



# Weatherford®

August 19, 2011

Office of Regional Administrator  
U.S. Nuclear Regulatory Commission  
Region I  
475 Allendale Road  
King of Prussia, PA 19406  
ATTN: Blake Welling/Michael Reichard

2011 AUG 22 AM 10: 25

RECEIVED  
REGION I

RE: Written report – Event Number 47085 for License # 42-26891-01 pursuant to 10 CFR § 20.2203(a)(2)  
Dosimetry Overexposure in excess of 5 rem.

Mr. Reichard,

I am writing on behalf of Weatherford International, Inc. regarding the initial telephone report, pursuant to 10 CFR § 20.2202(b)(1)(i), concerning a 2<sup>nd</sup> QTR dosimetry reading of 7545 mrem to a Well Logging Supervisor's dosimeter.

On July 20, 2011, Weatherford was notified by Landauer of an exposure of 7545 mrem on an employee's 2<sup>nd</sup> QTR dosimeter. This exposure is documented by Landauer as photon high energy greater than 200 keV with minimal neutron exposure. District sources were inventoried and confirmed to be secure and in proper storage. The employee was immediately removed from all radioactive material access, usage and handling, pending an investigation.

The investigation consisted of the following:

- Independent QA evaluation conducted for the dosimeter by Landauer
- Well Logging Supervisor interviews
- Co-worker interviews
- Review of Phone records
- Review of hand-written radioactive material Utilization Logs
- Review of Storage access control system records
- Review of Well Logging Supervisor job history for 2<sup>nd</sup> quarter involving radioactive material
- Review of Well Logging Supervisor exposure history

## Facility Source Storage

In general, logging sources at this facility are stored in metal storage holders, constructed of approximately 0.25 inches of steel, within subsurface storage tubes approximately 6-8 foot deep. A set of logging sources (one 5Ci Am-241Be & one 1.5Ci Cs-137), outside of shields, are placed into a metal holder and lowered into the storage tubes with an attached chain. The storage tubes are capped with a metal lid and locked with high security padlocks. The key for these padlocks can only be removed when the lock is in the closed/locked position. The storage tubes are located in an access controlled storage area within the facility.



## **Independent QA evaluation conducted for the dosimeter by Landauer**

Landauer conducted an independent QA evaluation of the dosimeter. One of their senior technical staff assessed the exposure information and judged the reported dose to the dosimeter to be accurate. This evaluation was in addition to a review by their operators and laboratory supervisor. Landauer reviewed the serial number, the process calibration, quality control, and the glow curve(s). The POSL dosimeter was reprocessed and the second read agrees with the reported dose. Landauer stated; "These are always reviewed in the laboratory, but the magnitude of the exposure to this badge has triggered an independent assessment by one of our technical personnel."

## **Well Logging Supervisor1 (WLS<sup>1</sup>) Interview**

WLS<sup>1</sup>'s typical routine:

Dosimeter is worn on the front chest pocket of their coveralls when removing sources from storage facility and placing them in transport shields, prior to transportation. After securing the loaded source transport shields on the vehicle, the dosimeter is moved to the employee's key ring, where it remains until arrival at the job location. Prior to removing sources from the transport shields, for utilization in well logging operations, the dosimeter is moved from the key ring back to the chest pocket of the employee's coveralls, where it remains for the duration of the job. Prior to leaving the job location and transporting the sources, the dosimeter is again placed on the employee's key ring, where it remains until the sources are returned to the storage facility and the employee leaves for the day.

WLS<sup>1</sup> stated that sometime during the 2<sup>nd</sup> Qtr 2011, they and a Well Logging Assistant (WLA) returned to the facility from a job location around 12:00 am. Upon arrival, the WLS<sup>1</sup> unlocked the transport shields on the truck and the door to the source storage area. The WLS<sup>1</sup> then unlocked the padlock on the downhole storage tube, leaving the keys hanging in the padlock with the padlock hanging on the lid of the downhole storage tube. Both logging sources, one at a time, were placed into the metal storage holders, approximately 8-12 inches from the dosimeter hanging on WLS<sup>1</sup>'s key ring, prior to placement in the downhole storage tube. The WLS<sup>1</sup> hastily left the storage area and proceeded to the restroom. While the WLS<sup>1</sup> was in the restroom, the door to the source storage area secured automatically with the keys inside. Upon return, the WLS<sup>1</sup> realized the keys were locked inside the storage area. The WLS<sup>1</sup> began making calls to other WLSs so they could retrieve the keys. Once contact was made with WLS<sup>2</sup>, WLS<sup>1</sup>'s keys and dosimeter were retrieved from the storage area and the logging sources were secured in the downhole storage tube, approximately 1.5 hours later. The WLS<sup>1</sup> stated that this incident was reported to their Engineer In Charge (EIC) the following morning.

## **Well Logging Supervisor2 (WLS<sup>2</sup>) Interview**

WLS<sup>2</sup> stated that sometime during the end of the 2<sup>nd</sup> Qtr 2011, they received a phone call, around midnight, from WLS<sup>1</sup> requesting access to the storage area so that WLS<sup>1</sup>'s keys could be retrieved, as the keys were unintentionally locked in the area. WLS<sup>2</sup> arrived at the facility approximately 15-20 minutes later. Upon opening the storage area, WLS<sup>2</sup> noticed WLS<sup>1</sup>'s keys and dosimeter hanging in the padlock, which was hanging on the lid of the downhole tube.

## **Phone records**

Phone records show only one call placed from WLS<sup>1</sup> to WLS<sup>2</sup> during the 2<sup>nd</sup> Qtr 2011, which occurred on 8-JUN-2011 at 12:50AM.



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## Radioactive Material Utilization Logs

Utilization Logs show entries, by WLS1<sup>1</sup>, returning sources to the storage area, around the times stated by both Well Logging Supervisors, on the following dates/times:

- 11-APR-2011 at 11:30 pm
- 17-MAY-2011 at 10:30 pm
- 29-MAY-2011 at 1:30 am
- 7-JUN-2011 at 11:30 pm
- 14-JUN-2011 at 10:00 pm
- 18-JUN-2011 at 12:30 am

## Electronic Storage Access Control System Records

The Storage Access Control System, for this facility, records the date and time on all entries into the radioactive material storage area. At the time of the incident in question, the system was not set up to record the specific individual that accessed the area.

Upon first analysis of the records, the Access Control System (ACS) dates/times did not coincide with the WLS1<sup>1</sup> entries in the Utilization Logs, nor did they coincide with any Utilization Log records for the entire 2<sup>nd</sup> QTR 2011. It was then realized that the ACS' internal time clock was incorrect. However, because the clock had been inadvertently reset to the correct time during data download, the exact time difference is unknown. Therefore, all ACS and Utilization Log records, for June 2011, were compared and the determination was made that the ACS' internal clock was behind actual time, approximately 1 hour and 50 minutes. After correcting the recorded times (forward 1 hour and 50 minutes) the ACS records coincide with all Utilization Logs for June 2011, within an average time of approximately 15 minutes.

## Analysis of Records

Because only one phone call occurred between WLS1<sup>1</sup> and WLS2<sup>2</sup> in the 2<sup>nd</sup> QTR 2011, the records for June 7<sup>th</sup> and 8<sup>th</sup> were scrutinized.

The Utilization Logs show that WLS1<sup>1</sup> returned two logging sources to storage on 7-JUN-2011 at 11:30 pm. This time coincides with the "corrected" ACS time of 11:31 pm on 7-JUN-2011.

Phone records show that WLS1<sup>1</sup> called WLS2<sup>2</sup> at 12:50 am on 8-JUN-2011, which was 1 hour and 20 minutes after entry into the storage area.

The next entry into the storage area, as recorded by the ACS "corrected" time, occurred at approximately 01:10 am on 8-JUN-2011, which is 20 minutes after the documented phone call.

The comparison of these records, phone, Utilization Logs and Access Control System (corrected time) corroborate the statements by both Well Logging Supervisors.

## WLS1<sup>1</sup>'s job history for 2<sup>nd</sup> quarter involving radioactive material

The employee participated in twenty well logging jobs during the 2<sup>nd</sup> Qtr of 2011. Of the twenty jobs, all included the removal and return of one 5Ci Am-241/Be source and one 1.5Ci Cs-137 source to/from storage. Fourteen of the jobs involved the installation of both sources to/from logging tools for well logging operations.



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WLS1<sup>1</sup> reported nothing out of the ordinary during this timeframe, other than the incident stated in WLS1<sup>1</sup> interview, above.

## WLS1<sup>1</sup>'s exposure history

For 2009 thru 2<sup>nd</sup> QTR 2010 the WLS1<sup>1</sup>'s exposure history is within a normal range when compared to employees in the district that regularly receive occupational dose. Their exposure does increase in the 3<sup>rd</sup> and 4<sup>th</sup> QTR 2010 to three times normal range, when compared to the previous six QTR's. When questioned about the increase, the WLS1<sup>1</sup> stated this was about the time they started placing their dosimeter on the key ring on a routine basis. Prior to beginning the placement of the dosimeter on the key ring as normal routine, the dosimeter was always worn on the chest pocket of the coveralls. Weatherford suspects the elevated dose starting in the 3<sup>rd</sup> QTR 2010 is due to the close proximity of the dosimeter to the sources while returning them to storage.

## Dose Calculations

Even though the exact details of the incident are not available (i.e., exact distances, exact time, exact line of sight, etc...), the dose recorded on the dosimeter of 7545 mrem is consistent with calculations conducted by Weatherford. The calculations completed included the following:

- Assumption of time (100 minutes)
- Assumption of distance (30cm)
- Known activity of the Cs-137 source (1487.5 mCi on 2-NOV-2004)
  - Due to decay and utilizing a 30.17 year half-life, Weatherford calculated the activity to be 1278.4 mCi on 7-JUN-2011.
- Known metal thickness of the metal storage holder (0.25 inches or 0.64cm)
  - Assuming HVL at 1.3cm for metal holder (approximate transmission factor of 0.75)
- Gamma Constant of 4.24 mR/hr per 1 mCi at 30cm

Dose rate in mR/hr = 4.24 (Gamma Constant) x 1278.4 (activity in mCi) = **5420.42 mR/hr**

Dose rate for assumed 100 minutes = 5420.42 (dose in mR/hr) / 60 (minutes) x 100 (assumed minutes) = **9034.03 mR**

Calculated dose rate after applying transmission factor = 9034.03 x 0.75 (transmission factor) = **6775.52 mrem**



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## Conclusion

On June 7, 2011, just before midnight, WLS1<sup>1</sup> entered the radioactive material storage area to return two well logging sources. The storage tube was unlocked and the WLS1<sup>1</sup>'s keys, with their dosimeter, were left hanging on the lid of the storage tube. Both logging sources were placed in the metal holder, approximately 12 inches (30cm) from the dosimeter. Prior to placing the sources and metal holder in the downhole storage tube, WLS1<sup>1</sup> exited the storage area and inadvertently locked their dosimeter and keys in the area. WLS1<sup>1</sup> called WLS2<sup>2</sup> approximately 1 hour and 20 minutes later to request access to the storage area for retrieval of the keys and dosimeter. WLS2<sup>2</sup> arrived approximately 20 minutes later and the keys and dosimeter were retrieved. The dosimeter was exposed to one 1.5 Ci Cs-137 source and one 5 Ci Am-241/Be source, both minimally shielded, for approximately 1 hour and 40 minutes at an approximate distance of 30cm.

Weatherford does not believe the exposure to the dosimeter was intentional. However, had the dosimeter been properly worn and controlled by the WLS1<sup>1</sup>, this overexposure would have been avoided. Weatherford believes complacency and disregard for the proper use and control of the dosimeter lead to this incident.

The WLS1<sup>1</sup>'s statement that the incident had been reported to the EIC could not be confirmed. The EIC stated that they do not recall being notified the morning after the incident. Had the incident been properly reported to the Site RSO and US RSO, the situation would have been immediately addressed.

Given the information acquired from this investigation, Weatherford concludes the dose of 7545 mrem is primarily to the dosimeter and not to WLS1<sup>1</sup>. Averaging the WLS1<sup>1</sup>'s previous 9 quarters of exposure (e.g., Qtr1 2009 thru Qtr1 2011), Weatherford estimates the employee's dose should have been approximately 394 mrem for the 2<sup>nd</sup> Qtr 2011. Therefore, Weatherford will request Landauer to remove 7151 mrem from the employee's dosimetry records and assess their dose at 394 mrem for the 2<sup>nd</sup> Qtr 2011.

## Corrective steps that will be taken to prevent future occurrence:

Weatherford will ensure WLS1<sup>1</sup> is retrained and reinstructed in the proper use and control of dosimeters and will not be allowed to work with radioactive materials for the remainder of 2011 until the NRC concurs that the YTD true dose is less than the applicable regulatory limits as calculated within this report.

All US radiation workers will be instructed on proper reporting procedures for all incidents involving radioactive material, dosimeters and all equipment associated with radioactive material.

Although the WLS1<sup>1</sup>'s elevated dose, seen in the 3<sup>rd</sup> and 4<sup>th</sup> QTR2010 and 1<sup>st</sup> QTR 2011, is within regulatory limits, Weatherford believes this incident could have been avoided by recognizing the elevation and investigating the increase and correcting the behavior. Immediately following this incident, Weatherford reduced the notification limits within the dosimetry providers system to aid in recognizing, acknowledging and investigating doses higher than normal.

This incident, along with corrective actions and an Internal Safety Alert will be disseminated to all radiation workers and their supervisors within the USA, in order to raise awareness and prevent similar incidents.

In attachments, you will find the following:

1. Facility Address
2. Employees information
3. Phone Records
4. Utilization Logs



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5. Access Control System Records (1-JUN-2011 thru 30-JUN-2011)
6. Access Control and Utilization Log time comparison and correction
7. Historical dosimetry records for WLS1 for the last 9 quarters.

If you have any further questions related to this incident, please do not hesitate to contact me. My contact information appears in the footer below.

Regards,

Christopher "Sean" Perry  
Radiation Safety Officer  
Weatherford International, Inc.

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