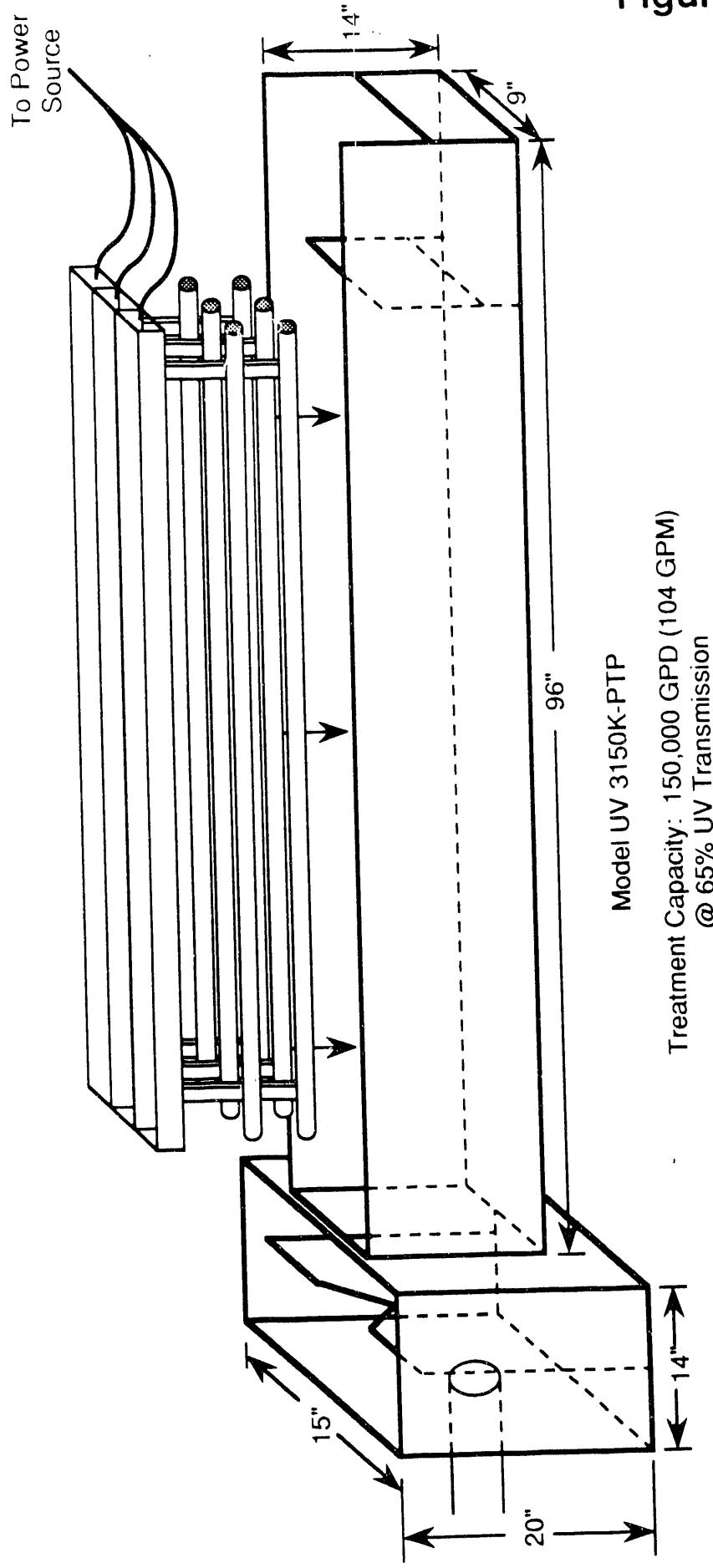


Figure 1

CHANNEL:

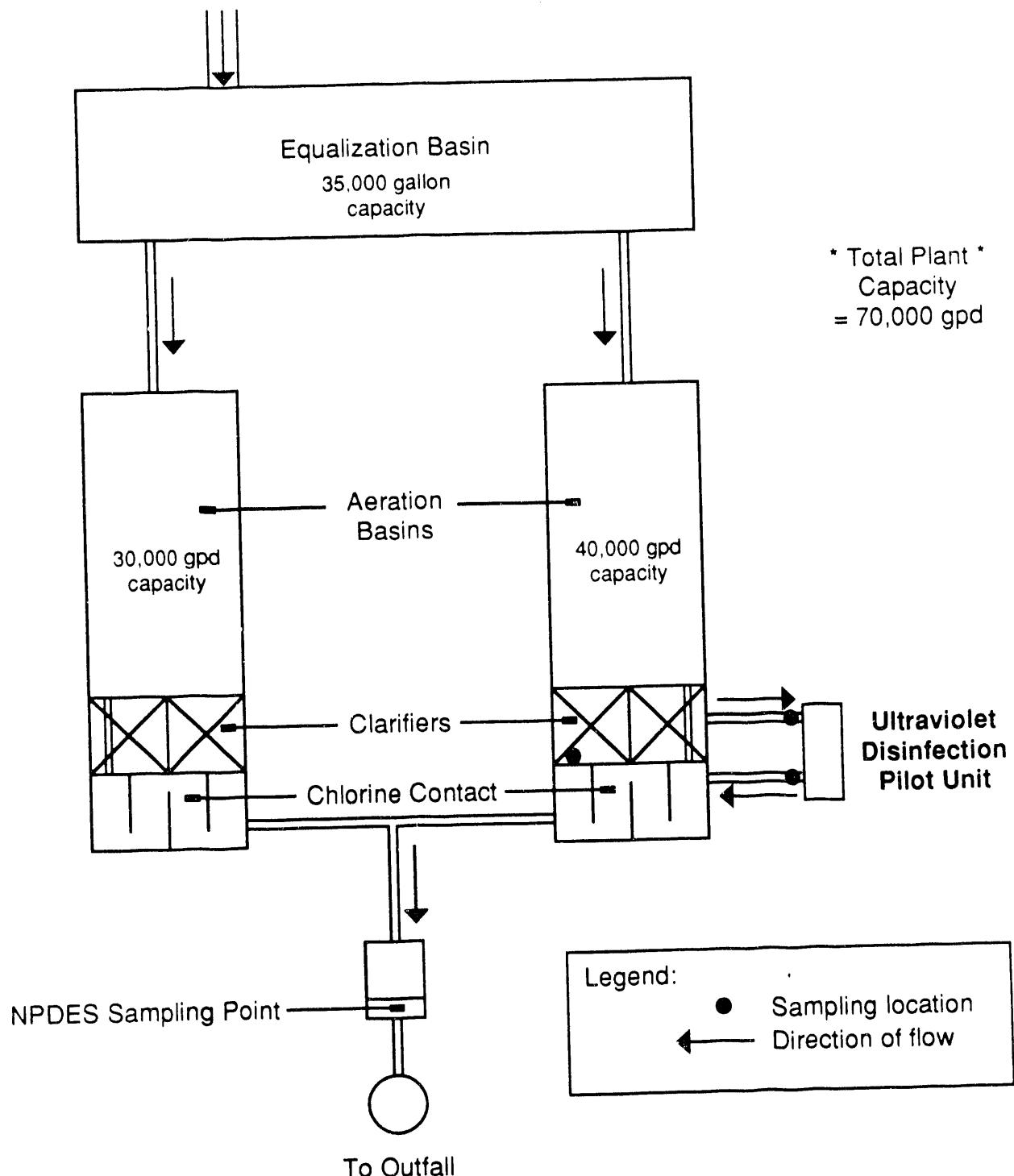
Constructed of 304 stainless steel
Retention Time: 7.25 seconds
Approximate dry weight: 150 - 200 lbs.

LAMPS:

The lamps will be submerged in the channel.
3 lamp modules each with 2 lamps
Power: 110 volt electricity

WSRC
SILT STABILIZATION STUDY
BAB 3.3.93

Figure 2
ULTRAVIOLET DISINFECTION PILOT STUDY
SWTP EQUIPMENT LAYOUT



NOT TO SCALE

Figure 3

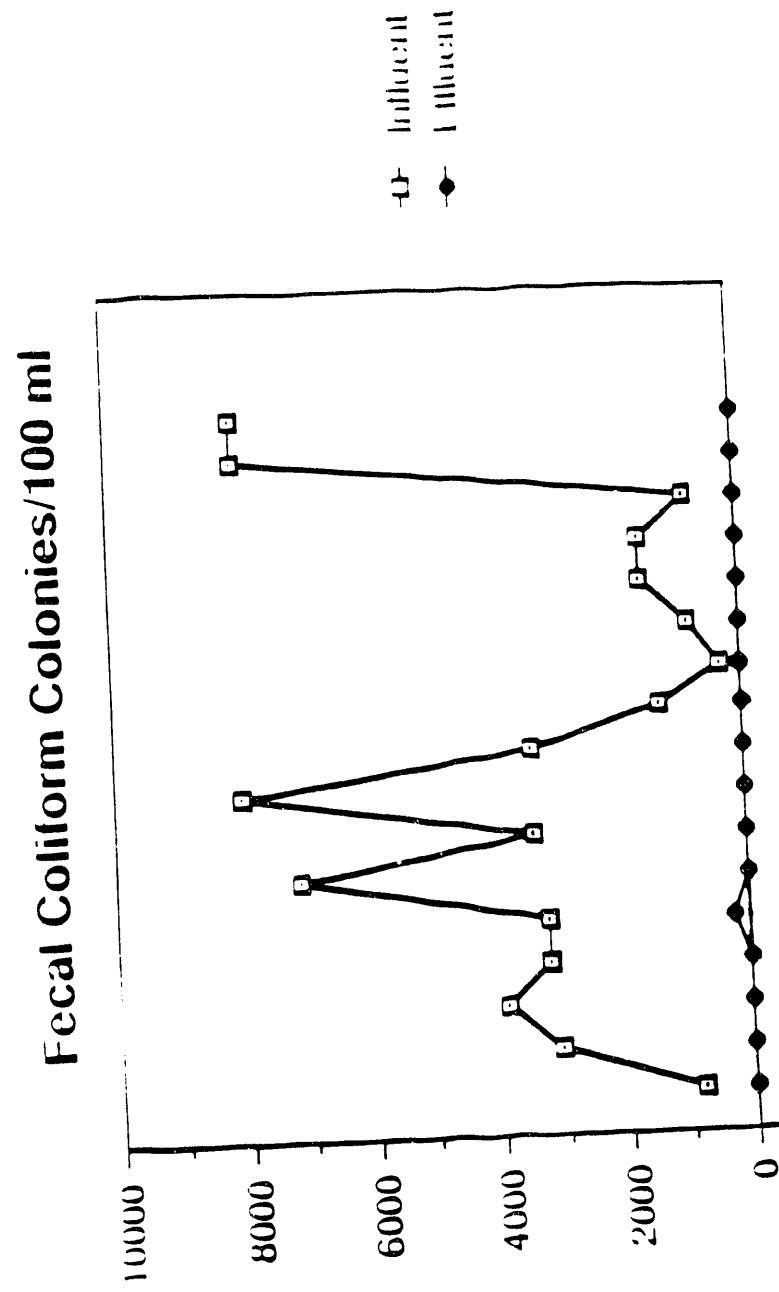
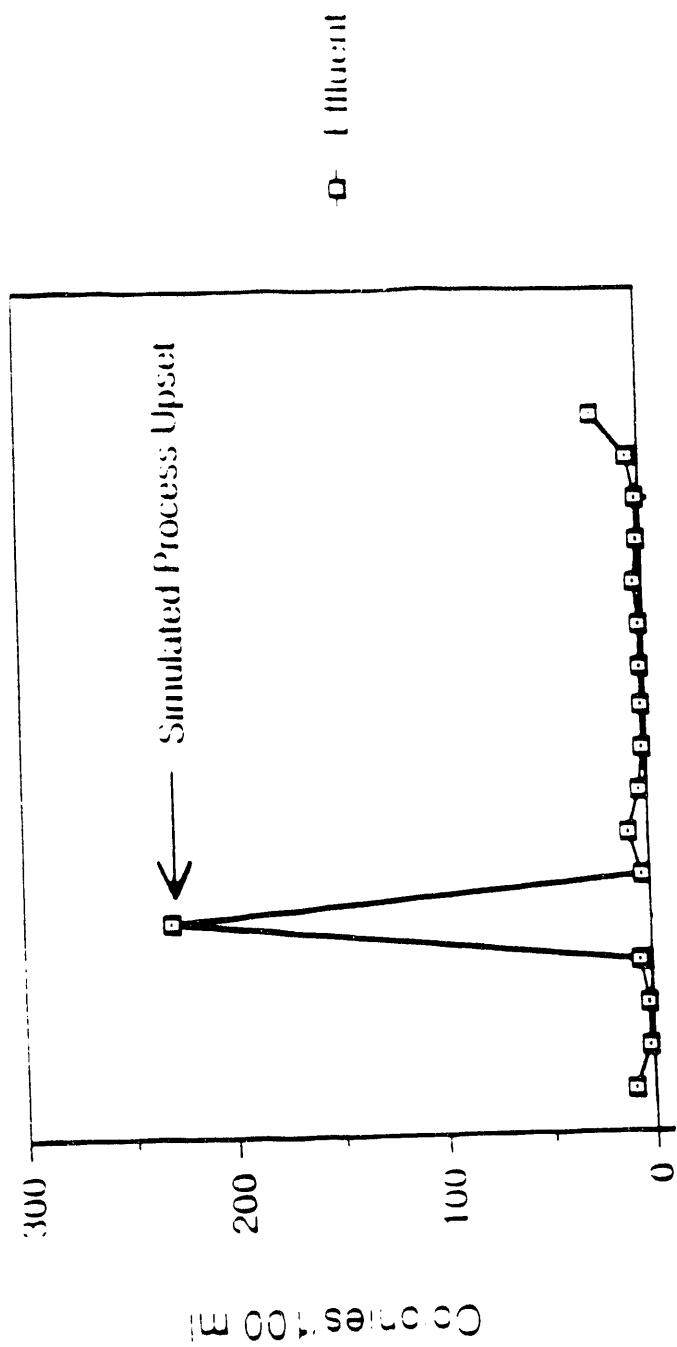


Figure 4

Fecal Coliform Effluent Analyses



FCC Form 100-10

Date	Equivalent	Equivalent	% Reduction	Location
1 14 92	>600	<10	99.9	Va
1 15 92	<1	<10	99.9	Va
1 16 92	<1	<10	99.9	Va
1 21 92	3100	<2	99.9	Va
1 22 92	3900	<2	99.9	Va
1 23 92	3200	5	99.9	Va
1 23 92	3200	230	92.3	Va
1 27 92	>100	<4	99.9	Va
1 28 92	<1	<4	99.9	Va
1 29 92	3400	<10	99.7	Va
3 4 92	>8000	4	99.9	Va
3 5 92	3400	<2	99.9	Va
3 6 92	<100	<2	99.9	Va
3 7 92	1300	<2	99.9	Va
3 10 92	315	2	99.4	Va
3 10 92	>800	<2	99.8	Va
3 11 92	>1600	<4	99.8	Va
3 11 92	>1600	<2	99.9	Va
3 12 92	>800	2	99.8	Va
3 12 92	>8000	6	99.9	Va
3 12 92	>8000	22	99.7	Va
AVERAGE	>2394	<5	>99.7	

**DATE
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8 / 4 / 93

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