

PARTICULATE MATTER AMBIENT AIR QUALITY

DATA REPORT FOR 1991

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1.0 EXECUTIVE SUMMARY

Routine particulate matter ambient air quality monitoring has been performed at two stations in the Yucca Mountain air monitoring network since the spring of 1989. The monitoring was established to: (1) support air quality permit monitoring requirements, and (2) use in general environmental characterization of the Yucca Mountain area. The monitoring program is described in the "Scientific Investigation Implementation Package for Air Quality Monitoring" (SIIP, YMP document TMSS/EFPD-91-002), and is implemented through Technical and Management Support Services (T&MSS) Work Instruction procedures. This document is a report of monitoring results for 1991, with some

comparisons to previous years. Data from 1989 and 1990 were presented in a previous report.

The air quality monitoring work is included in Work Breakdown Structure 13.4.2 (previously designated 1.2.5.4.2); T&MSS Environmental Field Programs Division is the responsible organization. The Quality Assurance Grading Report (T12542A) for this activity shows the work to be classified as not quality affecting.

The field sampling is performed using high-volume samplers for two sizes of suspended (airborne) particulate matter: total suspended particulate matter (TSP) and the inhalable portion of suspended particulate matter, also known as PM<sub>10</sub> or PM-10. The sampling period is 24 hours; samples are taken every sixth day following the Environmental Protection Agency national schedule.

The National and Nevada primary and secondary ambient air quality standards for particulate matter are based on PM<sub>10</sub> sampling. Prior to 1987, the National standards applied to TSP; the Nevada particulate matter standards were based on TSP until 1991. TSP sampling is being continued to determine the fraction of total suspended particulate matter that is in the inhalable size range (PM<sub>10</sub>).

Monitoring results were not required to be reported to the State of Nevada until Nevada Air Quality Permit to Construct No. 2693 was granted on June 12, 1991. One permit condition requires reporting PM<sub>10</sub> results on a quarterly basis. Reports on the PM<sub>10</sub> monitoring are submitted quarterly by the Yucca Mountain Site Characterization Project Office to the State of Nevada, Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Air Quality. The first report to the State covered the data sampled during July through September 1991.

The monitoring results from 1991 showed that the area remained in compliance with State of Nevada and Federal ambient air particulate matter standards. The standards are given in Table 1-1, with a summary of the monitoring results. The highest 24-hour concentrations observed were well below the value used to determine an exceedance, therefore the number of exceedances each calendar year is zero. Further, the annual average concentrations were below the standard. These results are very similar to those from the monitoring since it began in 1989.

The methods used in the ambient air quality particulate matter monitoring program are described in Section 2. The PM<sub>10</sub> and TSP monitoring results are presented in Section 3. Regulatory quality assurance requirements and results are also presented in both sections.

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TABLE 1-1. Summary of Particulate Matter Monitoring Results for 1991.

Data shown are 24-hour sampling results and quarterly arithmetic mean values, expressed in micrograms per standard cubic meter ( $\mu\text{g}/\text{m}^3$ ). See note<sup>(1)</sup> for National Ambient Air Quality Standards (NAAQS).

<u>PM<sub>10</sub></u>	<u>Data Recovery<sup>(2)</sup></u> (%)	<u>24-hr<sup>(3)</sup></u> ( $\mu\text{g}/\text{m}^3$ )	<u>Annual Average</u> ( $\mu\text{g}/\text{m}^3$ )
NTS-60 (Main) Site			
Primary <sup>(4)</sup>	98.3%	33	10
Collocated <sup>(5)</sup>	98.3%	31	10
40-Mile Wash Site	88.3%	46	11
<u>TSP</u>			
NTS-60 (Main) Site			
Primary <sup>(4)</sup>	80.0%	63	22
Collocated <sup>(5)</sup>	83.3%	63	22
40-Mile Wash Site	86.7%	103	25

NOTES:

- (1) NAAQS: Title 40 Code of Federal Regulations (CFR) Part 50.6, maximum allowable PM<sub>10</sub> concentrations used with 40 CFR 50 Appendix K to determine expected number of occurrences of sampling results exceeding the standard. The State of Nevada adopted the National standard (NAC 445.843) in 1991. The 24-hour and annual standards are basically:
  - the expected annual number of exceedances of 24-hour level (individual samples with concentrations in excess of 150  $\mu\text{g}/\text{m}^3$ ) must be less than or equal to one, and
  - the annual arithmetic mean must be less than or equal to 50  $\mu\text{g}/\text{m}^3$ .
- (2) Data recovery is the number of valid samples, expressed as percent of possible; a minimum of 80% is required for the air quality permit.
- (3) Highest 24-hour result in the year.
- (4) Primary sampler is source of monitoring results.
- (5) Collocated sampler is operated to obtain quality assurance "precision" results.

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## 2.0 PARTICULATE MATTER AMBIENT AIR QUALITY MONITORING METHODS

This section is a brief discussion of the methods used for ambient air quality monitoring for particulate matter in the Yucca Mountain network. Detail is presented in the SIIP for Air Quality Monitoring, and the T&MSS Work Instructions WI-AQ-001, "Routine Operations and Maintenance for Ambient Particulate Sampling", and WI-AQ-002, "Calibrations and Performance Audits of Particulate Matter Samplers".

The monitoring program is designed to meet U.S. Environmental Protection Agency (EPA), and State of Nevada, regulations and guidelines applicable to  $PM_{10}$  monitoring. The TSP monitoring program follows previous similar EPA regulations, which are no longer in effect. The nominal upper particle sizes sampled are approximately 50 micrometers for TSP, and an aerodynamic diameter of 10 micrometers for  $PM_{10}$ .

Particulate matter ambient air quality was monitored at two network site locations. The NTS-60 (Main) site is located in Midway Valley immediately east of the main Yucca Mountain Ridge. The 40-Mile Wash site is about half-way from Yucca Mountain to the Amargosa Valley area, in the valley floor that contains the Forty-Mile Wash. Both sites include  $PM_{10}$  and TSP monitoring.

### 2.1 Monitoring Requirements and Procedures

To meet EPA requirements, the  $PM_{10}$  equipment used must meet Reference Method designation requirements given in 40 CFR 53, Subpart D. Both types of samplers used in the network are manufactured by Wedding & Associates; the  $PM_{10}$  samplers are designated Reference Method RFPS-1087-062.

Further EPA requirements for the monitoring methods are specified in 40 CFR 50, Appendices B (TSP), and J ( $PM_{10}$ ). T&MSS procedures covering ambient air quality for particulate matter are given in Work Instructions WI-AQ-001, "Routine Operations and Maintenance for Ambient Particulate Matter Sampling," and WI-AQ-002, "Calibrations and Performance Audits of Particulate Matter Samplers." T&MSS data processing procedures are given in WI-AQ-001.

Gravimetric analyses are performed on the filters to determine the net mass of particulate matter collected on the filter. This result is used, with sampler airflow information, to determine average concentration of suspended particulate matter.

### 2.2 Quality Assurance

EPA quality assurance requirements for Prevention of Significant Deterioration Monitoring Programs are given in 40 CFR 58, Appendix B. These were adopted by the State of Nevada for the air quality permit monitoring that began in 1991.

The quality assurance items addressed are:

- perform "precision" assessments using collocated samplers,
- achieve 80 percent "completeness," or data recovery.

The "collocated" samplers used in precision assessments are at the NTS-60 site; only one site in a network is required to have collocated samplers. Collocated samplers are identical samplers mounted near the primary samplers, and are operated on the same schedule and with the same procedures as the

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### 3.0 RESULTS

Individual sampling results, quarterly and annual summaries, and relationships between results from 1991 and from previous years are presented in this section. The highest 24-hour concentrations observed were well below the Standard used to determine an exceedance; therefore, the number of exceedances in each calendar year is zero. Further, the annual average concentrations were well below the annual Standard.

#### 3.1 Individual Sampling Results

are reported in tables 5-16 through 5-4 in ~~Table 5-16 through 5-4 in~~ table shows PM<sub>10</sub> and TSP concentrations by ~~are reported in micrograms per standard~~ are reported in micrograms per standard ~~ts of the Standards. The samplers are~~ ts of the Standards. The samplers are ~~ions, which are explained in the footnotes~~ ions, which are explained in the footnotes ~~the following summary statistics:~~ the following summary statistics:

ded in the "Reported" row of the tables.

rations are reported in the "Average" row.

t sampling results for each period are d "2nd-high" rows. The second-highest ations if the highest result is an extreme us particulate matter standards were based average; some reviewers still request these

ulate concentrations are consistently well e very good air quality conditions. The rations were 46 and 103 micrograms per cubic annual period. The pattern of PM<sub>10</sub> and TSP -60 and 40-Mile Wash sites, that is, the tions occurring at one site typically gher concentrations at the other site. ed in the PM<sub>10</sub> and TSP results.

exceeded the 80 percent level typically used ng purposes, with the following exceptions:

TSP rates at the 40-Mile Wash site fell to ely, partly due to extended electrical site during construction of a nearby well

te from the collocated sampler at the rimary, due to problems encountered

ate from the primary sampler at the NTS to motor problems.

Results of each sampling event calendar quarter-year periods. Each sampler and by date; concentrations cubic meter, in keeping with the uni identified by letter-number designat of the tables. The tables also show

- Data recovery rates are provi
- The quarterly average concent
- The highest and second-highes presented in the "Highest" an results are reported as indic outlier or not. Also, previo on the second-highest 24-hour data.

The results show ambient partic below applicable standards, which ar highest 24-hour PM<sub>10</sub> and TSP concent meter ( $\mu\text{g}/\text{m}^3$ ), respectively, for the results were similar between the NTS dates of relatively higher concentra coincided with the occurrences of hi Also, similar annual trends were not

The data recovery rates met or as a minimum for regulatory monitori

- The April through June PM<sub>10</sub> and 66.7 and 73.3 percent, respectiv power outages experienced at the facility.
- The January through March TSP r NTS-60 site fell to 66 percent, with the motor brushes.
- The October through December TSP r 60 site fell to 73.3 percent, due

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Corrective action has been taken on the motor problems that lead to the data recovery rates in 1992 reflect an improvement in this area.

### 3.2 Quality Assurance Results

Typical regulatory requirements assessment of the completeness and discussed above in the reporting of expressed as the upper and the 95 percent confidence interval following steps.

ts include reporting results of the precision of the data. Completeness was of data recovery results. Precision is lower "probability intervals", which correspond to intervals. The intervals are calculated by the

( $d_i$ ) between the primary (X) and collocated (Y) sampler calculated from:

- (1) The differences ( $d_i$ ) results are calculated

$$d_i / [(Y + X) / 2].$$

$$d_i = (Y - X)$$

standard deviation (s) of the differences ( $d_i$ ) are quarterly and annual periods. These are used in the calculate the upper (UL) and lower (LL) probability

- (2) The mean (D) and standard deviation (s) are calculated for the following to calculate interval values:

$$UL = D + 1.96 \cdot s / (\sqrt{2}), \text{ and}$$

$$UL = D + 1.96$$

$$LL = D - 1.96 \cdot s / (\sqrt{2}).$$

$$LL = D - 1.96$$

precision assessment results is reported in Table 3-5. Measures of acceptability of precision results; the user of a given data set. These results are particularly given the very low concentrations used to calculate differences. Differences between two small appear large when expressed in percent. For example, a primary result of 4  $\mu\text{g}/\text{m}^3$  and a collocated result

A summary of the precision assessment results is reported in Table 3-5. There are no guideline measures of acceptability of precision results; the user of a given data set. These results are particularly given the very low concentrations used to calculate differences. Differences between two small appear large when expressed in percent. For example, a primary result of 4  $\mu\text{g}/\text{m}^3$  and a collocated result of 3  $\mu\text{g}/\text{m}^3$  is -29%.

leading percent-difference results that can occur concentrations observed, a second precision summary was calculated for concentrations which were at least 5  $\mu\text{g}/\text{m}^3$ . These results are reported in Table 3-5. Note that these precision confidence interval improved for the  $\text{PM}_{10}$ ; TSP sampling results were improved, so the more restrictive summary did not change the results as the  $\text{PM}_{10}$  results.

Given the possibly misleading nature of the percent-difference results with the typically low concentrations, a second precision summary was calculated using only concentrations of at least 5  $\mu\text{g}/\text{m}^3$ . These results are also reported in Table 3-5. Note that these precision confidence interval improved for the  $\text{PM}_{10}$ ; TSP sampling results were improved, so the more restrictive summary did not change the results as the  $\text{PM}_{10}$  results.

#### 1989 Through 1991

### 3.3 Summary of Results from

Air monitoring results from 1991 continue to reflect concentrations well below applicable ambient air quality standards. The results have not changed significantly since the beginning of the sampling program.

The particulate matter concentration levels that are well below applicable ambient air quality standards. The results have not changed significantly since the beginning of the sampling program.

of results reported since the beginning of the program. The  $\text{PM}_{10}$  sampling at the NTS-60 site, and the TSP

Table 3-6 is a summary of the results from the sampling program through this year.

sampling at NTS-60 and 40-Mile Wash sites, were included in this analysis. These data were chosen for this analysis because they have more continuity than those from the other samplers. The table shows that most of the maximum 24-hour values are well below the  $150 \mu\text{g}/\text{m}^3$  level associated with the 24-hour standard, and the annual averages are well below the  $50 \mu\text{g}/\text{m}^3$  annual average standard.

Table 3-6 also shows that the results during April through June and July through September are typically higher than those during January through March and October through December. The averages during the higher and lower periods can be a factor of two to three different. Part of the explanation for higher averages is the occurrence of the higher individual values, as seen by the 24-hour maxima shown in the table.

It is important to keep in mind that the low concentrations typically observed in the network often approach the threshold of reliable measurement using the high-volume air sampling technique. This is particularly important when examining long-term averages, that can be a combination of mostly low values combined with a few higher results. The "t-test" statistical analysis was applied to the monthly averages of the annual periods by sampler, and to the TSP results from the two sites. These comparisons showed there to be no statistically significant differences between the data sets compared. This conclusion did not change when outlier higher concentrations were removed from the 1990 data.

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Table 3-1. First Quarter 1991

Results are shown in micrograms per standard cubic meter

SAMPLE DATE	....PM-10 RESULTS...			.....TSP RESULTS.....		
	MS-1	MS-2	FM-3	MS-5	MS-6	FM-4
01/06/91	1	0	0	4	4	3
01/12/91	1	3	4	6	(2)	11
01/18/91	2	2	1	(1)	(1)	(1)
01/24/91	5	5	4	(1)	(1)	(1)
01/30/91	6	6	3	27	27	24
02/05/91	5	5	5	14	(1)	(1)
02/11/91	11	9	6	(1)	(1)	11
02/17/91	4	4	5	10	9	14
02/23/91	7	7	5	13	10	14
03/01/91	1	1	2	4	4	4
03/07/91	2	2	3	4	4	5
03/13/91	6	6	5	14	13	14
03/19/91	4	5	5	14	14	16
03/25/91	9	9	10	21	20	23
03/31/91	7	7	(2)	13	12	12
Reported	100.0%	100.0%	93.3%	80.0%	66.7%	80.0%
Average	5	5	4	12	12	13
Highest	11	9	10	27	27	24
2nd-High	9	9	6	21	20	23

Sampler Identifications and Footnotes:

MS-1: Primary PM-10 Sampler at NTS-60 (Main) Site  
 MS-2: Collocated PM-10 Sampler at NTS-60 (Main) Site  
 FM-3: PM-10 Sampler at 40-Mile Wash Site

MS-5: Primary TSP Sampler at NTS-60 (Main) Site  
 MS-6: Collocated TSP Sampler at NTS-60 (Main) Site  
 FM-4: TSP Sampler at 40-Mile Wash Site

- (1) Sample void: motor brush damage affected filter
- (2) Sample void: torn filter

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Table 3-2. Second Quarter 1991  
Particulate Matter Air Quality Data

Results are shown in micrograms per standard cubic meter

SAMPLE DATE	....PM-10 RESULTS...			.....TSP RESULTS.....		
	MS-1	MS-2	FM-3	MS-5	MS-6	FM-4
04/06/91	22	22	16	(2)	49	41
04/12/91	6	5	4	12	11	13
04/18/91	6	5	(1)	10	9	(1)
04/24/91	18	19	18	33	33	33
04/30/91	10	10	10	20	19	19
05/06/91	9	9	9	18	16	14
05/12/91	10	10	11	22	21	20
05/18/91	8	9	(4)	21	21	21
05/24/91	11	11	11	18	18	17
05/30/91	22	21	34	63	(5)	103
	(3)					
06/05/91	20	17	22	37	37	41
06/11/91	21	21	(1)	40	41	(1)
06/17/91	12	11	(1)	28	23	(1)
06/23/91	15	15	(1)	27	24	(1)
06/29/91	11	11	11	(6)	(4)	26
Reported	100.0%	100.0%	66.7%	86.7%	86.7%	73.3%
Average	13	13	15	27	25	32
Highest	22	22	34	63	49	103
2nd-High	22	21	22	40	41	41

Sampler Identifications and Footnotes:

MS-1: Primary PM-10 Sampler at NIS-60 (Main) Site  
MS-2: Collocated PM-10 Sampler at NIS-60 (Main) Site  
FM-3: PM-10 Sampler at 40-Mile Wash Site

MS-5: Primary TSP Sampler at NIS-60 (Main) Site  
MS-6: Collocated TSP Sampler at NIS-60 (Main) Site  
FM-4: TSP Sampler at 40-Mile Wash Site

- (1) Sample void: electrical power outage
- (2) Sample void: motor problem
- (3) MS-1 void on 5/12: torn filter; collocated result reported
- (4) Sample void: operator error
- (5) Sample void: check weight out of tolerance
- (6) Sample void: timer failure

Table 3-3. Third Quarter 1991  
Particulate Matter Air Quality Data

Results are shown in micrograms per standard cubic meter

SAMPLE DATE	....PM-10 RESULTS...			.....TSP RESULTS.....		
	MS-1	MS-2	FM-3	MS-5	MS-6	FM-4
07/05/91	25	27	27	62	59	55
07/11/91	13	13	12	(2)	(2)	24
07/17/91	10	10	9	15	19	18
07/23/91	9	9	9	17	18	17
07/29/91	14 (1)	14	15	35	38	39
08/04/91	10	12	32	20	(3)	54
08/12/91	33	31	46	61	63	88
08/18/91	15	15	15	24	26	24
08/24/91	15	16	10	(3)	29	21
08/30/91	11	14	11	28	26	28
09/03/91	17	17	17	45	45	46
09/09/91	14	15	18	33	31	43
09/15/91	6	6	6	15	20	17
09/21/91	18	18	18	35	49	35
09/27/91	12	10	6	22	29	18
Reported	100.0%	100.0%	100.0%	86.7%	86.7%	100.0%
Average	15	15	17	32	35	35
Highest	33	31	46	62	63	88
2nd-High	25	27	32	61	59	55

Sampler Identifications and Footnotes:

MS-1: Primary PM-10 Sampler at NIS-60 (Main) Site  
 MS-2: Collocated PM-10 Sampler at NIS-60 (Main) Site  
 FM-3: PM-10 Sampler at 40-Mile Wash Site  
 MS-5: Primary TSP Sampler at NIS-60 (Main) Site  
 MS-6: Collocated TSP Sampler at NIS-60 (Main) Site  
 FM-4: TSP Sampler at 40-Mile Wash Site

- (1) MS-1 void on 7/11: motor problem; collocated result reported  
 (2) Sample void: motor problem  
 (3) Sample void: timer failure

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Table 3-4. Fourth Quarter 1991  
Particulate Matter Air Quality Data

Results are shown in micrograms per standard cubic meter

SAMPLE DATE	....PM-10 RESULTS...			.....TSP RESULTS.....		
	MS-1	MS-2	FM-3	MS-5	MS-6	FM-4
10/03/91	8	8	8	19	23	19
10/09/91	11	10	7	20	22	16
10/15/91	8	8	5	16	16	12
10/21/91	9	9	8	23	22	17
10/27/91	4	3	9	(1)	18	55
11/02/91	4	4	4	(1)	8	11
11/08/91	9	9	(1)	(1)	18	9
11/14/91	6	6	13	16	15	40
11/20/91	4	4	3	14	12	10
11/26/91	12	13	11	25	26	24
12/02/91	10	11	8	38	34	41
12/08/91	5	6	5	10	9	8
12/14/91	6	5	4	12	10	9
12/20/91	2	2	6	4	4	26
12/26/91	3	4	5	(1)	9	12
Reported	100.0%	100.0%	93.3%	73.3%	100.0%	100.0%
Average	7	7	7	18	16	21
Highest	12	13	13	38	34	55
2nd-High	11	11	11	25	26	41

Sampler Identifications and Footnotes:

MS-1: Primary PM-10 Sampler at NTS-60 (Main) Site  
 MS-2: Collocated PM-10 Sampler at NTS-60 (Main) Site  
 FM-3: PM-10 Sampler at 40-Mile Wash Site  
 MS-5: Primary TSP Sampler at NTS-60 (Main) Site  
 MS-6: Collocated TSP Sampler at NTS-60 (Main) Site  
 FM-4: TSP Sampler at 40-Mile Wash Site

(1) Sample void: motor problem

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Table 3-5. Summary of 1991 Precision Assessment Results

Reporting Period	<u>PM<sub>10</sub></u>		<u>TSP</u>	
	UL	LL	UL	LL
Jan - Mar	+89.5%	-76.5%	+17.1%	- 5.7%
Apr - Jun	+16.5%	- 9.0%	+15.1%	- 3.5%
Jul - Sep	+11.2%	-16.7%	+10.3%	-30.2%
Oct-Dec	+18.2%	-19.2%	+18.4%	-12.3%

Calculations made using only concentrations at or above 5  $\mu\text{g}/\text{m}^3$  :

Jan - Mar	+12.3%	- 7.3%	+20.4%	- 4.2%
Apr - Jun	+16.5%	- 9.0%	+15.1%	- 3.5%
Jul - Sep	+11.2%	-16.7%	+10.3%	-30.2%
Oct - Dec	+13.1%	-14.7%	+19.4%	-12.7%

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TABLE 3-6. Selected Results of Particulate Matter Sampling from 1989 Through 1991



		1989		1990		1991	
		Samplers were not operating until 4/22/89					
		Jan - Mar		Jan - Mar		Jan - Mar	
		Apr - Jun	18 12.5	Apr - Jun	30 12.5	Apr - Jun	22 13.4
		Jul - Sep	42 18.1	Jul - Sep	41 15.9	Jul - Sep	33 14.8
		Oct - Dec	17 6.1	Oct - Dec	62 12.0	Oct - Dec	12 6.7
		Annual	42 12.2	Annual	106 22.3	Annual	33 9.9

Significant difference between samplers.

For sampling results, and averages shown, shown in micrograms per cubic meter.

of particulate matter.

Particulate matter.

High-volume air samplers.

Notes: There is not a statistically significant difference between the three annual averages by quarter.

The table shows maximum 24-hour averages by quarterly and annual period.

PM-10 is the inhalable portion of particulate matter.

TSP is total suspended particulate matter.

Sampling is performed using high-volume air samplers.