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UC Berkeley Nuclear Engineering Air Monitoring Station

Berkeley Radiological Air and Water Monitoring Team
BRAWM Team in the News

Food Chain Testing
Food Chain Sampling Results (grass, spinach, etc.)

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Results Log

3/5/2013 2:25pm: We have tested a sample of salmon from the Pacific Northwest that we purchased locally. No radioactive isotopes were detected from the reactors at Fukushima to very low limits. These results have been posted on the salmon section of our Food Chain page.

9/27/2012 5:20pm: Three more dried seaweed samples were tested recently that came from the same source as our measurements in 2011. As with the previous samples, no radioactive isotopes were detected from the reactors at Fukushima. These results have been posted on the seaweed section of our Food Chain page.

We have also tested a sample of soy sauce purchased in a local grocery store. The soy sauce was labeled as a product of Japan. No radioactive isotopes were detected that can be traced to the reactors at Fukushima. Our limits for Cesium-134 and Cesium-137 were 0.029 and 0.032 Bq/L, respectively. For comparison, the activity concentration of Potassium-40 (K-40) in the sample was approximately 100 Bq/L. These results have been posted on our Food Chain page.

8/28/2012 (5:15pm): We have posted our latest milk sample, with a best-by date of 8/30/2012. Once again, Cs-134 or Cs-137 were both below our detection limits.

7/13/2012 (5:40pm): We have posted two milk samples with best-by dates of 6/11 and 7/9 on our milk sample page. In both samples, no Cs-134 or Cs-137 were detected.

7/13/2012 (5:06pm): A recent sample of seawater collected at Point Reyes has been measured and posted on our new seawater page. No isotopes released by the Fukushima reactors were detected.

In addition, we measured a sample of sand from a yard in the Bay Area. As we have seen in the various soil measurements we have made in the Bay Area, very tiny amounts of Cs-134 and Cs-137 can be detected by our very sensitive germanium detectors. The activity concentration of Potassium-40 (K-40) in this sample was 730±73 Bq/kg, while both of the cesium isotopes had levels less than 0.2 Bq/kg, which is roughly 3,000 times lower than K-40. The sand measurements can be found here, alongside other soil measurements on our Food Chain page.

6/29/2012 (2:05pm): We are pleased to announce that our Department has been awarded a Presidential Citation from the American Nuclear Society:

> *For serving at the leading edge of communication to educate California and the nation about radiological impact to the U.S. from the Fukushima incident. By collecting atmospheric-transported*

> *radiation samples from Japan, explaining the significance to the public via public forums and the UC-Berkeley Nuclear Engineering Air Monitoring Station website, the UC-Berkeley Nuclear Engineering Department gained national recognition as a trusted source for rational, accurate and authoritative information about radioactivity and its potential impacts on the U.S. population.*

Here is a link to the full press release.

6/27/2012 (4:00pm): The summer is now well along, and we have been continuing our testing. Results will be out soon for some recent milk, seaweed, and ocean water samples. Work on a continuous air filter monitoring system is also continuing this summer.

4/9/2012 (5:45pm): Three recent milk test results have been posted on the milk sample page with "best by" dates of 3/12, 4/9, and 4/16. Very low levels of Cs-134 and Cs-137 were detected in the samples — the amounts are so small that it would require drinking over tens of thousands of liters of milk to receive the small dose that one receives from a cross-country airplane flight. These isotopes can still be detected in milk because they have long half-lives (2 years and 30 years, respectively) and therefore trace amounts will remain in the grass and hay that the cows feed on.

2/27/2012 (3:37pm): Last week we were able to measure a rainwater sample collected during the week of Feb. 10–17. The results have been posted in the data table on the Rainwater page. ***As expected, no fission products were seen above MDA.*** *This has been true for all rain samples since April 20, 2011.*

2/13/2012 (2:52pm): This is an update on some of the other activity going on around here that is not visible on this website. We currently have some students designing and building a more permanent air monitoring system that will be operated on the roof of our building. This system will allow us to make continuous measurements of gamma-ray emitting radioactive isotopes in the air, such as the naturally-occurring decay products of radon gas. We will then be able to study the natural variations in radon gas concentration in the air as well as to continue monitoring for fission product isotopes such as those that we detected last year from the Fukushima accident.

2/6/2012 (2:31pm): A new milk sample has been measured, this one with a best-by date of 2/16/2012. The results are posted to the milk sample page. ***Low levels of both Cs-134 and Cs-137 were still detected in the sample.***

1/14/2012 (9:40am): A milk sample with a best-by date of 12/29/11 has been tested and the results posted to the milk sample page. ***Low levels of both Cs-134 and Cs-137 were still detected in the sample.***

By integrating all of the milk data we have collected since March 11, we can estimate the total effective dose equivalent (TEDE) one could have received from exposure to fission product isotopes in milk to date. For someone drinking milk at the relatively high rate of one gallon per week, ***the TEDE could be nearly 1 microsievert, or the total effective dose equivalent for only 12 minutes on an airplane flight or 3.7 hours of the average person's background exposure from natural sources of radiation.***

1/13/2012 (12:50pm): We are back from winter break now, and we have posted the results of a rainwater sample that was collected in November. The results have been posted in the data table on the Rainwater page. As with all our rain samples since April 20, ***no fission product isotopes were seen above MDA.***

11/4 (5:26pm): There has been construction going on in the room where we currently have our detector, hence the current gap in our testing. We will continue testing milk samples once the work is finished.

10/18 (3:40pm): The final two layers of soil from Oakland have been tested, and the results are posted on the Food Chain page. As with all the layers but for the very top, Cesium-134 was not detected but Cesium-137 was detected. This Cs-137 is from atmospheric nuclear weapons testing fallout in the 1950s and early 1960s, not from Fukushima.

10/18 (3:25pm): Milk sampling is continuing with weekly to biweekly samples. One new store-bought milk sample has been posted with a Best By date of 10/10. Low levels of both Cs-134 and Cs-137 are still present.

10/8 (11:00am): Two more layers of soil have been tested from Oakland, and the results are posted on the Food Chain page. Cesium-134 was not detected in these samples, although the detection limits we reached were not quite low enough to rule out the tiny levels of Cesium-134 that had been measured in the top layer of soil. However, Cesium-137 was detected down to a depth of 6 cm. This Cs-137 is not from Fukushima for two reasons: (1) the cesium from Fukushima came in a one-to-one ratio of Cs-137 to Cs-134, and (2) cesium deposited earlier this year through rain could not yet have diffused down more than a centimeter or two into the soil (cesium diffuses very slowly through soil). As with our other "older" soil samples, this excess of Cs-137 must be due to previous fallout depositions, primarily from atmospheric weapons testing.

Two final layers down to a total depth of 14 cm will be finished next week.

9/27 (12:17pm): We have posted two new store-bought milk samples with Best By dates of 9/26 and 10/1. We continue to detect low levels of both Cs-134 and Cs-137.

9/16 (3:10pm): We are in the process of testing several layers of soil from a yard in Oakland, CA. The first test of the top 2 cm has been performed and the results are posted on the Food Chain page. The soil has a smaller amount of Cs-134 than in any other soil sample we have tested, while the Cs-137 level is on par with the other older soils we have tested, yielding a 137/134 ratio of about 30. The yard is made of older soil, so the presence of higher levels of Cs-137 is expected from pre-Fukushima fallout depositions.

Our testing is continuing, but at a slower rate. We are sharing a room with a laboratory course and cannot count samples when they are doing their experiments, so that limits the time we have for testing. It will take several days to finish testing the remaining soil layers, which go down to a depth of 14 cm.

9/6 (5:26pm): We tested a topsoil sample and a dried manure sample from the Sacramento area. The manure was produced by a cow long before Fukushima and left outside to dry; it was rained on back in March and April. Both samples showed detectable levels of Cs-134 and Cs-137, with the manure showing higher levels than the soil probably because of its different chemical properties and/or lower density.

In addition, a soil sample from Sonoma county was tested. This sample had been collected in late April but we had not had the chance to test it until now.

One interesting feature of the Sacramento and Sonoma soil samples is that the ratio of Cesium-137 to Cesium-134 is very large — approximately 17.6 and 5.5, respectively. All of our other soil samples until now had shown ratios of between 1 and 2. We know from our air and rainwater measurements that material from Fukushima has a cesium ratio in the range of approximately 1.0 to 1.5, meaning that there is extra Cs-137 in these two soil samples. The best explanation is that in addition to Fukushima fallout, we have also detected atmospheric nuclear weapons testing fallout in these soils. Weapons fallout contains only Cs-137 (no Cs-134) and is known to be present in older soils (pre-1963). Both of these samples come from older soils, while our samples until this point had come from newer soils.

This direct comparison between Fukushima fallout and atmospheric weapons fallout in these soils shows that the fallout from Fukushima in Northern California is significantly less than the amount of Cs-137 that still remains from weapons testing, which has had nearly 50 years to disperse and decay.

9/6 (4:13pm): We have added a new store-bought milk sample with a Best By date of 9/12 to our milk results page. As with the previous sample, we detected both Cs-134 and Cs-137 just above our limits.

9/1 (4:22pm): Two raw milk samples were added to our raw milk page. Both samples come from a single dairy the Sacramento area, and one sample is cow milk and the other is goat milk. Both samples show detectable levels of Cs-134 and Cs-137.

8/25 (5:10pm): Our new test setup has been calibrated, and our first sample has been completed. The new setup allowed us to measure a milk sample with a Best By date of 8/22 to our lowest levels yet, and we detected both Cs-134 and Cs-137 just above our limits.

In addition, a milk sample with a Best By date of 8/11 was added to our results. This sample had been measured with the old setup but had not yet been reported. Cs-134 was detected but Cs-137 was not detected.

8/20 (9:00pm): The department web server was down last night but has been working again since 4:00 this afternoon. Apologies for the interruption in service.

Since classes at Berkeley are starting next week, we have had to make space in the teaching laboratory that we have been occupying since March. Because of that, we have moved our operations to a new testing station. We are currently calibrating the new station and will be done by the end of next week. No new results will be posted until the calibration is complete.

8/16 (6:48pm): We just finished testing a sample of carrots and a sample of cherry tomatoes, both from a local organic farm that has supplied most of our strawberry samples. ***No radioactive isotopes from Japan were detected.***

8/12 (6:20pm): This week we were able to test three more samples of seaweed from Northern California. ***Once again, no isotopes from Japan were detected.*** *In addition, the seaweed data table has been expanded to include the naturally-occurring isotope Beryllium-7, which is often found in samples that have been outside or in contact with rain. Other food chain data tables are being expanded to include this natural isotope as well to provide a point of comparison.*

Over the next week we will be testing some tomatoes and carrots. Updates on those to come.

8/9 (5:30pm): Another two samples of topsoil from San Diego, CA have been tested. These samples come from the next layer of soil, under 3–4 inches below the surface. As opposed to the previous sample from the top 3–4 inches of soil, no Cs-134 or Cs-137 were found in the next layer of soil. A control sample of exactly the same soil also showed no fission products, as expected.

8/4 (10:03am): We have tested two samples of topsoil from San Diego, CA. One sample was soil that had been stored inside, while the other sample was exactly the same kind of soil but it had been outside during the period 3/11 to 6/29/2011. As expected, the sample from outside has detectable levels of Cs-134 and Cs-137 while the sample kept inside does not.

8/3 (6:42pm): We tested a sample of dried hay from Nevada. ***No isotopes from Japan were detected in the hay sample.*** *The hay from that region is often shipped to the Central Valley of California as feed for livestock. In fact, much of the hay for cows in the Bay Area comes from as far away as Canada. Though the hay sample is from only one location, this sample may provide evidence that long-term contamination of milk is unlikely.*

8/1 (10:36pm): Milk samples with dates of 7/28 and 8/4 were added to our Milk results. ***Cesium-134 was detected in both samples just above our detection limits, while Cs-137 was not detected.*** *We will continue following milk levels until they are consistently below our detection limits.*

7/31 (9:15pm): We have finished the analysis of the alpha particle spectrum from an air filter collected on April 16–19. We did not detect any Uranium, Plutonium, or Americium-241, and our calculated detection limits indicate safe levels. Our limits are much higher than the limits set by the EPA in their testing for Uranium and Plutonium. If you would like to skip directly to our limits, please click here.

Thanks for your patience with us as we ventured into alpha spectroscopy, which is very different from our main expertise in gamma-ray spectroscopy.

7/18 (6:00pm): The rain we collected during the rainstorm on 6/28 has been analyzed and added to our rainwater page. ***This is our sixth consecutive rain sample with all non-detections, and we have set our lowest detection limits yet. These limits are about 200 times below our peak detections in March.***

7/18 (5:05pm): A milk sample with a Best By date of 7/21 was added to our Milk results. ***This is the second consecutive non-detection of all isotopes in store-bought milk.***

7/13 (7:53pm): A milk sample with a Best By date of 7/16 was added to our Milk results. ***We have our first non-detection of all isotopes in store-bought milk.***

7/9 (8:43pm): Our final air sample, spanning 6/24–7/1, has been analyzed and posted. ***This sample is the fourth consecutive non-detection of all isotopes in our air filters, for a total of 31 days of non-detections. Our air sampling system remains off but on standby if there are any further major releases from Fukushima.***

We have not yet released results for our rainwater sample from 6/28 since it is still being counted and analyzed.

7/1 (10:41pm): Our latest air sample from 6/17–24 has been analyzed and posted. ***This sample is the third consecutive non-detection of all isotopes in our air filters, for a total of 24 days of non-detections. We are now turning off our air sampling system but will remain on standby if there are any further major releases from Fukushima.*** *We will be counting our last air filter (6/24–7/1) over the next week and releasing those results on or around Friday 7/8.*

In addition, a rainwater sample was collected during a strong rainfall on Tuesday 6/28 and is being counted in our detector over the holiday weekend.

7/1 (10:23pm): A new strawberry sample purchased yesterday (6/30) has been tested, ***yielding our second consecutive non-detections of both Cs-134 and Cs-137 in strawberries.***

6/30 (6:32pm): A milk sample with a Best By date of 7/7 was added to our Milk results. Cesium-134 and Cs-137 continue to be detected. We will continue testing milk until levels are consistently below our MDA.

6/28 (6:34pm): Snowmelt from a waterfall feeding Hetch-Hetchy Reservoir has been tested. ***No radioactive isotopes from Japan were detected in the snowmelt.***

6/25 (11:47am): A raw milk sample collected on 6/15 was added to the raw milk page. ***We have our second consecutive non-detection of all isotopes in raw milk and will be discontinuing raw milk testing.***

6/25 (11:28am): ***Our second consecutive non-detection of all fission product isotopes has been posted on the air results page*** *for a sample collected on 6/8–17. The MDA levels for I-131, Cs-134, and Cs-137 are the lowest we have achieved to date — over 1,000 times lower than our highest detections in late March. If the next air sample also shows undetectable levels, we will discontinue our air sampling effort in order to focus on refining our calibrations.*

6/21 (6:40pm): A milk sample with a Best By date of 6/27 was added to our Milk results. Cesium-134 and Cs-137 were both detected just above our MDA, though both continue to show a downward trend.

Also, a new strawberry sample from 6/9 was tested, ***yielding our first non-detections of both Cs-134 and Cs-137 in strawberries.***

6/17 (8:55pm): Air results have been fully revised to compensate for the small amount of Cs-137 contamination detected in our lab. Removing the Cs-137 background has caused our measurements of Cs-137 to decrease by approximately 5–50% over the course of our sampling period. One effect of this revision is that the Cs-137 results now track even more closely with our Cs-134 measurements — in fact,

a slight discrepancy between the measurements is what tipped us off to the possibility of contamination in the first place.

Two air samples were added, for 5/25-31 and 5/31-6/7. ***In the latter sample, no fission products from Fukushima have been detected.***

6/14 (12:25am): A milk sample with a Best By date of 6/20 was added to our Milk results. Cesium-134 was detected again at levels similar to previous measurements, but Cesium-137 levels decreased.

Also, a new raw milk sample collected on 6/8 was added to the raw milk page. ***We have our first non-detections of all isotopes in raw milk.***

Lastly, we are in the process of revising our air results for Cesium-137. Since we have been counting samples for many days instead of only 24 hours, we decided to take a long background spectrum to check for possible contamination. A very weak gamma-ray line for Cs-137 was detected in the lab, probably due to contamination of our lead bricks from an old experiment or from radioactive cesium in the lead itself. The presence of this extra Cs-137 has been creating a systematic increase in the Cs-137 measurements we have been reporting. Now that we have measured its strength to good precision, we can subtract it off of our measurements. This is going to lead to a downward revision of our Cs-137 measurements in the coming days. We will make a note when the revision has been made and new air data have been posted.

6/9 (11:10pm): Food chain samples have been updated with new samples of topsoil, grass, and seaweed. Cesium-134 and 137 were detected in the soil sample, but no fission product isotopes were detected in the grass or seaweed samples.

6/2 (4:25pm): A milk sample with a Best By date of 6/9 was added to our Milk results. ***We have our eighth non-detection of I-131 in milk, a non-detection of Cs-134, and a detection of Cs-137 right above our detection limit.***

6/1 (7:04pm): A milk sample with a Best By date of 6/6 was added to our Milk results. ***We have our seventh non-detection of I-131 in milk, and Cs-134 and Cs-137 both continue to decline.***

In addition, the food chain samples have been updated with one new kale sample measurement (5/19). Unlike one of the previous samples from 4/28, no fission product isotopes were detected.

6/1 (6:28pm): Air results were updated with our most recent sample, collected from 5/15-5/21 and counted for a 8 days. ***We have had our third non-detection in a row for I-131, and Cs-134 was also not detected. Cs-137 continues to decrease but is still detectable.***

5/25 (9:48pm): The food chain samples have been updated with one new topsoil measurement (5/18) and one new strawberry measurement (5/19). ***The levels of all isotopes have significantly decreased in both samples. Iodine-131 is still present in the soil but it is now just above our minimum detectable level.***

5/24 (10:17am): Since we have at this point received several "raw" milk samples, including five from a single farm, we have created a separate page for raw milk results, including plots of that farm's data.

In the process of refining the raw milk data, we found that we accidentally overestimated the Iodine-131 concentrations in raw milk. Our first measurements of raw milk had been reported with levels of I-131 that were much higher than store-bought milk. The root of the problem was that our analysis code accidentally over-corrected for the decay of I-131 in raw milk, and so the activity reported for I-131 was about 5 times too high. ***We have revised the code to report the correct activity, and the values are on par with the store-bought milk. This includes recent non-detections of I-131, and declining levels of Cs-134 and Cs-137.***

5/23 (9:42pm): Milk samples with Best By dates of 5/26 and 5/31 were added to our Milk results. ***We have our fifth non-detection of I-131 in milk, and Cs-134 and Cs-137 both continue to decline.***

5/23 (6:11pm): Air results were updated with our most recent sample, collected from 5/10-5/14 and counted for a 9 days. ***We have had our second non-detection in a row for I-131, and Cs-134 and Cs-137 continue to be at very low levels.***

5/20 (5:35pm): A milk sample with a Best By date of 5/23 was added to our Milk results. ***We have our fourth non-detection of I-131 in milk.*** *The latest data point for Cs-137 is slightly higher than the previous one, but within error bars, the trend continues to be a decline in both Cs-134 and Cs-137.*

5/20 (5:15pm): The rain we collected on 5/15-16 has been analyzed and added to our rainwater page. ***This is our fifth rain sample in a row where we haven't detected any radioisotopes from Japan, and we have set our lowest detection limits yet.***

5/17 (7:22pm): We collected a small rain sample two days ago and analyzed the data, now available on our rainwater page. ***This is our fourth rain sample in a row where we haven't detected any radioisotopes from Japan.*** *Yesterday we collected a much larger rain sample and just started counting it with our detector -- this should set an even better limit on the presence of the isotopes. That sample should*

be analyzed about two days from now.

A milk sample with a Best By date of 5/19 was added to our Milk results. ***We have our third non-detection of I-131 in milk, and the levels of Cs-134 and Cs-137 continue to decline.***

5/14 (8:35pm): Air results were updated with our most recent measurement, spanning 5/6-5/10. ***I-131 has not been detected for the first time, and Cs-134 and C-137 continue to decline.***

5/14 (6:25pm): Our food chain samples have been updated with new samples of topsoil, grass, wild mushrooms, spinach, kale, and strawberries.

Kale on 4/28 had the first detectable amounts of Cs-134 and Cs-137 since a sample on 4/7. Strawberries continue to show levels of Cs-134 and Cs-137.

Although I-131 was still found in the soil, it was not detected in any of the new grass or food measurements.

5/12 (7:08pm): A milk sample with a Best By date of 5/16 was added to our Milk results. ***We have our second non-detection of I-131 in milk, and the levels of Cs-134 and Cs-137 continue to decline.***

5/11 (9:25pm): Air results were updated with one measurement from 5/2-5/6. I-131, Cs-134, and Cs-137 were all detected, but they all continue to decline.

5/9 (10:30pm): Milk measurements are now updated with samples of milk up to a Best Buy Date of 5/9. ***We have the first non-detection of I-131, and Cs-137 and Cs-134 have both declined.***

5/9 (9:40pm): Air measurements were updated with two recent measurements. ***Only I-131 and Cs-137 were detected in the most recent measurement, at levels that are about 100 to 1000 times lower than their peak measurements in March.*** *Air sampling will continue at a frequency of about three days until we can no longer detect I-131 and Cs-137 in a practical amount of time.*

5/2 (5:20pm): Our food chain samples have been updated with new samples of topsoil, spinach, kale, and arugula. We have also begun testing Northern California seaweed.

There are no isotopes from Japan detected in the new spinach, kale, arugula, and seaweed samples. The new strawberry samples from 4/20 show no I-131, but Cs-134 and Cs-137 are present. ***The highest levels of radioisotopes detected would require the consumption of more than 3 tons of strawberries in order to receive the same equivalent dose as a cross-country airplane flight.***

The topsoil continues to show decreasing levels of I-131, while the trend for Cs-134 and Cs-137 is not yet clear.

4/28 (10:35pm): Air and rain water results have been updated with our most recently analyzed data.

4/28 (2:35pm): Milk samples have been updated with a raw milk sample from April 20th. ***We observed a decrease in the levels of all fission product isotopes.*** *Similar to the recent water results the I-132 result is due to background interference and low statistics in that energy region.*

4/27 (2:03pm): Air results have been updated to include our latest results. ***We continue to observe a decrease in all fission product isotopes.***

4/27 (8:48am): We have compared the amount of potassium-40 in our milk to the USDA standard and have found that they are equivalent within the margin of error of our measurement. A table has been added to the milk samples page with the data showing the comparison.

4/26 (11:57am): Rain water results have been updated to include 3 more recent rain samples. All fission product isotopes are approaching our minimum detectable amount. ***The apparent increase in reported I-132 for the last two samples is due to interference with a background peak at the same energy.*** *I-132 emits gamma rays at several discrete energies and after cross referencing them the actual I-132 level is below our minimum detectable amount. If the increase were real we would also expect to see a corresponding increase in Te-132 which we have not observed.*

4/25 (7:25pm): Due to the fact that our measured levels in our air samples are approaching our minimum detectable amount we have transitioned from 24 hour sampling periods to 48-72 hour sampling periods. This will allow us to more accurately measure the decreasing levels. ***This also means that there will be a longer delay between postings.*** *In addition the majority of the BRAWM team is at a conference this week which may add to the delay.* ***We continue to monitor the levels in air, water, milk and the food chain closely.***

4/25 (3:38pm): Air and tap water measurements have been updated with our most recent data. ***We continue to see no evidence of fission product isotopes in tap water.*** *We have also added insets to the air sampling data graphs so the recent trends are clearer.*

4/20 (9:35pm): Tap water measurements have been updated with another measurement. ***No fission product isotopes are detected.*** *In addition, we have posted updated Minimum Detectable Activity levels for all tap measurements. Another tap measurement is in progress to try to obtain even better sensitivity.*

4/20 (8:40pm): Air measurements have been updated through 4/18, including a reanalysis with our new script. The levels of all species are continuing to decline, following the trend of the last couple weeks. Since the levels are getting near our current limit of detectability, we are going to increase both the filter collection time and the gamma-ray counting time from 24 hours to 48 hours in order to continue tracking the air concentrations.

4/19/2011 7:45pm: Milk samples were updated to a Best By date of 5/2, and we added two raw milk samples from local Bay Area dairy farmers. ***The store-bought milk levels of I-131, Cs-134, and Cs-137 are showing definite signs of leveling off.****.*

4/19/2011 7:15pm: Our food chain samples have been updated with numbers from our refined analysis code. New samples of topsoil and grass were added. The grass data clearly shows an ongoing decrease in all species. The soil clearly shows a decrease in I-131 but the cesium levels are not yet conclusive.

Also, one result of our improved code is that our Minimum Detectable Activity (MDA) levels have been improved. So for some samples, this has allowed us to conclude that we have a detection where we previously reported non-detection. However, these detections are all close to our MDA levels.

We collected rain last night and will test it soon. There are still air and milk results from that last few days that we will post soon -- including some raw milk samples from local farmers. We are currently making more tap water measurements, too. Please stay tuned.

4/17/2011 12:20pm: We have updated our rainwater measurements with results from the rain collected on 4/13. ***Sharp decreases in activity are seen for all species that are still detectable.***

We are currently updating our analysis tools to provide more accurate measurements, so there this will lead to a few changes in the coming days:

- ***Slight changes in the activity measurements (no more than 5-10%)***
- ***More accurate determination of the Minimum Detectable Activity for each measurement (this can already be seen on the rainwater plots)***
- ***Our spectrum plots are being improved with more readable labels to distinguish between background peaks and fission-product peaks (for example, the latest rainwater data)***

We have a backlog of recent samples (milk, topsoil, tap water) that will be updated in next few days. Thank you for your patience as we continue to organize and report these results.

4/13/2011 8:40pm: ***Major revision note:*** *We just performed a major revision of our preliminary milk measurements. Our activity measurements for milk with a "best by" date after 4/4/2011 were accidentally calculated for the "best by" date itself, rather than an earlier date such as the purchase date. Since milk can be on the shelves starting almost 18 days before the "best by" date, our numbers after 4/4/2011 did not accurately reflect the maximum activity that the radioisotopes could have at the time of purchase. Incidentally, our first two milk measurements were not corrected at all and therefore reflect the activity at the time of measurement. The original numbers are at the bottom of the page for reference.*

In order to make a valid comparison between all milk samples, we decided to correct all milk samples to represent the activity at their time of bottling -- this is 18 days before the "best by" date. This revision does not change the Cs-134 or Cs-137 numbers since they have long radioactive half-lives. The I-131 activity increases by factors of 2 to 5 because of its 8 day half-life. ***Please note that though all I-131 activities have increased due to this revision, the levels are still very low -- one would have to consume at least 1,900 liters of milk to receive the same radiation dose as a cross-country airplane trip.***

In addition, two new milk measurements were added to the table. The Cs-134 and Cs-137 levels are very low but are trending upward. This trend is probably due to a combination of the uptake rate by both the cow and grass. We'll continue to watch the milk levels to see how the iodine and cesium end up concentrated or dispersed with time.

4/13 (5:40pm): A few updates were made to the food chain tests. Samples of local organic kale and arugula were tested, with only a few possible detections of radioisotopes. A second sample of strawberries showed levels of I-131, Cs-134, and Cs-137 consistent with the first measurement. Two more more grass measurements were added, showing falling levels of I-131, Cs-134, and Cs-137.

4/12 (7:10pm): Air measurements have been updated through 4/10. As we've been seeing for the last several days, I-131 and Cs-137 are detected, but their levels are continuing a downward trend toward our detectable limits.

4/10 (11:15pm): Air measurements have been updated to be current to 4/8. All species are now at our estimated detection limit. Also, we were able to collect a small rainwater sample during a brief rain shower on 4/6-7, and the data has been analyzed and posted on the rainwater results page. Te-132, with the shortest half-life, has completely disappeared. I-131, Cs-134, and Cs-137 were all detected at approximately the same levels as the previous rainfall on 3/28.

4/8 (12:15am): Our food chain tests have been updated to include strawberries, topsoil, and a second grass measurement. Overall, activity in the grass seems to be falling, but the grass may be concentrating cesium by a factor of approximately 5 relative to the soil. The topsoil currently has more I-131 than any of

the plant or food samples. We are continuing to sample to better understand the isotope pathways from the soil into plants.

4/7 (11:15pm): Air measurements have been updated through 4/5. The uptick observed on 4/3 in all isotopes continues to decay away. Our first new rainwater sample in almost two weeks was collected last night and is currently being counted with our 10% HPGe detector. With a small chance of rain in the forecast for the coming days, we are eager to see how the air concentrations will be affected.

4/6 (7:30pm): Air measurements have been updated through 4/4. The uptick observed on 4/3 in all isotopes has not lasted -- the levels have decreased for all isotopes.

4/6 (6:20pm): Our first food chain tests are now posted. So far, we have measured spinach, cilantro, grass, and mushrooms. ***We have detected I-131, Cs-134, and Cs-137 in these samples, but the levels are very low -- consuming 403 kg of spinach could give you a radiation dose equivalent to a roundtrip flight from San Francisco to Washington, DC.*** *Not all isotopes are present in all samples, and the levels vary widely.*

4/6 (1:00pm): The new milk results are now posted. ***Iodine-131 is detected at lower levels than previously measured, but Cs-134 and Cs-137 are now being detected as well.*** *We are interested in watching these trends in the coming days, so we will continue monitoring the milk levels.*

Thanks for everyone's patience as we set up and calibrated a new liquid testing station using a germanium detector loaned to us by ORTEC/AMETEK.

Creek water and tap water measurements were also updated. ***No radioisotopes are detected other than natural background.***

4/5 (9:25am):

Response to some misleading claims about our measurements

Some claims have been made recently that our data shows that Bay Area water exceeds EPA regulations by a factor of 181 -- sometimes this has been reported as 18,100% higher, or erroneously as a factor of 18,100 higher. This claim is misleading. Specifically, the reports refer to the I-131 activity of 20.1 Bq/L measured in rainwater on 3/23. The EPA limit for I-131 is 3 pCi/L, or 0.111 Bq/L. There are a number of things wrong with this claim.

First, the measurement we made was of rainwater, not drinking water, so the drinking water limit does not apply. We instead should be discussing tap water, in which we detected a small amount of I-131 (0.024 Bq/L). This is a factor of almost 1,000 below the rainwater measurement and ***a factor of 4.6 below the EPA limit.***

It should also be noted that the EPA limit assumes the water is ingested over the course of an entire year. That is, someone drinking 3 pCi/L water for an entire year would reach the EPA dose limit of 4 millirem, which is a very small dose. The tap water measurement of 0.024 Bq/L on 3/29 is our only detection of I-131; on subsequent days it could not be detected, probably due to the radioactive decay of I-131. So this tap water could have been ingested for at most 1 day, giving the public a dose 365 times smaller than if one assumes an entire year of ingestion. ***That means the tap water is effectively a factor of 1,700 below the EPA limit.***

Finally, we believe that the clear decay in all isotopes shown in our air filtration measurements is an indication that water activity levels are declining at least for now.

4/4 (8:20pm): Thank you all for your participation in our public forum! In response to your feedback, we have decided to update our Frequently Asked Questions page. In particular, there has been a lot of interest in understanding radiation dose and the health effects from low radiation exposure. We have compiled answers for these topics that we hope will provide more information for the discussion. Here are the questions we have updated and addressed:

- ***What does radiation do to your body?***
- ***What steps would you recommend members of the public take to avoid the radiation?***
- ***How do your measurements compare to regulatory limits from the EPA or other government agencies?***
- ***Is there a health risk from low doses of radiation, such as the levels you are measuring?***
- ***What risk model do you assume in your calculations?***
- ***Is it valid to compare doses from these radionuclides to a cross-country plane flight?***
- ***What is total effective dose equivalent (TEDE)?***

4/4 (7:45pm): Air measurements through 4/3 are now posted here. ***There is clearly an ongoing decay in all species, with even iodine-131 dipping very close to our minimum detectable levels.***

4/4 (12:30pm): Over the weekend, another measurement of tap water was posted, showing no detectable radionuclides. In addition, creek water data was added, in which I-131 and Te-132 are seen at low levels, but Cs-137 was below the limit of detectability. We haven't had any rainfall here, so no changes have been added to the rainwater page.

Today there are a few things on the agenda: a few new air measurements from the weekend will be posted later today. We are also catching up on milk measurements and need to perform a calibration of the new system we are running to measure milk now. Lastly, we are revising our FAQ page to include some of the questions from the forum. This log will notify everyone when these updates are made.

3/31 (8:00pm): Our first preliminary tap water samples have been analyzed. The only isotope we have detected besides background is I-131, at low significance: 0.024 ± 0.014 Becquerels per liter. This level is much lower than our rain water measurements by a factor of approximately 300, and lower than our milk measurement by a factor of 30. ***We will be continuing measurements of tap water to confirm this result; the level is so low it is approaching the threshold of detection.***

Quick updates on our other samples: Rainwater results have been updated to be current as of the last rainfall on Saturday 3/26. Air filtration will be posted this evening to be current to 3/30. A sample of milk from before Fukushima has been added to the milk sampling results.

One additional note: There was some confusion about the dating of the milk data. Yesterday we listed the date incorrectly as "Purchased on" but the date was in fact the "Best By" date. The date itself was wrong -- the sample listed yesterday as 3/25 was actually 4/4. The background sample posted today was 3/25. Apologies for any confusion.

3/30 (5:30pm): Our milk sampling results are now posted. The only isotope we have detected besides background is I-131, at 0.70 Becquerels per liter. This level is lower than our rain water measurements by a factor of approximately 10, while higher than our creek water measurements by a factor of 10. ***One would have to drink roughly 3,800 liters of milk to receive a radiation dose equivalent to a round-trip cross-country flight.***

3/29 (11:35am): Our air results and rain water results have both been updated. The isotope amounts in both have leveled out, which means that we might not be observing a downward trend at this point. We are continuing these tests so that we can observe the eventual expected decline in activities.

3/28 (2:24pm): Latest Air and Water Results data/spectra is now posted. We note decreased levels from previous peaks. This could be due to a number of reasons to include the lack of rain in the past 48 hours to an actual lower amount of particles in the air. Note, this is not a trend unless we see a sustained reduction. We are heading into a period of high pressure in the Bay Area and the jet stream will shift away from our area and this may cause even lower readings. We continue to test run-off creek water, tap water, and milk.

3/27 (2:00pm): Strawberry Creek run off results posted. We do observe all signatures in the run off creek water, but the dilution is from ~2% for I-131 to 15% for Cs137. However, Cs137 and Te132 are just below minimum detectability for our system and the real dilution is most likely closer to 2-5%. Reservoir and tap water sampling begins next week. ***These activities are factors of 10 to 50 below rain water results.***

3/26 (6:20pm): Rain water sample results posted for 3/24 - 3/25. I-131 and Te-132 activities are lower than previously observed (3.12 and 0.27 Bq/L resp.) while Cs137 remains near the high point at ~0.5 Bq/L.

3/26 (10:45am): Air sampling results posted for 3/22 - 3/24. We have observed correlated increasing trends in Cs-137 and I-131 with the water sampling results. Te-132 seems to have increased more in air than in the rain water. Full understanding of the these trends may not be understood for some time until we start to combine this data with other information. ***Levels remain extremely low, but we are maintaining a close watch on these trends.***

3/26 (9:45am): Rain water results posted for the past few days. Delay was due to testing of new data analysis chain script that will make posting results more efficient. We have observed a sharp up-tick in Cs-137 levels from around 0.2 Bg/L to 0.55 Bq/L. I-131 had a sharp rise on 3/23 of I-131 concentration from 6 Bq/L to 20 Bq/L. I-131 levels returned to 6 Bq/L on 3/24. Reasons for the I-131 spike is still unknown. Te-132 and I-132 levels remain relatively constant.

3/24 (2:40pm): Our new air sampling results are now posted. These results should be considered preliminary because we are trying to learn more about the efficiency of our 0.3 micron HEPA filters for capturing the particles of interest (we have assumed 100% efficiency for our current calculations). We thank everyone for their patience as we worked to ensure we had the correct calibration for these measurements. ***According to our measurements, the exposure to the public is very low -- at the highest levels we measured, breathing the air for 2,000 years would increase one's radiation dose by the same amount received by taking a cross-country airplane flight.***

3/23 (2:00pm): Our rainwater data has been revised to account for the half-lives of the different isotopes we are measuring. This has led to slight increases in our previously posted activity levels. Details on the correction can be found here.

3/23 (9:00am): Rain water sampling results from 3/20 are posted. A decrease in the I-131 and Te-132 activity is noted. We expect Te-132 to decay by 1/2 every 3 days and I-131 to decay by 1/2 every 8 days. Cs-137 activity remains extremely low and constant. Air samples for the last 3 days will be posted today as we have calibrated our system. Estimated limits of detectability will also be posted today for both water

and air sampling systems.

3/22 (3:05pm): Rain water sampling results from the evening of 3/19-3/20 are now posted. We continue to observe elevated levels of radioisotopes originating from the Japanese reactors. Some trends in activity are starting to emerge, such as a slow increase in the activity of I131, and a decrease and then increase in the activity of Te132. Cs137 activity may be constant. We will continue to monitor these trends. ***Our measured activity levels remain extremely low and exposure to the public is insignificant.***

3/21 (12:35pm): Rain water sampling results for precipitation from 3/19 10:15am to 9:45pm are posted. Slight increase in activities are noted which may be due to many reasons from actual increase from Japan to differing atmospheric chemistry effects. ***Activity levels remain extremely low and exposure to the public is insignificant.***

3/20 (4:15pm): Rain water results show trace levels of radioactive iodine (I131,I132), cesium (Cs134, Cs137), and tellurium (Te132). The amounts show that the activity we are observing originated from any of the three operating reactors that was shut down since I-131 and Te132 half-lives are less than 10 days and the spent fuel from unit 4 had not operated for > 130 days. ***The calculated exposure to the public is so low that the consuming of ~500 liters of this water would only increase dose by the same amount received by taking a cross-country airplane flight.***

3/19 (8:37 pm) Initial analysis of first rain water sample has been completed. Peer review of concentration amounts and radioactivity is in progress. We expect to post results of multiple samples tomorrow. We apologize for the delay.

3/19 (10:34am): Rain fall from 3/17-2pm to 3/18-12:15pm. Preliminary results show trace amounts of radioactive iodine (I131, I132), cesium (Cs137, Cs134), and tellurium (Te132) which are not naturally occurring elements and are assumed to originate from the Fukushima nuclear site. In context, we also see Be-7 (cosmogenically produced) and Pb-212 (radon daughter) which are naturally occurring isotopes that also show up normally in rain water. ***Preliminary analysis show levels remain well below that which would cause health effects.*** *We are currently awaiting better calibration of our detector system to publish amounts.*

3/18: Due to the rainfall overnight and throughout the day, we expect an amount of "scrubbing" of the atmosphere as particles attach to rain drops. We have collected many liters of rainwater and are currently shifting our focus to sampling and testing the rainwater. Rainwater samples taken today will be counted overnight with results to be posted tomorrow morning. In addition, we are increasing our flow rate for air sampling and will not post air sampling results until Sunday night. However, due to the expected moderate levels of precipitation over the weekend we expect greater sensitivity within the rainwater samples.

The UC Berkeley Department of Nuclear Engineering is currently performing measurements to detect a potential increase in radiation here in Berkeley that could be associated with the release of radioactive materials in Japan. We perform this measurement by sampling air flowing through a particle filter mounted at the top of Etcheverry Hall. We first calibrated the monitor to account for normal background radiation levels. After a period of 8-12 hours of particle collection, we take the filter down to our counting station in our laboratory and, using highly sensitive detection instruments, can determine the concentration of target radioactive elements within the air sample collected by counting gamma-ray photons emitted. This is to determine if any radiation signatures are present above normal background radiation levels.

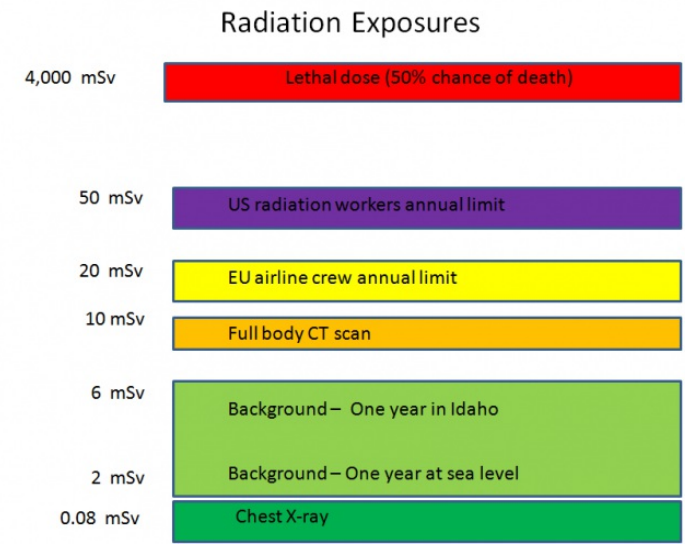
The detection instruments we are using are not only able to measure the amount of radiation in the sample, but also its energy. More specifically, we measure gamma rays and their energies in our detector, which provides a unique fingerprint of a specific radioisotope. By measuring the energy of the gamma rays with high precision, we can not only determine the amount of radiation due to a specific radioisotope, but we can distinguish it from the natural background radiation we measure as well.

For example, we can measure gamma rays from isotopes of Cesium (Cs) such as Cs-134 or Cs-137, Iodine (e.g. I-131), or Tellurium (e.g. Te-132), which we would expect to see from the release due to the fission products in Japan.

It is important to realize that all because we can detect radiation does not mean it is harmful. Our instruments are so sensitive that we can measure radiation far below the levels of the natural background radiation we live in day to day. For example, even if we are able to observe a tens of counts per hour of I-131 or Cs-137, we have to compare that to a natural background radiation level of > 300000 counts per hour when expressed in these terms. Therefore, even if we were able to observe these small amounts of radiation, it will only lead to a very small increase in the radiation we are exposed to due to the natural radiation and will have no measurable health effect.

We express the biological effect of radiation in terms of doses and dose rates expressed for example in terms of millirem (mrem) or milli-Sievert (mSv) per hour, day, or year. One millisievert is equivalent to 100 millirems. The average dose of a person living in the U.S. is about 620 mrem (6.2 mSv) per year. This can be broken down into about 300 mrem per year due to natural background, such as radon and ultraviolet rays from the sun, and 320 mrem per year due to artificial exposures, such as X-rays or Computed Tomography (CT) scans. One Chest-CT scan produces about a 1,000 mrem dose of radiation exposure, or about three times the level due to just the natural exposure. The radiation levels we expect to measure

due to the events in Japan will be 1,000 times smaller than the natural levels of background radiation.



source: MIT NSE Nuclear Information Hub

The maximum measured dose rate at the Fukushima plant has been reported at 11.4 mSv/hr (source and plots) which puts the dose in one hour to be near a full-body CT scan and one-fifth the annual US dose limit for US radiation workers. No health effects have been proven below the 50mSv per year level.

We began the air sampling at 6pm, Wednesday March 16, 2011 and moved the filter to our counting lab at 9 a.m. Thursday, March 17. The chart above presents our first and preliminary results.

The "data" link for each measurement leads to a so-called energy spectrum obtained with our detector, which is a high-purity germanium semiconductor detector. Indicated are features and lines reflecting background radiation from primordial materials such as potassium, thorium and uranium. The number of counts within the various peak regions will be tabulated and compared to normal background to determine if the filter paper contains radioactive materials. What is also indicated are regions where we expect to see specific lines from materials and specific radioisotopes that could be associated with the release of radioactive materials in Japan.