March 28, 2013
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AREVA

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Director, Division of Spent Fuel Storage
and Transportation
Office of Nuclear Material Safety and Safeguards
Washington, D.C. 20555-0001

Gentlemen:

Subject: **Report of Non-Compliance with Conditions in Certificate of Compliance 9291 for the Model Liqui-Rad (LR) Licensed Shipping Container; AREVA NP Inc. Richland, WA and Erwin, TN Facilities**

Attached please find information as required by 10 CFR 71.95(c) pursuant to three shipments of uranyl nitrate solution in Liqui-Rad (LR-230) licensed shipping containers that did not fully comply with NRC Certificate of Compliance (COC) USA/9291/B(U)F-96, Revision 8 for that container. The shipments were from AREVA's Erwin, TN facility to AREVA's Richland, WA facility. The instances of non-compliance were related to issues with the internal draw tube within the LR-230 vessel – a component depicted on license drawing LR-SAR Revision 8 but that is utilized strictly in conjunction with the downloading of the container contents at the receiving facility. The draw tube, its associated welds, and its orientation within the vessel are not germane to the ability of the LR-230 to maintain containment of its contents during transit. Accordingly, these instances of non-compliance with the cited license drawing did not reduce the safety of the affected shipments.

Specifics of the issues relative to the draw tube are provided in the attachment to this letter. The overall issue is being managed within AREVA's corrective action program and pertinent parties, the COC holder has been appropriately apprised of the situation.

If you have questions, please feel free to contact me at 509-375-8409.

Very truly yours,

R. E. Link, Manager
Environmental, Health, Safety, & Licensing

NM5524

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Attachment

Event Information Required by 10 CFR 71.95(c) Relative to Three Shipments of Two Liqui-Rad Packages (LR-230) That Did Not Meet the Requirements of License Drawing LR-SAR Revision 8 for NRC COC 9291

(1) A brief abstract describing the major occurrences during the event, including all component or system failures that contributed to the event and significant corrective action taken or planned to prevent recurrence.

On January 8, 2013 during the unloading of uranyl nitrate (UN) from LR230-19 by AREVA Richland personnel, it was noticed that the unloading operation took an excessive amount of time to empty the container. It was unknown at the time why it took longer than normal. Subsequent evaluation determined that this condition was caused by a cracked internal draw pipe.

On January 9, 2013 the trailer containing LR230-19 was shipped with eight other empty LR-230 containers from the AREVA Richland, WA site to the AREVA Erwin, TN site for refilling. It is likely the draw pipe attached to the primary lid of LR230-19 broke off completely while in transit to Erwin.

On January 18, 2013 AREVA Erwin personnel filled LR230-19 with UN along with the other eight LR230s on the trailer, not knowing that the draw pipe for LR230-19 had broken off. (The draw pipe is not needed to fill the container and is only used to empty the contents.)

On January 22, 2013 AREVA Erwin shipped LR230-19 full of UN while the draw pipe had broken off from the primary lid, in violation of license drawing LR-SAR Revision 8 and NRC CoC 9291 Rev. 8 for the Model Liqui-Rad package.

On January 28, 2013 AREVA Richland personnel were unable to unload the UN from LR230-19. An examination through the primary lid draw port revealed that the draw pipe for LR230-19 had broken off. In order to empty the container, a temporary draw tube was made that was inserted into the permanent draw pipe cap opening and temporarily attached to the top of the draw pipe assembly. Using the temporary pipe, AREVA Richland personnel were able to empty LR230-19.

On February 1, 2013 AREVA Richland shipped empty LR230-19 back to AREVA Erwin along with eight other empty LR-230 containers.

On February 4, 2013 AREVA Erwin removed the primary lid from LR230-19 and confirmed that the draw pipe was completely broken off. The break was next to the lower weld on the bottom of the primary lid. The broken draw pipe was removed from LR230-19 and the inside of the vessel was visually examined for damage; none was found. In order to get LR230-19 back in service, the primary lid from LR230-47 (LR230-47 had never been used) was placed on LR230-19. License drawing LR-SAR Revision 8 has a requirement for the gap between the end of the draw pipe and the bottom of the vessel to be 3/8" ± 1/8". AREVA personnel assumed that the Liqui-Rad primary lids were interchangeable and therefore did not recognize a potential issue with the pipe to vessel gap. This assumption was based on the fact that in 2003 the primary lid on

LR230-15 had been replaced with the lid from LR230-01 (LR230-01 having never been used) and LR230-15 had been used since that time with no problems, although the pipe to vessel bottom gap had never been measured since the replacement lid had been placed on the packaging. The required leak tests were successfully completed on LR230-19 and it was filled with UN.

As a result of this incident, CHT (the design owner), Transnuclear (CHT's new owner), TVA (the owner of the affected Liqui-Rad packaging), NFS and Westinghouse Electric Company (other registered users of the package), and the NRC were notified of the condition.

(As described below, it was later [February 22] found out from CHT that the primary lids are not interchangeable with respect to the draw tube length and that the length of each draw pipe was custom determined during fabrication of each container. Also as described below, it was determined that the pipe to vessel bottom gap for LR230-19 with the primary lid from LR230-47 did not meet the license drawing requirement.)

On February 7, 2013 AREVA Erwin shipped LR230-19 full back to AREVA Richland along with eight other full LR-230s. As discussed above, the pipe to vessel bottom gap of LR230-19 did not meet the license drawing requirement; therefore the shipment was made in violation of the requirements of CoC 9291 Rev. 8.

On February 11, 2013 AREVA Richland personnel successfully emptied LR230-19 with no problems but reported difficulty trying to empty LR230-16. LR230-16 had the same symptoms that LR230-19 showed before the draw pipe broke off, and it was suspected that the draw pipe in LR230-16 had cracked. AREVA personnel successfully emptied LR230-16 using the temporary draw tube.

On February 12, 2013 AREVA Richland shipped LR230-16 and LR230-19 empty along with seven other empty LR-230s to AREVA Erwin. LR230-16 was sent to Erwin so the primary lid could be replaced with the primary lid from LR230-50, which had never been used.

On February 14, 2013 AREVA Erwin replaced the primary lid on LR230-16 with the primary lid from LR230-50, again assuming that the lids were interchangeable. LR230-16 was successfully leak tested and filled with UN along with the other eight LR-230s on the trailer, including LR230-19. (As described below, it was later [February 22] determined that the pipe to vessel bottom gap for LR230-16 with the primary lid from LR230-50 did not meet the license drawing requirement.) AREVA Erwin personnel also confirmed that the draw pipe on the primary lid removed from LR230-16 was cracked, with the crack being next to the lower weld on the primary lid just as it had been for LR230-19. The cracked draw pipe on the primary lid from LR230-16 was deliberately broken off to better examine the fracture surface.

On February 16, 2013 AREVA Richland personnel reported difficulty trying to empty LR230-33 (which was on a different trailer than 16 and 19), and suspected a cracked draw pipe. AREVA Richland personnel were able to successfully unload LR230-33 using the temporary draw tube. A hold tag was placed on LR230-33, indicating that it had a suspected cracked primary lid draw pipe.

On February 18, 2013 AREVA Richland personnel removed LR230-33 from the trailer since the two remaining spare LR-230s (48 and 49) were in Richland.

On February 21, 2013 Columbiana Hi-Tech (CHT) issued a letter confirming that the welded draw pipe connection to the primary lid is not part of the containment boundary for the LR-230 container and that the containment boundary is not affected by cracking or failure of the draw pipe or the welds that attach it to the primary lid.

On February 22, 2013 AREVA Erwin shipped LR230-16 and LR230-19 full back to AREVA Richland along with seven other full Liqui-Rad packages. As discussed above, the pipe to vessel bottom gaps of LR230-16 and LR230-19 did not meet the license drawing requirement and therefore violated the requirements of CoC 9291 Rev. 8.

Later in the day on February 22, 2013 AREVA Richland personnel examined the primary lid from LR230-33 and visually verified that the draw pipe was cracked next to the lower weld on the primary lid, just like the other two draw pipe failures. The length of the draw pipe on lid 33 was measured from the bottom of the primary lid to the end of the pipe and was found to be 45 ½" long. The draw pipe lengths on the two available spare primary lids were also measured, with lid 48 having a draw pipe length of 45 ¼" and lid 49 having a draw pipe length of 45 ½". Since the draw pipe length for lids 49 and 33 were identical, primary lid 49 was placed on LR230-33.

During the afternoon of February 22, 2013 CHT informed AREVA that the draw pipe length for each LR230 was custom fitted during the manufacturing process. Based on this information and the differences found in the pipe lengths of lids 48 and 49, a Condition Report (CR 2013-1581) was generated to document that the pipe to vessel bottom gaps for LR230-15, LR230-16 and LR230-19 were in question.

On February 26, 2013 AREVA Richland personnel placed LR230-33 (with lid 49) back on its trailer and shipped it (with eight other empty LR-230s) to AREVA Erwin for leak testing and filling with UN. Also on February 26 Richland Maintenance fabricated a measuring device to measure the draw pipe end to vessel bottom gaps on Liqui-Rads 15, 16, and 19.

On February 27, 2013 AREVA Richland personnel emptied Liqui-Rads 15, 16 and 19 with no difficulties and then used the measuring device to measure pipe to vessel bottom gaps in the three containers. The gap for LR230-15 was acceptable at 0.44", but the gaps for LR230-16 and LR230-19 were unacceptable at 0.7525" and 0.6275" respectively. Based on these results LR230-15 was released for use and LR230-16 and LR230-19 were taken out of service.

(Note that before the end of February a qualified weld inspector visually inspected the outer primary lid welds on the draw tubes for all of the Liqui-Rad packagings and all were found to be sound, including the three lids with cracked fill pipes.

On March 7, 2013 AREVA Richland personnel determined during emptying of LR230-15 that the draw pipe (on lid 01) was cracked, and LR230-15 was taken out of service after emptying. LR230-15 was on the same trailer as LR230-16 and LR230-19.

On March 13, 2013 AREVA Richland personnel determined during emptying of LR230-20 that the draw pipe was cracked and LR230-20 was taken out of service after emptying. LR230-20 was on a different trailer than Liqui-Rads 15, 16, and 19.

On March 18, 2013 AREVA Richland personnel determined during emptying of LR230-11 that the draw pipe was cracked and LR230-11 was taken out of service after emptying. LR230-11 was on the same trailer as Liqui-Rads 15, 16, and 19.

For further discussion of corrective actions from this event, see discussion under (4), below.

(2) A clear, specific, narrative description of the event that occurred so that knowledgeable readers conversant with the requirements of Part 71, but not familiar with the design of the packaging, can understand the complete event. The narrative description must include the following specific information as appropriate for the particular event.

A narrative of the event was provided under (1), above. Liqui-Rad license drawing LR-SAR Revision 8 shows the draw pipe in place and requires the gap between the end of the draw pipe and the vessel bottom to be 3/8" ± 1/8". As described above, one shipment of LR230-19 was made with UN with the draw pipe completely broken off, two shipments were made with this container while full of UN with the pipe end to vessel bottom gap requirement being exceeded, and in one of these same shipments LR230-16 was shipped full of UN with the pipe to vessel bottom gap being exceeded. All three of these shipments violated the requirements of the Liqui-Rad license drawing and therefore violated the requirements of COC 9248 Rev. 8.

(i) Status of components that were inoperable at the start of the event and that contributed to the event;

As described above, the events involved shipping blended low enriched UN in Type B Model Liqui-Rad packagings that were not compliant to the license drawing. The draw pipe has no significance during shipping and is only needed to empty the UN from the package. The UN was fully contained in the package during transport and all other operations.

(ii) Dates and approximate times of occurrences;

On January 22, 2013 LR230-19 was shipped full with a broken draw pipe from AREVA Erwin to AREVA Richland.

On February 7, 2013 LR230-19 (with the primary lid from LR230-47) was shipped full of UN from AREVA Erwin to AREVA Richland with the draw pipe to vessel bottom gap exceeding ½".

On February 14, 2013 LR230-16 (with the primary lid from LR230-50) and LR230-19 (with the primary lid from LR230-47) were shipped full of UN from AREVA Erwin to AREVA Richland with the draw pipe to vessel bottom gaps exceeding ½".

(iii) The cause of each component or system failure or personnel error, if known;

It appears that the draw pipes failed due to metal fatigue. The Liqui-Rad packaging design appears to be flawed in that the ~45 ½" long draw pipe (called a fill pipe on the fabrication drawings) is restrained at one end by welding to the primary lid but the other end is unrestrained, which can cause movement of the unrestrained pipe end during shipping.

The pipe end to vessel bottom gap violations occurred because AREVA assumed that the primary lids were fully interchangeable, when in actuality this was not the case relative to the draw pipe to vessel bottom gap dimension.

(iv) The failure mode, mechanism, and effect of each failed component, if known;

The draw pipes appear to have failed due to metal fatigue in the lower pipe to primary lid weld heat-affected zone. The unrestrained end of the draw pipe could move during shipping which could cause microcracks to form in the heat-affected zone of the lower lid to pipe weld. Once one or more microcracks initiated, they would propagate to form one or more macrocracks. The macrocracks would continue until the wall of the pipe was cracked through or, as in the case of LR230-19, the draw pipe broke off completely. The draw pipe has no safety or shipping function and is only needed to remove the UN from the package. It has been shown that a temporary draw tube can serve the same function as the permanent draw pipe and that functionally the permanent draw pipe is not needed.

The 3/8" ± 1/8" pipe to vessel bottom end gap requirement appears to be overly conservative in that the package can be adequately and safely emptied with a gap larger than ½".

(v) A list of systems or secondary functions that were also affected for failures of components with multiple functions;

Other than the draw pipe, no other systems or functions were affected by the failures.

(vi) The method of discovery of each component failure or procedural error.

The cracks in draw pipes were identified by AREVA personnel having difficulty in removing the UN from the Liqui-Rad packages, although it took some time to understand the problem.

The non-compliant draw pipes to vessel bottom gaps were found by measuring the gaps using the fabricated measuring device.

(vii) For each human performance-related root cause, a discussion of the causes and circumstances;

It is believed that the designers of the Liqui-Rad package assumed that vibration caused by normal transportation would not affect the draw pipe, while evidence has shown that under the right conditions, normal transportation vibrations can cause fatigue failures of the draw pipes. The weakness in the design was only discovered when the long distance round trip shipments between Erwin, TN and Richland, WA were initiated.

The two pipe to vessel bottom gap violations occurred because AREVA personnel assumed that the primary lids on the Liqui-Rad packagings were fully interchangeable, when in reality they were not with respect to the pipe to vessel bottom gap dimension.

(viii) The manufacturer and model number (or other identification) of each component that failed during the event;

The draw pipe attached to the primary lid of the Liqui-Rad packagings was designed and manufactured by CHT.

(ix) For events during the use of a packaging, the quantities and chemical and physical forms(s) of the package contents;

For the shipments, the contents consisted of up to 230 gallons of ≤ 5 weight percent ^{235}U liquid UN that met the requirements of Table 1 in Section 5(b)(2) of CoC 9291 Revision 8.

(3) An assessment of the safety consequences and implications of the event. This assessment must include the availability of other systems or components that could have performed the same function as the components and systems that failed during the event.

There were no safety consequences as a result of these events. As stated above, the draw pipe has no safety function during transportation and neither it nor its welds are part of the containment boundary. The draw tube is classified as a Safety Category C item. It has been shown that a temporary draw tube can be used as effectively to remove the UN from the package as the permanent draw pipe.

(4) A description of any corrective actions planned as a result of the event, including the means employed to repair any defects, actions taken to reduce the probability of similar events occurring in the future;

- *Fifteen replacement draw pipes have been purchased from CHT. The lengths of the draw pipes are long enough so that they can be cut as needed to meet the pipe to vessel bottom gap requirement. To date, a draw pipe in the primary lid for LR230-33 has been replaced by drilling out the old pipe and welding in the new pipe. The final leak tests have not been completed and the pipe has not been cut to length. The plan is to replace other cracked draw pipes as needed with replacement pipes on other affected primary lids.*
- *The plan is to remove the primary lids from LR230-16 (lid 50) and LR230-19 (lid 47) and return them to their matching Liqui-Rad packagings (LR230-47 and LR230-50) and place these previously unused Liqui-Rads into service.*
- *CHT and Transnuclear (who now owns CHT) have been informed of the design flaw and it will be up to them to address the design issues.*

(5) Reference to any previous similar events involving the same packaging that are known to the licensee or certificate holder.

AREVA NP is unaware of any previous similar events involving the Liqui-Rad packagings.

(6) The name and telephone number of the person within the licensee's organization who is knowledgeable about the event and can provide additional information.

Robert E. Link, Manager
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(7) The extent of exposure to individuals to radiation or radioactive materials without identification of individuals by name.

During the use of the temporary draw tube to empty the affected Liqui-Rad packagings and during the processes to remove, repair or replace the primary lids, appropriate steps were taken to limit the exposures of workers to radioactive materials. There was no incremental risk to the public at any time due to the component failures associated with these shipments.