Ute Mountain Ute Tribe Environmental Monitoring Report

Air Quality Monitoring White Mesa, Utah

Dakota Hargett

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I. PROJECT DESCRIPTION

The Environmental Programs Department is initiating regular PM10 - Filter based local conditions monitoring as part of an area source environmental protection effort in addition to collecting EPA recommended meteorological data. Tribal goals for environmental protection are to protect human health and natural resources. . This project was developed in response to growing concerns about air quality from the transport and dispersal of radioactive dust, volatile organic compounds (VOC's) and other hazardous air pollutants (HAP's) from the nearby Uranium and Vanadium Mill, White Mesa Mill (The Mill).

The measurement goal of this ambient air quality monitoring program is to estimate the activity, in units of picocuries per filter, of radioactive laden particulate matter with mean aerodynamic effective diameter less than 10 microns in the ambient air characteristic of the air breathed on tribal land. The primary goal is to establish baseline measurements through selective analysis of the filter, including heavy metal laden particulates, more specifically Uranium and those metals associated with the Uranium decay series including Thorium, Radium, Cesium and Lead. Measurements will be performed by using a filter that has been carefully handled according to the Ute Mountain Ute Tribe's QA/QC protocol, set to collect particulate matter for one week, to then be sent to a commercial speciation laboratory for selective analysis. Data collected will be closely correlated with meteorological measurements to accurately qualify conditions in atmospheric variability to particulate matter collected. The results will also be closely checked for comparison to the semi-annual effluent monitoring report of White Mesa Mill. QC checks will be made before and after each measurement. The measurements are made to estimate human exposure and will be made in accordance with EPA and the equipment manufacturer's recommendations. The performance requirements of the analyzer have been specified in Appendix B of 40 CFR Part 50. Measurements will be obtained for time periods at one-in-seven day intervals, after initial dry runs with the equipment and system. Guidance from the Department of Energy's (DOE) Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance document is also noted and referenced for quality control procedures. Other prospective future studies for our environmental protection effort will include atmospheric transport and diffusion computations and dose assessments for radionuclides that have the potential to harm human populations, in addition to detection of VOC's and

HAP's.

II. BACKGROUND

Stating the problem:

There has been concern recently that air quality conditions have deteriorated on tribal land from White Mesa Mill just three miles North of White Mesa Ute community. This office has received complaints about acidic and rusted metal smells, particularly in the morning and evening, increased cancer rates among young adults and children, and instances in which people will not graze their animals on the land or drink the water for fear of radioactive contamination. We have sufficient evidence to monitor air quality due to the Environmental Programs Departments past studies on surrounding radionuclide analysis on water, sediment and vegetative sampling that have suggested the offsite migration of uranium laden particulate matter. The Ute Mountain Ute Tribe (UMUT) had requested the U.S. Environmental Protection Agency (EPA) and the U.S. Geological Survey (USGS) to perform an independent evaluation of the potential offsite migration of radionuclides and trace elements associated with the ore storage and milling process to tribal members from various exposure pathways. Potential air- and water-exposure pathways of uranium and other trace elements to tribal members include (1) airborne dust from uncovered ore storage pads, (2) airborne emissions from the mill's drying ovens, (3) dissolution of airborne dust deposited on soil and plant surfaces, (4) transport of material from the ore storage pads that are eroded into ephemeral channels draining the mill site during rain and snowmelt events, and (5) leakage from the tailings ponds to shallow aquifers beneath the mill, resulting in offsite migration toward the reservation (David L. Naftz, 2010) . We do not have information on air quality, and if conditions continue to change we will not be able to track whether changes in health and radioactive distribution are correlated to the Mill.

White Mesa Mill

White Mesa Mill has been in operation since 1980 for the conventional processing of Uranium ore for the production of yellow cake (U_3O_8) in addition to a byproduct Vanadium (V_2O_5) recovery circuit. The mill uses a sulfuric acid (H_2SO_4) leaching and a solvent extraction recovery process to extract and recover the U_3O_8 and V_2O_5. The mill is licensed to process an average of 2,000 tons per day of ore and produce 8.0 million pounds of U_3O_8 per year, in addition to receiving and processing alternative feeds, of which the mill has made 15 license amendments since 2006 for the receipt of 18 different alternative feed materials. Of these amendments, nine involve the processing of feeds provided by nuclear fuel cycle facilities and private industry and one has involved the processing of material from the United States Department of Energy ("**DOE**"). These ten feed materials have been relatively high in uranium content and relatively low

in volume. The remaining five amendments have been made to allow the mill to process uranium-bearing soils from former defense sites, known as FUSRAP sites, which are being remediated by the U.S. Army Corps of Engineers. These materials are typically relatively low in uranium content but relatively high in volume (Denison Mines Annual Information Form 2010).

The Mill is considered an area pollution source which includes evaporative tailings ponds, ore storage pads and high temperature smokestacks from the drying of U_3O_8. The ore delivered to the Mill from the Colorado Plateau, the Henry Mountains Complex and Arizona 1 mines have a typical U_3O_8 grade of 0.25-0.60%, naturally occurring, following processing is concentrated to around 90% U_3O_8. The ore remaining after processing, or sludge, retains around 85% of its initial radioactivity arising from thorium-230 and radium-226 as Uranium progeny. Destined for the solid tailings cells, the sludge contributes the largest source of radon-222 emissions on the Mill site not to exceed 20 pCi/m^3 for any given m^3 quadrant. With a total of 2,000 tons of ore delivered on site per day, ore piles rapidly accumulate, contributing the largest source to offsite migration of radionuclide laden particulate matter. Radionuclides of greatest concern for many DOE facilities for example, are Uranium 234 and 238 in particulate form, or dust (Guidance on Implementing the Radionuclide NESHAP, 1991). The Mill's State of Utah air quality permit sets a visual opacity standard for the ore piles not to exceed 20%, and is required to cease operations if winds exceed 25 mph, in addition to watering down the ore piles and roads as to limit all dust generating activities. The Mill is required by the Utah Department of Environmental Quality (UDEQ) to monitor the ambient air for subsequent analysis of the filters at five different locations within the Mill's property boundaries. Filters are collected on a weekly basis, averaged for a month, and released as semi-annual effluent reports on a quarterly basis. This indicates that the filters are collected and stored for three months before they are sent for analysis. The reports have sporadically been submitted to the Ute Mountain Ute Tribe for review, based on our inquiries with the most recent report being January-June 2006, where no alarming levels of radionuclides were presented. It can be noticed in 2006 though; production was from alternative feed, and not conventional ore, where conventional ore contributes the largest to offsite migration of particulate matter.

There also exists a regulatory gap between the definition of background radiation, and milling radiation impact levels as reviewed in the document, "Guidance on Implementing the Radionuclide NESHAP's" by the United States Environmental Protection Agency, office of Radiation Programs the following definition is defined as follows:

> *Background levels are defined as general ambient radionuclide concentrations that are not related to an emission source. In some cases, sources other than the facility of interest may contribute to the radionuclide concentrations at the critical receptor location. Uranium mining and milling regions, where numerous sources of emissions exist in the same area, are an example of*

multiple sources contributing to the measured environmental concentration at a receptor location. However, this situation can exist wherever several different facilities releasing similar contaminants are in the same area. In these cases, it is extremely difficult, if not impossible, to distinguish the contributions of the various sources to the radionuclide concentrations at the receptor locations. Similarly, when the radionuclide being monitored also occurs in nature (e.g., potassium-40 at Battelle Memorial Institute in Ohio), the contribution to airborne concentrations from natural sources during high-wind conditions could not be distinguished from the amount of the radionuclide released from the facility. Therefore, because of these uncertainties, no correction (subtraction) of concentrations resulting from other sources to the concentration measured at the receptor location should be allowed (i.e., the total measured radionuclide concentration shall be used to determine compliance). Monitoring programs that include subtraction of concentrations from other emission sources should not be approved; rather, the total airborne radionuclide concentration measured should be compared to the concentration levels for environmental compliance in Table 2, Appendix E of 40CFR 61, to determine compliance (Guidance on Implementing the Radionuclide NESHAP, 1991)

Conversely, the Mill used to operate a background monitoring station that has since been taken out of the monitoring plan due to its relative 'consistent' analytical results. Thus the Mill uses a constant value for background radiation and compares it to the Mill's collected radionuclide measurements, which could be stated by the Mill to have negligible effects on the environment due to high background radiation levels.

The Mill's current analysis includes total Uranium 238, Thorium 230, Lead 210, Radium 226, total alpha and gamma emitted radiation and Radon-222, of which the Ute Mountain Ute Tribe's Air Quality Program will emulate to a certain degree. Also required by the Mill's Radioactive Materials License are vegetative, soil and stack sampling as well as meteorological measurements. The quality control and quality assurance documents of the Mill are inaccessible, and thus questionable in terms of data validity. There has been a dramatic increase in production at the facility since the UMUT-Environmental Programs Department's most current review of the Mill's semi-annual effluent reports of 2006 as shown in **Table 1**, in addition to the sporadic influx of the processing and disposing of alternative feed material. Research by the UMU-EPD evaluates White Mesa Mill's environmental and regulatory compliance parameters which include regulatory effluent concentrations limits, lower limits of detection, detection limits and concentration levels for environmental protection quantitatively summarized in **Table 2**, as set by the Nuclear Regulatory Commission's (NRC) Radionuclide Table 2, 40 CFR Part 61 Appendix E, the Code of Federal Regulations (CFR) National Emission Standards for Hazardous Air Pollutants (NESHAPS) 10 CFR Part 20 Appendix B, and the Utah Administrative Code (UAC) Standards for the Protection Against Radiation R313-15 respectively.

Table1: White Mesa Mill U_3O_8 Production since 2006

Year	2010	2009	2008	2007	2006
Alternative Feed Milled (tons)	310	177	-	44,136	214
Conventional Ore Milled (tons)	194,440	144,434	248,744	-	-
U_3O_8 Produced (tons) from alternative feed	149.5	95.5	47	127	121
U_3O_8 Produced (tons) from conventional ore	377	211.5	395.5	-	-

Denison Mines Annual Information Form

As seen in **Table 1**, the production has taken a dramatic increase since 2006, especially in consideration to alternative feeds. The amendments made to the Mill's Radioactive Materials License was an economical decision based upon U_30_8 produced to volume received from 2009 to 2010, with the exception to the high volume received and low U_30_8 produced from alternative feed in 2007. A note to be taken here is that alternative feeds contain other heavy metals and elements that are not included in the ambient air monitoring protocol set by the UDEQ. Examination of these elements, in addition to VOC's and other HAP's should be included in future UMU air quality framework of investigations. Quantifying these pollutants would require a different method of collection because of their varied dispersal mechanisms from the Mill. A special study's project could be conducted with loan equipment from the Tribal Air Monitoring Support (TAMS) Center or continued sampling methods could be researched and allocated through future grant acquisitions to further and enhance the UMU air quality program.

III. MEASURING DATA

The White Mesa Mill currently has five high volume monitoring stations for particulate matter collection of 10 microns or less in diameter, which are operated continuously for seven days. The volume of air collected is large, equating between 8-12 million liters per collection cycle, averaging 40 standard cubic feet per minute (SCFM). Deducing details about radionuclide monitoring efforts by scientists from Lawrence Livermore National Laboratory (LLNL) and from experts at the National Air and Radiation Environmental Laboratory (NAREL), a collection cycle of this length is subject to filter overload and error associated with radionuclide lifetimes and the sporadic decay of total ionizing radiation. The Mill sends twelve filters at once, composited on a quarterly basis to *Energy Laboratories* of Casper Wyoming for analysis. The laboratory then analyzes the filters to produce a concentration equating in units of pCi/ml or µCi/ml. Since there may be error with filter loading and the time elapsed between filter collection and

analysis, the UMUT-AQP is constructing an additional monitoring plan.

Recommendations made through Inter-tribal networking and correspondence with EPA region 8 followed the acquisition of four Tisch-Environmental High Volume PM 10 instruments from the Southern Ute Indian Tribe's Air Quality Division (SUIT-AQD). The instruments are typically used for NAAQS measurements, for the loaded filter weight measurement in a 24 hour period, as to not exceed 150µg/m^3 no more than three times in any given year. These instruments also have a typical volumetric flow rate of 40 cubic feet per minute (cfm), although unlike the Mill's instruments, running these machines continuously to a level of 8-12 million liters per cycle would conclude in the purchasing of a new motor and parts every three weeks. As the distance from the Mill to the current monitoring station and existing power source is 3.5 miles, and as radiation decreases as an inverse squared to distance relationship, the instruments obtained were deduced as insufficient for trace radionuclide detection in order to emulate as best as possible the air monitoring efforts of the Mill with contoured specificities to the UMUT.

The UMU-EPD's CAA103 grant for the fiscal year 2012 (FY12) was rearranged for the acquisition of an American Ecotech MegaVol instrument for trace radionuclide detection. The monitor has a 120-150m^3/hour volume collection rate, which equates to a 24 hour measurement of 3,600m^3, compared to the Mill's total seven day volume collection of 10,376m^3. The increase in air volume collected versus time running is 40% with the MegaVol as compared to the HiVol which allows the UMU-AQP to avoid spending additional funds on motors, calibration equipment and other equipment accessories for the previously planned Tisch Environmental HiVol's. The specified MegaVol instrument mentioned here where measurements made are not being compared to NAAQS, thus absent of a Federal Reference Method (FRM). In addition to particulate matter collection and subsequent analysis, the UMU-AQP will also be utilizing a Geiger counter in addition to thermo luminescent dosimeters (TLD's) for alpha, beta and gamma radiation detection and dose for prior screening of the filters and area before filter shipment.

Table 2: Radionuclide Concentration Levels

Radionuclide	Concentration for environmental compliance				Regulatory ECL's	Mill's ALARA	Detection Limits
	Ci/m3	µCi/m3	µCi/L	µCi/mL	µCi/ml	µCi/ml	µCi/ml
Ra-226	3.30E-15	3.3E-09	3.3E-12	3.3E-15	9.00E-13	2.25E-13	1.00E-16
Th-230	3.40E-15	3.4E-09	3.4E-12	3.4E-15	3.00E-14	7.50E-15	1.00E-16
U-238	8.30E-15	8.3E-09	8.3E-12	8.3E-15	6.00E-14	1.50E-14	1.00E-16
Pb-210	2.80E-15	2.8E-09	2.8E-12	2.8E-15	6.00E-13	1.50E-13	1.00E-16

*Concentrations for environmental compliance as set by CFR
*Regulatory Effluent Concentration Limits (ECL's) as set by NRC based on one year values for a calculated total effective dose equivalent (TEDE) not to exceed those levels.
*Mill's self-imposed ALARA as 25% of ECL's
*Detection limits specified by laboratory for analysis

With consideration to the UMU air quality program, the above parameters shown in **Table 2** should be fully understood in order to make a scientific and legal investigation to the effect White Mesa Mill may have to the Ute Mountain Ute White Mesa community. As measurements are made and analytical results are formulated, the above numerical values should be transposed to dose equivalencies to qualify levels to human populations for the determination of potential health effects. This is a difficult thing to do, as potential dose equivalencies vary by magnitudes from person to person, as they do all biological systems, and quantifying and analyzing units of radiation dose as mentioned before can have high degrees of error.

Table 3: Radiation doses

	Whole Body	Eye	Skin	
General Public	0.002rem/hour or 0.05rem/year			
Radiation Workers				

From the Nuclear Regulatory Commission 10 CFR Part 20 Derived Air concentrations table, the worker values can be taken and divided by ten for non-worker values, then multiplied by four, accounting for 168 hour weeks as opposed to 40 hour work weeks. Also, the NESHAP values for each radionuclide of question can be summed by fractions to calculate air concentrations for each. For a measurement standard of total alpha, the most limiting radionuclide value is used.

IV. Weather Patterns

White Mesa, Utah 37.28'6" N, 109.28'3" W

	Total Rain (mm)	Maximum Wind Speed (mph), Date, time	Sample Wind Speed (mph) Max	Wind Direction (Degrees)
5/5-5/20	13.208	42.6, 5/9/11, 9:01	29.7	248.1
5/20-6/2	0.762	54.01, 5/23/11, 15:01	34.33	213.26
6/2-6/23	0.0	43.27, 6/6/11, 16:08	28.88	219.39
6/23-7/21	13.462	45.46, 6/30/11, 11:33	32.28	228.97
7/21-8/18	7.366	41.52, 7/25/11, 20:03	23.5	105
8/18-9/15	13.208	38.84, 9/14/11, 19:00	29.98	292.93
YTD	48.01	N/A	N/A	N/A

Meteorological data for the White Mesa Ute community has been collected since May 5th, 2011 where patterns in wind class, distribution and direction are measured, in addition to precipitation, relative humidity, temperature and barometric pressure. It has been observed that the primary wind direction comes from the south, southwest and only sporadically comes from the direction of the mill (northwest). The wind direction is based upon a 360 degree rotation, of which the Mill is estimated to be between the

325 and 345 degree band. Under closer inspection of this band, it has been observed that winds do not usually exceed 15 mph and occur primarily in the late evening to early morning. For the time interval of data collected as seen in **Table 4**, maximum wind speeds are shown with their respective wind directions where 0 degrees is true north, 90 corresponds to east, 180 to the south, and 270 to the west. The wind class and predominant direction is also displayed in Wind Rose generated graphs from *Lakes Environmental* air monitoring software.

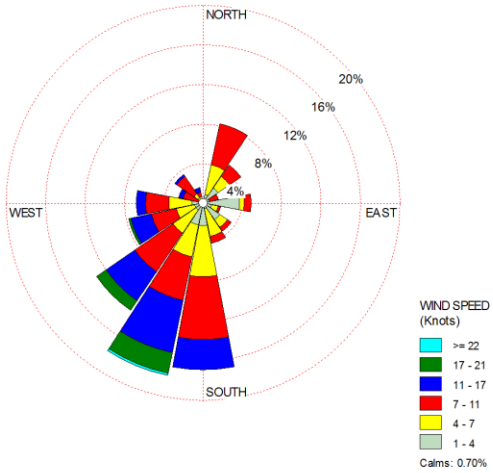

Figure 1: Wind Speed and predominant wind direction 5/5/11-5/20/11

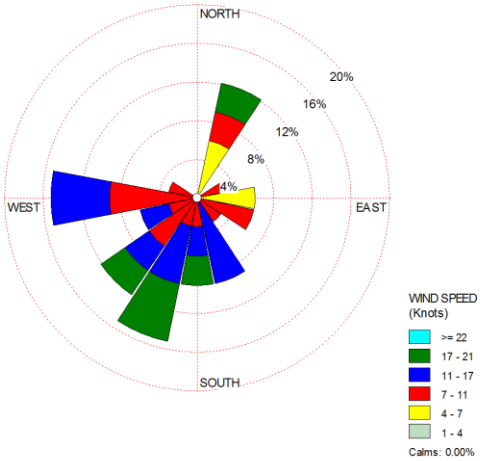

Figure 2: Wind Speed and predominant wind direction 5/20/11-6/2/11

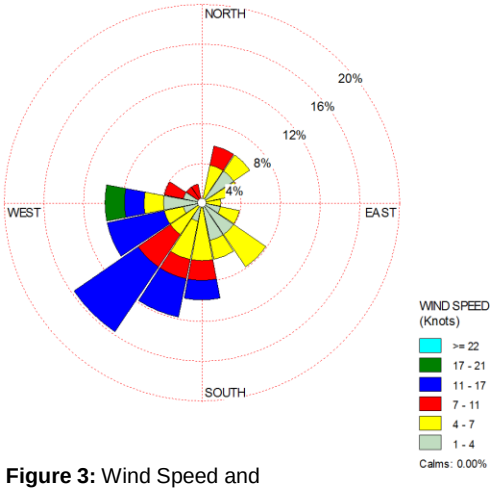

Figure 3: Wind Speed and predominant wind direction 6/2/11-6/23/11

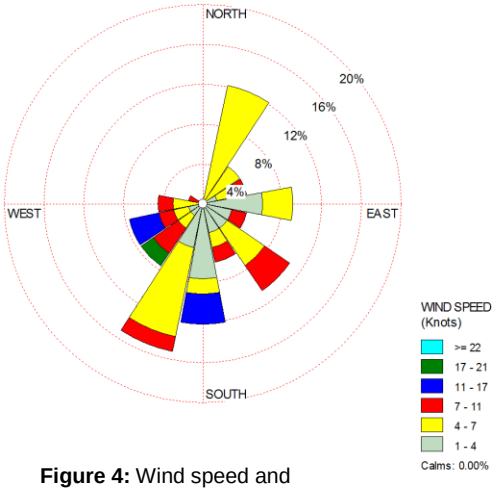

Figure 4: Wind speed and predominant wind direction 6/23/11-7/21/11

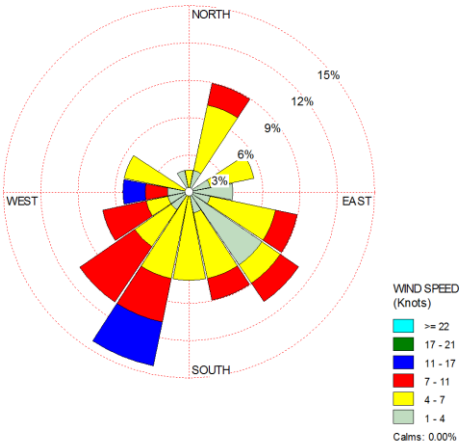

Figure 5: Wind speed and predominant wind direction 7/21/11-8/18/11

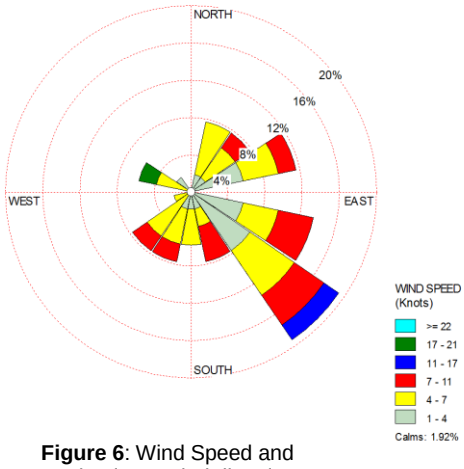

Figure 6: Wind Speed and predominant wind direction 8/18/11-9/15/11

The figures above show winds blowing from and are depicted by color as their respective wind speed class. The wind direction and speed differs from the Mill's meteorological data which reports that the predominant wind direction comes from the north/northeast. This supports the notion that there are random and uneven weather pattern distributions within the region due to the high desert landscape and dramatic and alternating geologic features. This could indicate reasons to move the monitor location in the future to a site that is closer to the Mill but still on Ute land. Collecting data that would detect different weather patterns in addition to different levels of radionuclide concentrations would improve our investigative approach in compiling the possible effects White Mesa Mill has to the air quality of White Mesa Ute community.

The data and information gathered thus far for this environmental monitoring report is to support the Ute Mountain Ute Tribe's Air Quality Program in assessing air pollutants that may be harmful to Ute Mountain Ute Tribal members. This report is meant to analyze and interpret data gathered as the program progresses, and is a living document not yet conclusive at this time. As data is gathered, conclusions will be made as to increase monitoring frequency, move monitoring site locations, or by taking a different approach to the monitoring method used to best obtain useful information on air pollution and the effects White Mesa Mill may have to the White Mesa Ute Community.