Pitfalls of Transparency: Lessons Learned from the Milford Flats Fire - 8185

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ABSTRACT

The Community Environmental Monitoring Program (CEMP) consists of a network of 29 radiation and weather monitoring stations located over a 160,000-km^2 area of southern Nevada, southwestern Utah, and southeastern California. The program provides stakeholders with a hands-on role in the monitoring for airborne radioactivity that could result from ongoing or past activities on the Nevada Test Site (NTS).

The CEMP's mission includes provisions for the transparency of the monitoring data as well as public accessibility to these data. This is accomplished through direct stakeholder participation, public outreach, and near real-time uploads of monitoring data to a publicly accessible web site located at http://cemp.dri.edu/.

In early July 2007, a lightning strike ignited a wildfire just outside the city of Milford in southeastern Utah. This fire, named the Milford Flats Fire, grew rapidly and eventually became the largest wildfire in recorded history in the state, burning approximately 567 square miles. At about the same time, the pressurized ion chamber (PIC) located at the CEMP station in Milford began reporting average exposure rates that ranged from four to seven times normal for the area. Initially, it was believed that elevated readings could be a result of gamma-emitting radon progeny released by the fire and transported in smoke plumes. The U.S. Department of Energy issued a press release offering this as a possible first explanation, and the release received a great amount of attention, particularly in the state of Utah, where concerns were expressed that the fire could be causing re-suspension of radionuclides associated with fallout from past nuclear testing at the NTS. Subsequent analyses of particulate air filter samples obtained from the Milford station, as well as an examination of the data reported by the PIC, the timing of the incident, and diagnostic testing on the PIC, showed that the abnormal gamma readings were a result of instrument malfunction.

This paper will review the data from the PIC and the analytical results of air filter samples collected at Milford, and present lessons learned from the Milford Flats Fire Incident on providing real-time access to monitoring data for the public.

INTRODUCTION

The Community Environmental Monitoring Program (CEMP) consists of a network of 29 radiation and weather monitoring stations located over a 160,000-km^2 area of southern Nevada, southwestern Utah, and southeastern California (Fig. 1). The program provides stakeholders with a hands-on role in the monitoring for airborne radioactivity that could result from ongoing or past activities on the Nevada Test Site (NTS).

Figure 1. This map shows the locations of the twenty-nine monitoring stations associated with the CEMP program.

The CEMP's mission includes providing for transparency of the monitoring data as well as public accessibility to it. This is accomplished through direct stakeholder participation, public outreach, and near real-time uploads of monitoring data to a publicly accessible web site located at http://cemp.dri.edu/. The CEMP is administered by the Desert Research Institute (DRI) of the Nevada System of Higher Education and funded by the Department of Energy's (DOE) National Nuclear Security Administration through its Nevada Site Office (NNSA/NSO).

A history of the CEMP and a detailed description of the evolution of its capabilities and support functions have been presented elsewhere [1, 2, 3].

PRELIMINARY IDENTIFICATION OF THE PROBLEM

On Thursday July 6, 2007, a lightning strike ignited a wildfire just outside the city of Milford in southeastern Utah. This fire, named the Milford Flats Fire, grew rapidly and eventually became the largest wildfire in recorded history in the state, burning approximately 567 square miles. A DRI faculty member who was camping in the general area over the following weekend took note of the rapidly growing smoke plume and photodocumented the event (Fig. 2). Coincidentally, this same faculty member was involved in the implementation of preliminary studies to measure for the potential re-suspension of radionuclides as a result of future wildfires that could affect contaminated soils areas on the Nevada Test Site. Aware that a release of radon progeny could also occur during wildfires (e.g., this phenomenon was also observed in measurements taken during the June 2000 Cerro Grande Fire at Los Alamos, New Mexico) [4], the faculty member logged on to the CEMP web site upon returning to his office on July 9th, curious to see whether or not this effect was observable in readings collected from the CEMP station located at Milford, Utah. To the surprise of him and others, the pressurized ion chamber (PIC) located at the CEMP station in Milford was, in fact, reporting periodic average gamma exposure rates that ranged from four to seven times normal background for the area (Fig. 3).

Figure 2. The Milford Flat Fire photographed on the afternoon of July 7, 2007 near the town of Beaver, Utah along Interstate 15. Later that same day, the fire would cause the highway to be closed to traffic.

Initially believing that the elevated readings could be a result of gamma-emitting radon progeny released by the fire and transported in smoke plumes, DRI notified DOE of the readings and preliminary thoughts on their cause. The DOE issued a press release on July 12th offering this as a possible first explanation, along with a statement that the elevated readings, which were of short duration, were not expected to have any impact on public health or the environment.

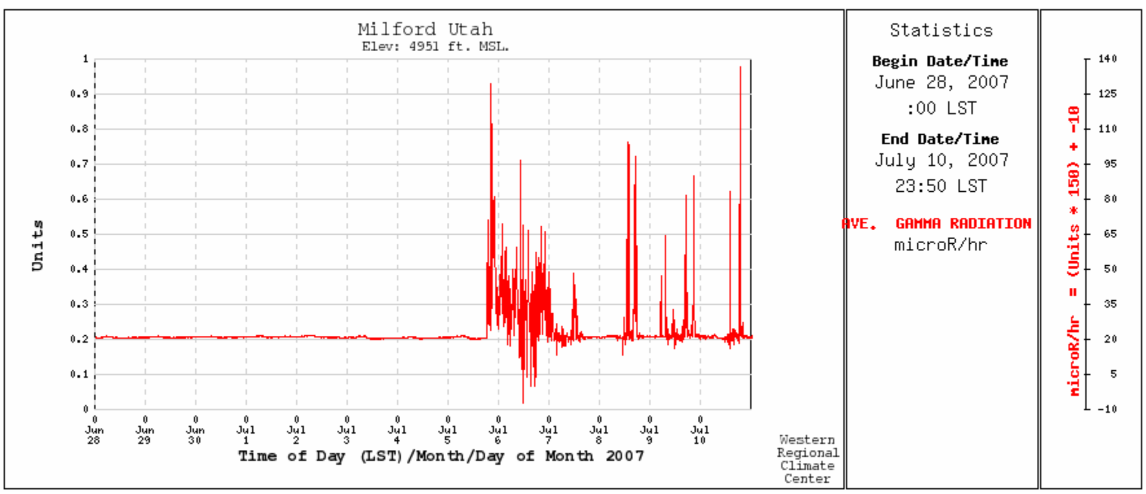

Figure 3. A graphical display from the CEMP web site showing ten-minute average values of gamma radiation levels at the Milford CEMP station between June 28th and July 11th. Normal gamma background activity for the site is approximately 20 micro-R/hr. Note the formulas at the right side of the figure to convert the data to micro-R/hr. Average elevated gamma values reported by the PIC ranged up to about 140 micro-R/hr, albeit for very brief periods.

MEDIA COVERAGE

The DOE press release received a fair amount of media attention, primarily from media in the state of Utah, where the Milford Flats Fire had already burned over 500 square miles in the first few days and involved upwards of 400 firefighters. Initial reports in print, internet, and television media ran the gamut from fairly simple reporting of the press release to expressions of disbelief that the readings could be caused by radon progeny to concerns that the fire could be causing re-suspension of radionuclides associated with fallout from past nuclear testing at the NTS. Concerns were expressed about the potential health effects for firefighters working on the scene, regardless of the cause of the readings. Commitments were made to journalists who contacted the NNSA/NSO to provide additional updates as more information was known and confirmed. Reacting to the initial media reporting of the radiation readings, a few vocal environmental organizations in Utah publically expressed their concerns and began to question the data and what was being reported through the CEMP station and the NNSA/NSO. From a historical perspective, many residents in southern Utah have a lack of trust and confidence in information reported by the federal government due to their experiences related to historic atmospheric nuclear testing and subsequent radioactive fallout. As such, in spite of subsequent abundant evidence discussed in this paper and provided to the public that the anomalous gamma readings were caused by equipment malfunction, the data being reported by NNSA/NSO and through the CEMP internet site was often overshadowed by the conjecture and speculative remarks by others. The Utah Department of Environmental Quality, Division of Radiation Control, was contacted for comment and indicated that while the results being reported were not significant to cause public health concerns, they did warrant further investigation to conclusively explain the elevated readings.

DIAGNOSING THE PROBLEM

Analyses of Air Particulate Filters

Immediately after the anomalous gamma readings were identified, DRI began to pursue several avenues of analysis in an attempt to identify the cause of the readings. Foremost among these was an analysis of air particulate filters from the Milford station. While the only “real-time” data on radioactivity that the CEMP stations are equipped to provide is the gamma exposure rate as measured by the PIC, 27 of the 29 stations, including Milford, are equipped with continuously running low-volume air particulate samplers. Filters are normally collected once weekly from the samplers by local citizens who are trained and who are part of the official chain of custody for the collected samples. The samples are then mailed to DRI where they are collated and delivered to Test America (Formerly Severn-Trent) Laboratories, Inc. in St. Louis, MO, where they are analyzed individually for gross alpha and beta activity, with a spectroscopic analysis of gamma activity performed on a quarterly composite sample.

In the case of Milford, the air samples containing particulate matter associated with the onset of the fire and the anomalous gamma readings (week of July 2-9) had been collected by local station managers and were already in transit via regular mail to DRI when the anomalous PIC readings were noted. As a quality control measure, in addition to the fixed air samplers located at the CEMP stations, DRI has three “mobile” duplicate samplers that are rotated throughout the CEMP network on a quarterly basis. Fortuitously, one of the duplicate samplers was in place at the Milford station at the time of the anomalous gamma readings, allowing duplicate samples to be analyzed for the period in question.

In order to expedite analysis of the samples and to address public concern about the potential for the elevated readings to have been caused by re-suspension of fallout from past nuclear testing at the NTS, the University of Nevada, Las Vegas Radiation Services Laboratory (UNLV-RSL) agreed to conduct a spectroscopic analysis of gamma activity on filters collected from the Milford station immediately upon receipt at DRI's Las Vegas campus. In addition, UNLV-RSL conducted identical analyses on a filter collected from Milford for the week prior to the start of the fire (week ending July 2) as well as filters collected for these same two weeks from the CEMP station located at Delta, Utah, located approximately 75 miles north and generally downwind of Milford. Eyewitness accounts suggest that Delta received at least as much, if not more, smoke in town as a result of the Milford Flats Fire as Milford. However, PIC readings at Delta were normal throughout the period in question.

Upon completion, a report on the methods and full results of the analyses conducted by UNLV-RSL on filters from Milford and Delta, UT was published on the CEMP web site and made available for download at http://www.cemp.dri.edu/CEMPREPORT_UTAHFIRES_Final.pdf [4]. In conducting the spectroscopic analyses, a special interest was placed on the detection of Cesium-137 (Cs-137) in the samples, as this is the major long-lived gamma-emitter associated with fallout from past nuclear testing at the NTS, and is readily detectable from its ~662 keV emission-line. Neither Cs-137 nor any other manmade radionuclides were detected in any of the filters analyzed (Fig. 4). Several naturally-occurring radionuclides were identified in the samples, with Beryllium-7 (Be-7) and Potassium-40 (K-40) representing the most prominent gamma-emitting components at 8 to 10 mBq/m^3 and 3 to 4 mBq/m^3 respectively (Fig. 4). Be-7 is a cosmogenically-produced radioisotope formed in the upper atmosphere, and K-40 is ubiquitous in atmospheric dust particles, virtually all types of geologic materials, and even in radiation shielding materials and cement flooring. Other naturally-occurring radioisotopes in the uranium and thorium decay series were detected, but only in variable and relatively small amounts. In summary, not only did the spectroscopic analysis rule out NTS legacy fallout as the source of the anomalous gamma reading recorded by the PIC, they also appeared to rule out the occurrence of naturally-occurring radioisotopes in sufficient quantities to have caused the apparent increase in activity levels displayed by the PIC. Pre-fire samples were comparable to those collected during the fire at Milford and at Delta, both in terms of radioisotopes present and activity levels. Media members tracking the issue were notified of the report's availability resulting in several stories.

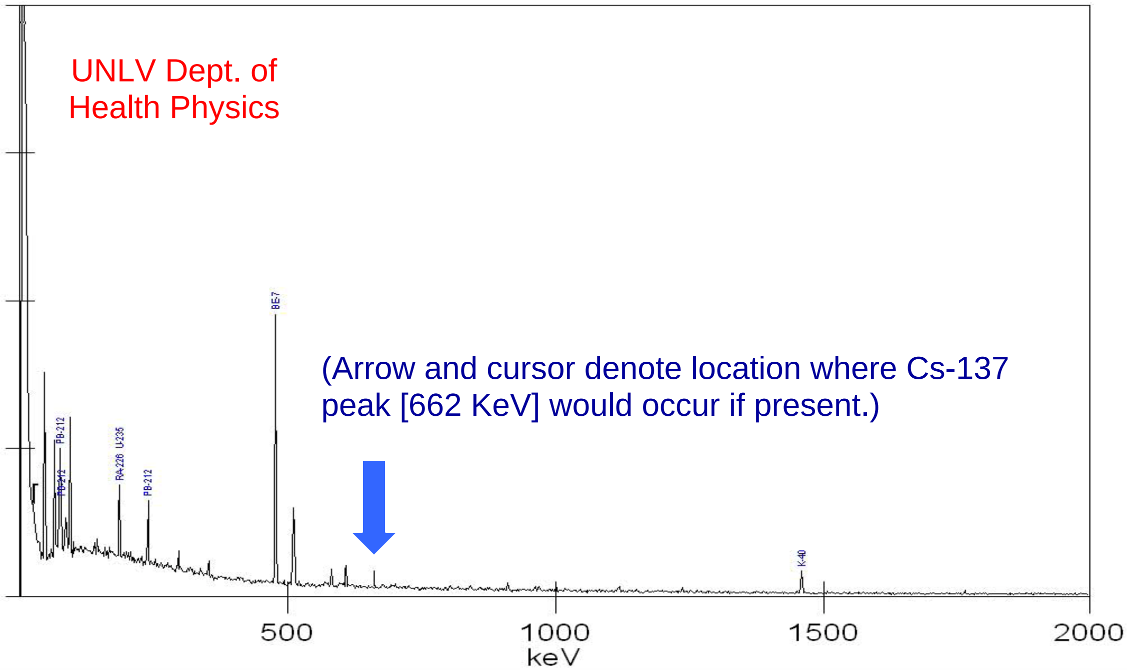

Figure 4. Gamma spectrographic analysis conducted on the Milford air filter for the week ending July 9, 2007.

In an effort to address concerns related to potential increased alpha and beta activity as a result of the fire, DRI had Test America Laboratories conduct expedited gross alpha and beta activity analyses on the filter samples collected from Milford for the week ending July 9th (Table I). The full report is available for download from the CEMP web site at http://cemp.dri.edu/cemp/Test_America_Gross_Alpha_Beta.pdf. All alpha and beta activities for these filters fell well within the normal range of measurements from calendar year 2006 and the 1st quarter of 2007 for the Milford CEMP station and, in fact, actually fell below the mean values for those periods. Interestingly, this is in spite of the fact that the particulate loading on samples collected for the week of the fire mass almost twice as much as pre-fire samples as a result of deposition of particulates associated with the smoke from the fire.

Table I. Gross alpha and beta activity for filters collected from the Milford CEMP station for the period July 2-9, 2007, with comparison to calendar year 2006 and 2007 (1st quarter) activity.

Gross Alpha (pCi/m^3)				
	Maximum	Mean	Minimum	Notes
CY2006	0.0029	0.0012	0.0003	2006 Results for Comparison
CY2007 (1st qtr)	0.0030	0.0015	0.0003	1st Qtr 2007 Results
CEMP-09593		0.0010		Main Milford Station Sample
CEMP-09593		0.0009		Duplicate Milford Sample
CEMP-09594		0.0014		Duplicate Laboratory Sample
Gross Beta (pCi/m^3)				
	Maximum	Mean	Minimum	Notes
CY2006	0.050	0.024	0.010	2006 Results for Comparison
CY2007 (1st qtr)	0.056	0.030	0.014	1st Qtr 2007 Results
CEMP-09593		0.021		Main Milford Station Sample
CEMP-09593		0.022		Duplicate Milford Sample
CEMP-09594		0.025		Duplicate Laboratory Sample

Analysis of Pressurized Ion Chamber Data

Concurrent with the commencement of air filter sample analyses, an in-depth examination of data collected by the Milford PIC was initiated. It was during this analysis that it became strongly suspected that equipment malfunction was responsible for the anomalous gamma readings. The first indication that the readings were probably not related to the fire came when it was confirmed that the Milford Flats Fire had begun on the afternoon of July 6th, while the anomalous gamma readings began nearly a full day before the fire started, on July 5th (see Fig. 3). A correlative comparison of the gamma readings with concurrent precipitation and barometric pressure, as well as with lightning strike data supplied by the Vaisala National Lightning Detection Network, showed no correlation of the readings with meteorological events. However, it is worth noting that the highest temperature ever recorded in Utah (118 F near St. George, UT) occurred on July 5th, and temperatures recorded at the Milford station that day were also very high (around 100 F).

While a graphical output of “average” gamma exposure rates (3-second readings averaged over each 10-minute period) is the default for the CEMP web site, it is also possible to select for “maximum” and “minimum” exposure rates and produce a graphical display that shows the maximum or minimum *individual* 3-second readings for each 10-minute period. Because the datalogger at the CEMP station queries the PIC twenty times each minute, selecting for the maximum exposure rate produces a graph that shows the individual highest reading for each ten-minute period.

Typically, the maximum and minimum readings will generally closely mimic the behavior of the averaged readings, occurring closely above and below this line.

However, when the maximum and minimum readings for the period July 5th through July 7th are plotted together on the same graph (Fig. 5), one can observe that there is an extremely abrupt initiation of both very high and very low (in fact, negative!) gamma readings. The abnormal initiation and termination of the spikes is extremely abrupt and not indicative of expected behavior for passage of a plume, nor are the nearly concurrent high and low readings, which are much more comparable to the signature one sees when switching the PIC's power on or off.

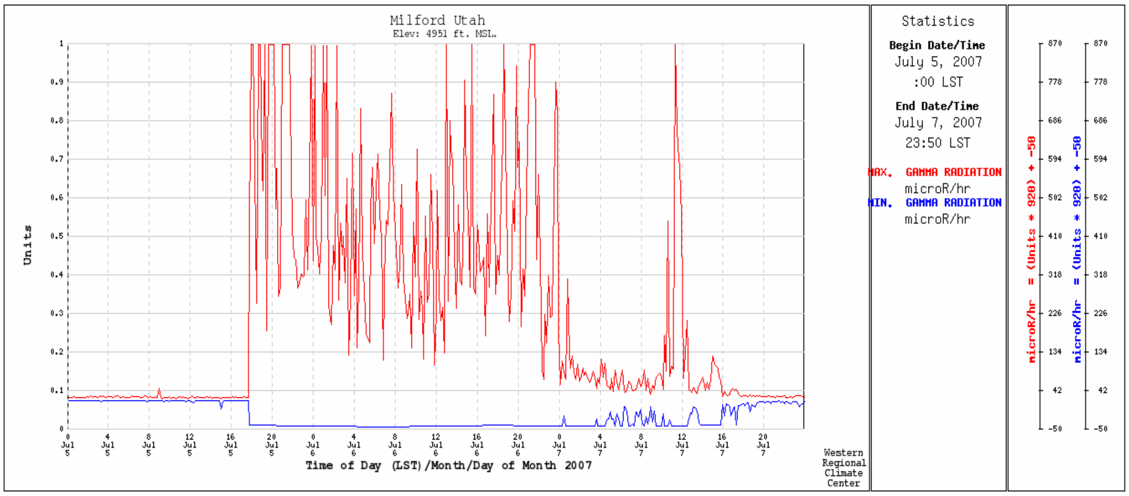

Figure 5. A plot of maximum and minimum gamma exposure rate data from the Milford CEMP station for the period July 5-7, 2007. Note the formulas at the right side of the figure to convert the data to micro-R/hr. High positive and low "negative" readings initiate concurrently late in the afternoon of July 5th.

Diagnostic Testing of the PIC

When it became clear from analysis of the above data (subsequently supported by initial screening of the filter samples) that equipment malfunction was likely responsible for the anomalous gamma readings (and unfortunately, less than a day after the press release), the Milford PIC was replaced (on July 14th) and sent to Pacific Northwest National Labs (PNNL) for diagnostic testing. Results of the testing showed that the 70-pin SIMM socket on the PIC's data acquisition board was severely warped (Fig. 6). Possible causes of the warping cited by PNNL included extreme heat and/or incorrect seating of the board by the instrument's manufacturer. Incomplete connection of the pins with the SIMM socket may have caused a shorting of the electronics, resulting in the data signature seen in Figure 5.

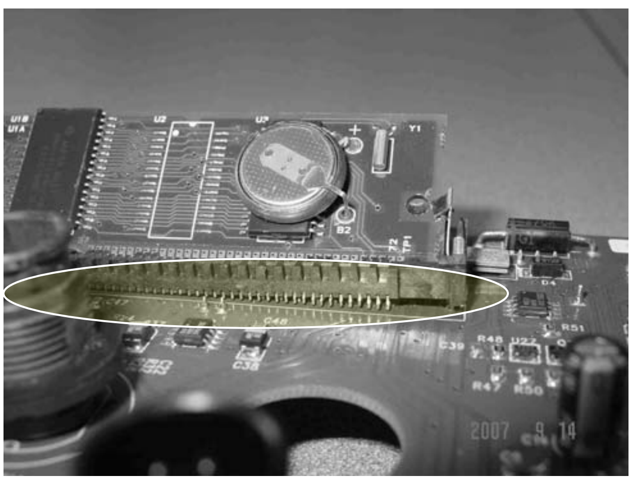

Figure 6. A diagnostic examination of the PIC's electronics by PNNL revealed a severe warping of the 70-pin SIMM socket of the data acquisition board.

CONCLUSIONS AND LESSONS LEARNED

There is a high degree of confidence that abnormal readings measured by the pressurized ion chamber at Milford in early July, 2007 were the result of equipment malfunction and not the result of either an increase in naturally-occurring radionuclides or re-suspension of legacy fallout from the Nevada Test Site. Analyses of particulate air filters from the period of the Milford Flats Fire from both Milford and Delta, Utah, as well as from the pre-fire period, show results consistent with previous measurements of normal background activity, and no detectable manmade radionuclides related to legacy fallout or any other manmade source. The timing of the PIC readings indicates no causal link with the onset of the anomalous readings and the onset of the Milford Flats Fire. In addition, the abrupt and erratic initiation and termination of high positive and low negative readings is inconsistent with expected PIC behavior (not to mention physically impossible in the case of the negative readings). Finally, diagnostic testing of the Milford PIC shows severe warping of the SIMM socket on the data acquisition board.

There were a number of valuable (and sometimes quite painful) lessons learned from the Milford Flats Fire incident. As stated earlier, one of the important missions of the CEMP is to provide for transparency and public accessibility of the collected monitoring data. It does this in part through allowing access to near real-time data on a public web site. The positive side is that the public knows it is seeing the collected data just as soon as DOE federal employees or anyone else is---an important consideration in building public trust that there is no data manipulation occurring prior to public release. The down side, and it can be a significant one, is that the public has access to the data before any quality assurance can be carried out on the data. Although a statement regarding the provisional nature of the data was present within the CEMP web site previously, as a result of this incident the statement has been greatly expanded and now occurs on the home page and every page within the site on which automated data displays occur. Despite this incident, the authors continue to believe, however, that the benefits of providing public access to near real-time monitoring data outweigh the potential adversities it can cause.

“Murphy’s Law” was in constant operation from the time of the initial discovery of the anomalous gamma readings and for a period of about three months thereafter, especially related to the timing and or delays associated with disseminating (or decisions not to disseminate) information to the public. The fact that the readings went unnoticed by project personnel for several days (the fire began on the Independence Day holiday weekend) followed by a subsequent delay in identifying the PIC data signatures that were indicative of a likely equipment malfunction can be attributed to the absence of key personnel at the time of the incident. These situations have been remedied by the implementation of an alarm mode for the CEMP that generates emails to key project personnel whenever a monitoring station records an exposure rate that is more than two times normal background for a period greater than ten minutes. In addition, a graphic “primer” on PIC data signatures is currently being developed that will aid those who are less familiar with the causes of various anomalies and how they display, as well as detail a chain of notification to follow in the event an anomaly occurs. At least once daily checks of all CEMP station PIC readings also have been implemented.

Much thought has been given to the timing and content of the press release issued by NNSA/NSO. There was some criticism leveled for being too tardy in sending out the release, but more for sending out a release prior to identifying the true cause of the readings. The NNSA/NSO elected to err on the side of notifying the public what it believed to know at the time about the incident rather than delay releasing the information. In hindsight, advancing additional possible causes for the readings might have been a more prudent approach. However, it is interesting to note that had it been delayed one more day to issue the release, suspicions of equipment malfunction could have been strong enough that public notification may have been in the form of a footnote on the CEMP web site, or perhaps a very differently worded press release.

The NNSA/NSO and DRI representatives continued to provide updates on the filter analysis by UNLV and Test America Laboratories to the few reporters who continued to follow the issue. However, after the results of the gamma spectroscopy confirmed that there was no evidence of re-suspension of legacy fallout, media interest dropped significantly. A decision was made to *not* issue a subsequent press release on the UNLV analysis since those media representatives tracking the story already had the updated information. The final reports on the air sampling analyses were posted on the CEMP web site as they became available, and DOE individually notified media who had done previous stories based on the initial press release that there was no evidence of legacy fallout based on the filter studies. While this may have allayed most concerns about the origin of the gamma readings, it did not answer questions about what caused the readings in the first place.

While confidence was high that the readings were caused by equipment malfunction, a decision was made not to speculatively publicize this until conclusive evidence was in hand. Unfortunately, there were several delays in obtaining the conclusive laboratory analysis of the equipment. During this time, one environmental organization continued to publish their perspectives of the elevated readings and did not give full discussion or consideration to the facts that were being released through the CEMP web site and agency representatives. Eventually an environmental organization asked the Utah Radiation Control Board (URCB) for an explanation of the gamma readings.

The NNSA/NSO and DRI had actually already been in contact with the URCB, and were invited to make a presentation at a regularly-scheduled meeting in Salt Lake City on October 5th (a PDF of the Powerpoint presentation is available for download from the CEMP web site at http://cemp.dri.edu/DRI_Presentation_for_Utah_Radiation_Control_Board.pdf). During its communication with the URCB during and after the fire, the CEMP program had provided the URCB with the results of analyses prior to public dissemination, as well as informing them of the strong feeling that equipment malfunction was the likely cause of the readings.

The NNSA/NSO and DRI presentations were well-received by the URCB, and served to answer the concerns expressed about the Milford incident by community organizations and the media. An individual representing the most vocal organization admitted that they had been intentionally provocative with their public comments because they wanted to ensure that a full investigation of the matter was conducted. Unfortunately, there was no attempt by the group to seek clarification from the CEMP directly, either by phone or via the website, or its community representatives.

In the end, this experience has made the CEMP a better program. For example, it provided the program an opportunity to develop a positive relationship with the URCB. Internal and external notification procedures of irregular equipment readings from any cause have been streamlined. In addition, more comprehensive documentation of how a PIC can respond to natural phenomena that causes variations in external gamma readings (e.g., meteorological phenomena) as well as responses to equipment malfunctions was prepared by DRI personnel working on the CEMP that will hopefully lead to enhanced program capabilities and a better knowledge of how to deal with future incidents which are cause for public notification. Program management were pleased that the chain-of-custody program involving citizens who live in the communities that host the CEMP stations collecting the air filters and sending them to DRI worked successfully. It was also appreciated that newspapers in Utah that originally carried stories about uncertainties about the causes of the anomalous PIC readings, also published stories when data was available that showed that no man-made radionuclides contributed to the readings. However, although information was reported by newspapers, no subsequent comments and updates were published by the one vocal environmental organization expressing their satisfaction that the issue was sufficiently resolved.

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