AOS
Alpha-Omega Services, Inc.

April 28, 2021

ATTN: Document Control Desk

Director, Division of Fuel Management

Office of Nuclear Material Safety and Safeguards

U.S. Nuclear Regulatory Commission

Washington, DC 20555-0001

Subject: Regulatory Requirement §71.95 Report; 60-Day Written Notification of Event
AOS SAR Document No. FM9054 Revision H-7 (1)
Docket No. 71-9136; Certificate Number 9316 (1)

Pursuant to the requirements of §71.95(a)(3) Alpha-Omega Services, Inc. is providing USNRC with written notification and report for instances in which the conditions of approval in the Certificate of Compliance were not observed in making a shipment. The report is being submitted within the 60 days of discovery of the event (March 10, 2021) as required by 10CFR 71.95; and in accordance with AOS SOP PR9015.2 Revision D (12-20-2018) Section 6.3.

This letter serves as the notification and final report to the Commission per §71.95(c); with information proved for §71.95(c) (1) through (7) as required.

If you or your staff have any questions, require additional information, or wish to discuss this matter further, please feel free to contact me.

Sincerely,

Alpha-Omega Services, Inc.

Troy Hedger, President

Attachment: 60-Day Notification of Reportable Event

(1) Since discovery on March 10, 2021, the SAR document FM9054 has been revised to Revision J; and the USNRC Certificate of Compliance has been amended to Revision 10.

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

The AOS Safety Analysis Report (SAR) Document No. FM9054 Revision H-7 [(2)] Section 8.2.2(b) provides for the helium Mass Spectrometer Leak Detector (MSLD) used for periodic leak testing to have, "a sensitivity of < 1 x 10^{-9} ref-cm^3/sec (helium)".

USNRC CoC 9316 Revision 9 [(3)] Condition No. 6(b) states, "Each packaging must meet the Acceptance Tests and Maintenance Program of Chapter No. 8 of the application."

Contrary to this requirement it has been found that (13) of the (18) annual (periodic) helium leak tests completed on the AOS-100A Transport Packagings between 2014 and 2020 were identified as not being in compliance with the SAR requirement regarding instrument sensitivity. All shipments made by AOS using the subject packaging comply with the requirements of ANSI N14.5 1997 and/or 2014; and there was no impact on the effectiveness, or the safety of the shipments made during the same period.

[(2)] Since discovery on March 10, 2021, the SAR document FM9054 has been revised to Revision J. Reference made to this document throughout the report will remain as Revision H-7.

[(3)] Since discovery on March 10, 2021, the USNRC Certificate of Compliance has been amended to Revision 10. Reference made to this document throughout the report will remain as Revision 9.

(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*.

Reference: AOS Document Number FM9054 Rev. H, *Radioactive Material Transport Packaging System Safety Analysis Report for Model AOS-025, AOS-050, and AOS-100 Transport Packages (Note: Revision H, dated December 30, 2012; Docket No. 71-9136*; Chapter 8 Acceptance Tests and Maintenance Program); and subsequent SAR revisions issued to date.

SAR FM9054 Section 8 Acceptance Tests and Maintenance Program; Section 8.2.2(b) Periodic Leak Testing, states, in part, "*Periodic leak testing must be performed annually, or prior to the transport package being used, after a storage period of more than one (1) year, or prior to returning to service after repairs (such as weld repair) and/or replacing containment components. The cask lid seal, vent and drain threaded pipe plugs, and the port plug conical seal must be leak-checked with a helium MSLD.* ***This instrument has a sensitivity of < 1 x 10^{-9} ref-cm^3/sec (helium)***."

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During the 2021 NRC Inspection (March 8-11, 2021) of AOS QA Program activities in accordance with 10CFR Part 71 requirements a sampling of records was conducted of the 2019 and 2020 Annual Inspection Requirements of the AOS-100A Transport Packages that the instrument range (and resolution) for the helium mass spectrometer was recorded. Based on the MSLD resolution reported for three of the four annual inspection documentation packages reviewed, it was subsequentially determined that actual instrument sensitivity exceeds the SAR required instrument sensitivity and determined not to be in compliance with the statement in the SAR Document.

AOS corrective action was initiated (re. CAPA No. FM9016.1-032021-001) and a review of all previous annual inspections was conducted to determine the extent of the reported condition. Results of the review identified that of the eighteen (18) annual (periodic) helium leak tests completed between May 22, 2014 and December 6, 2020 there were thirteen (13) instances where the helium leak tests completed were found not in compliance with the SAR requirement regarding instrument sensitivity. This information was reviewed and concurred by Leak Testing Specialists Inc., the AOS approved leak testing supplier.

It has been determined that all shipments made by AOS within the same time period using the subject packaging comply with the requirements of ANSI N14.5 1997 and/or 2014, and there was no impact on the effectiveness or the safety of the shipments.

(a) *Status of components or systems that were inoperable at the start of the event and that contributed to the event*.

The AOS-100A Packagings were controlled in accordance with designated procedures for performance of the annual inspection and maintenance activities. All helium MSLDs used at the time of occurrences were properly calibrated - at the time of equipment startup and calibration, by the approved leak testing services supplier in accordance with their approved procedures and using calibrated Helium standard leaks. The equipment calibration is determined to be meeting the requirements specified by ANSI N14.5; and further, system sensitivities were performed and documented accordingly.

(b) *Date(s) and approximate time(s) of occurrence(s)*.

Dates of occurrences for subject annual inspection (Packaging Serial Nos.):

- May 21 and 22, 2014 (SNs AOS-100A-0002; AOS-100A-0004)
- March 18 and 20, 2015 (SNs AOS-100A-0001; AOS-100A-0003)
- June 6, 2015 (SNs AOS-100A-0002; AOS-100A-0004)

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- June 24 and 25, 2016 (SNs AOS-100A-0001; AOS-100A-0002; AOS-100A-0004)
- May 2 through 7, 2019 (SNs AOS-100A-0001; AOS-100A-0002; AOS-100A-0004)
- June 17-18, 2020 (SN AOS-100A-0002)

(c) *The cause of each component or system failure or personnel error, if known*.

(AOS) The apparent cause of the condition adverse to Quality stems from verbiage in the SAR document not appropriate to ANSI N14.5 requirements. Leak Testing Specialists issued AOS a letter providing their Level III comments and observations for the reconciliation of LTS procedures and plans for leak testing, the AOS SAR and Procedure PR9110, and correspondence between AOS and the USNRC. The letter is dated November 27, 2013.

The letter was transmitted to AOS via email on December 3, 2013.

A review of the letter was completed by AOS on December 5, 2013 as identified in an email.

From a review of correspondence with NRC and SAR revisions completed at that time, it is apparent that the issue regarding “instrument sensitivity” as addressed by the LTS letter was not incorporated into the SAR document (re. FM9054 Rev. H, as supplemented).

AOS also failed to reconcile the LTS Leak Test Procedures with the specific requirements of the conditions applicable to the SAR document Section 8.2.2(b).

The genesis of the instrument sensitivity SAR requirement is from ASME Boiler & Pressure Vessel Code Section V Nondestructive Examination - 2004 Code Edition and Addenda, Article 10 Leak Testing - Appendix IX Helium Mass Spectrometer Test – Hood Technique. Section IX-1060 Calibration - Subsection IX-1061.2 Calibration states in part, “… The instrument shall have a sensitivity of at least 1×10^{-9} std cm^3/s (1×10^{-10} Pa m^3/s) for helium.”

ANSI N14.5, *American National Standard for Radioactive Materials – Leakage tests on Packages for Shipment* Section 1 states, “This standard specifies methods for demonstrating that Type B packages designed for transport of normal form radioactive material comply with the containment requirements of Title 10 of the Code of Federal Regulations Part 71 (10 CFR Part 71).”

Per ANSI N14.5 Table 1 – Containment boundary test requirements for maintenance (7.4) and periodic (7.5) test; and the test criteria specified is “*Leakage rates less than the reference air leakage rate, L_R*”. There are no specific requirements relating to “instrument sensitivity”.

(LTS) During development of the AOS-100 Periodic Procedure in 2013, LTS issued a letter identifying needed SAR changes to address ANSI N14.5 1997.

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This letter's subject was "Leak Test Level III Comments and Observations for reconciling LTS Leak Test Procedures, plans for AOS 100 leak testing, AOS 100 SAR, AOS Procedure PR9110, and AOS-USNRC Correspondence" issued on November 27, 2013. The following areas of this letter addressed eliminating the SAR instrument sensitivity statements and replacing them with ANSI N14.5 requirements referencing "leaktight" acceptance criteria and minimum test procedure sensitivity:

1. Change 10 of Letter detailed on page 7 of 12: this addresses the Table 8-1 footnote "f" discrepancy.
2. Change 12 detailed on page 8 of 12: this addresses the Paragraph 8.1.4 mention of instrument sensitivity (needs change to test procedure sensitivity).
3. Change 15 detailed on page 9 of 12: this addresses the Paragraph 8.2.2(b) mention of instrument sensitivity (the NRC minor violation).
4. Change 18 detailed on page 11 of 12 addresses the MSLD instrument sensitivity mention in AOS Procedure PR9110; this should be corrected as well.

After issuance of the letter, LTS completed procedure qualifications and the final procedure development without confirming that the SAR changes were incorporated. Since the original procedure issuance, LTS has revised the AOS-100 procedure twice more without "again" confirming that the changes recommended to SAR in the November 27, 2013 were completed. Current revision of the AOS-100 Periodic procedure is MSLT-C100-AOS Revision 5980-02.

(d) *The failure mode, mechanism, and effect of each failed component, if known*.

The failure mode has been provided in (c), above. Committed actions not carried out by both AOS and LTS; and organization to organization interface deficiencies attributed to the condition adverse to Quality.

As discussed above, there is no effect on any components. All shipments made by AOS using the subject packaging comply with the requirements of ANSI N14.5 1997 and/or 2014; and there was no impact on the effectiveness, or the safety of the shipments made during the period identified.

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(e) *A list of systems or secondary functions that were also affected for failures of components with multiple functions*.

There are no systems or secondary functions that were affected as there was no failure of components with multiple functions identified.

(f) *The method of discovery of each component or system failure or procedural error*.

The method of discovery is based on the review of the sampling of records conducted of 2019 and 2020 Annual Inspection Requirements; and the minor violation reported to AOS by the USNRC Inspection team during the 2021 NRC Inspection (March 8-11, 2021).

(g) *For each human performance-related root cause, a discussion of the cause(s) and circumstance(s)*.

Committed actions not carried out: Action should have been taken by AOS after receipt of the letter from LTS and made appropriate changes to the SAR. Void of completing changes to the SAR document to remove or change the requirement, instrument sensitivity should have been addressed in the LTS leak testing procedures, as the requirement was identified as a SAR requirement. AOS, in their review and approval of the leak testing procedures should have identified and commented on the lack of a statement in the procedures; and the procedures corrected. Use of equipment meeting or exceeding the specified requirement would also resolve any deficiency in the performance of the procedure requirements.

Organization to organization interface deficiencies: See committed actions not carried out.

(h) *The manufacturer and model number (or other identification) of each component that failed during the event*.

There were no component failures identified with the event reported.

Components associated with the event are:

- Packaging Serial Number AOS-100A-0001
- Packaging Serial Number AOS-100A-0002
- Packaging Serial Number AOS-100A-0003
- Packaging Serial Number AOS-100A-0004

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(i) *For events occurring during the use of packaging, the quantities and chemical and physical form(s) of the package contents*.

Not applicable; the subject Packagings were not in use at the time of the events reported; the Packagings were empty and prepared for annual inspection and maintenance activities in accordance with procedural requirements.

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

There are no safety consequences or implications based on the event reported. It has been determined that all shipments made by AOS within the same time period using the subject packaging comply with the requirements of ANSI N14.5 1997 and/or 2014 editions, and there was no impact on the effectiveness or the safety of the shipments.

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

AOS has initiated Corrective and Preventive Action, CAPA No. FM90-16.1-03202-001 to identify the condition adverse to quality. The following are the five (5) corrective and preventive actions to be completed by AOS.

a. <u>Notify Leak Testing Specialists, Inc. (LTS) to initiate corrective action for the condition adverse to quality and to provide an apparent cause analysis</u>.
Leak Testing Specialists, Inc. was notified by AOS via email dated 3/15/2021; Subject - AOS CAPA No. FM9016.1-032021-001; SAR Section 8.2.2(b); to initiate corrective action for the condition adverse to quality and to provide an apparent cause analysis.

LTS has provided AOS with a copy of their written corrective action, CAR No. 21-03 (03-16-2021) providing a summary, detailed engineering description, technical acceptance of condition, probable cause, remedial action and corrective action. Completion of the LTS CAR will be done concurrently with the AOS CAPA document in accordance with the LTS quality assurance program.

LTS Remedial Action:

AOS is revising the AOS-100 SAR to address relevant LTS recommended changes detailed in letter “Leak Test Level III Comments and Observations for reconciling LTS Leak Test Procedures, plans for AOS 100 leak testing, AOS 100 SAR, AOS

Procedure PR9110, and AOS-USNRC Correspondence" issued on November 27, 2013. LTS will complete an independent evaluation of the SAR after these changes are incorporated and before submittal to the NRC.

LTS Corrective Action:

When permitted and notified by the Client, LTS will review the affected SAR sections in the future during procedure revision cycles to evaluate whether recent SAR changes impact LTS leak testing practices. LTS will implement additional training on SAR's (Sections 7 and 8 – typically the leak testing portions) for company procedure writers and engineers to orient personnel on how to traverse these types of documents to review applicable requirements. In addition, LTS-QA will create a Procedure Qualification Log to follow status of Client SAR change requests.

b. Perform a Regulatory Requirements Reportability Evaluation of the condition adverse to quality; and if reportable, complete the specific reporting requirements.

AOS has initiated Regulatory Requirements Reportability Evaluation, No. FM9015.2-032021-001; and the Evaluation and Summary of the Evaluation and Basis for Conclusion has been completed. It has been concluded that although the difference in MSLD instrument sensitivity is considered technically insignificant; the issue was that the event is not in compliance with stated requirements of §71.95(a)(3), as follows:

- The AOS Safety Analysis Report (SAR) Document No. FM9054 Revision H-7 Section 8.2.2(b) provides for the helium Mass Spectrometer Leak Detector (MSLD) used for periodic leak testing to have, "a sensitivity of $< 1 \times 10^{-9}$ ref-cm^3/sec (helium)".
- USNRC CoC 9316 Revision 9 Condition No. 6(b) states, "Each packaging must meet the Acceptance Tests and Maintenance Program of Chapter No. 8 of the application."

As both these requirements are directly related to the event, this has been determined to be a reportable event. In accordance with §71.95(c), a written report is to be submitted to the Commission within 60 days (no later than May 10, 2021) of the event or discovery of the event.

c. Review and verify the need to identify "instrument sensitivity" in the SAR document as it relates to the requirements specified by ANSI N14.5-2014.

LTS CAR No. 21-03 provides "Technical Acceptance of Condition" and its conclusion (see LTS CAR No. 21-03 and Apparent Cause – "Excerpted from CAR No. 21-03", above). It has been concluded that, "Overall, the difference in MSLD instrument sensitivity is considered technically insignificant. The importance of the

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test procedure sensitivity (or system sensitivity) far outweighs the instrument sensitivity because it is a direct indicator of test capability and already considers factors such as MSLD instrument sensitivity."

d. Review the SAR FM9054 with ANSI N14.5-2014 to determine changes necessary to clarify any specific requirements relating to the periodic helium leak test; and complete the SAR Revision for submittal and approval by USNRC.

The SAR FM9054 Revision J has been reviewed and a revision is currently being prepared for submittal to request amendment of the current certificate of compliance. The review and subsequent revision to Chapter 7 (Package Operations) and Chapter 8 (Acceptance Tests and Maintenance Program) regarding issues applicable to this event are identified below.

Changes to be made to SAR FM9054 Chapter 7 include:

1. Page 7-12; 7.1.3.3: Change to read as follows: "To verify that the transport package's containment system is properly assembled for shipment, perform one of the following Pre-Shipment Leak tests – Test A1, A2 or B – depending on the content and cask lid seal type. Tests A1 and A2 are minimum requirements for shipments that contain Special Form contents. Test B is the minimum test required for shipments that contain Normal Form content. However, Test B can be performed in lieu of Tests A1 or A2. Notes: A Periodic or Maintenance Leak test performed on a loaded cask in accordance with Subsection 8.2.2 may be acceptable as a Pre-Shipment Leak test, provided that the test meets or exceeds the requirements for Pre-Shipment Leak testing described below. When the Model AOS-100A-S is used, both cask lid seals must be leak tested."

2. Page 7-13; 7.1.3.3 Test B: Change title, "Tracer Gas: For Normal Form Contents (Tests: Lid (Cask Lid Seal), Vent and Drain Ports). Replace entire section as follows, "The cask lid seal, and vent and drain threaded pipe plugs must be leak-tested in accordance with ANSI N14.5-2014 [7.8]. The acceptance criteria is 1×10^{-7} ref-cm^3/sec air at an upstream pressure of a minimum of 1 atmosphere and downstream pressure of 0.01 atmosphere absolute or less. The test procedure sensitivity must be one-half of the reference air leakage rate (i.e., 5×10^{-8} ref-cm^3/sec of air) or less."

Changes to be made to SAR FM9054 Chapter 8 include:

3. Page 8-2; Table 8-1 Acceptance Test Matrix Footnote 'f': Change to read, "MSLD Helium test procedure sensitivity of at least 5 x 10^{-8} ref-cm^3/sec."

4. Page 8-4; 8.1.4 Leakage Tests: Replace entire section as follows: "The containment system, which includes the cask cavity, cask lid, welds, port plug

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assembly, seals, and penetrations, is leak tested during fabrication in accordance with ANSI N14.5-2014 [8.4]. The acceptance criteria is 1×10^{-7} ref-cm^3/sec of air at an upstream pressure of 1 atmosphere and downstream pressure of 0.01 atmosphere absolute or less. The test procedure sensitivity must be one-half of the reference air leakage rate (i.e., 5×10^{-8} ref-cm^3/sec of air) or less. Note: Casks manufactured prior to April 2016 were leak tested in accordance with the 1997 edition of ANSI N14.5."

5. Page 8-17; 8.2: Correct end of last sentence to read, "… as detailed in Subsection 8.2.2(b)."

6. Page 8-17; 8.2.2(b): Change section to read, "Periodic leak testing must be performed prior to the transport package's first use, after its third use, annually, and/or prior to the transport package being used after a storage period of more than one (1) year. The cask lid seal, vent and drain threaded pipe plugs, and the port plug conical seal must be leak-tested in accordance with ANSI N14.5-2014 [8.4]. The acceptance criteria is 1×10^{-7} ref-cm^3/sec air at an upstream pressure of 1 atmosphere and downstream pressure of 0.01 atmosphere absolute or less. The test procedure sensitivity must be one-half of the reference air leakage rate (i.e., 5×10^{-8} ref-cm^3/sec of air) or less."

7. Page 8-17; 8.2.2: Add subsection (c) Maintenance Leak Testing; the section to read, "Maintenance leak testing is performed to confirm that maintenance, repair, and/or replacement of components has not degraded containment system performance. The portion of the containment system affected by the maintenance, repair and/or component replacement must be leak-tested in accordance with ANSI N14.5-2014 [8.4]. The acceptance criteria is 1×10^{-7} ref-cm^3/sec air at an upstream pressure of 1 atmosphere and downstream pressure of 0.01 atmosphere absolute or less. The test procedure sensitivity must be one-half of the reference air leakage rate (i.e., 5×10^{-8} ref-cm^3/sec of air) or less."

   Correct 1st note to read, "Notes: For shipments of Special Form material, a Maintenance Leak test is not necessary after replacement of a cask lid elastomeric seal, provided that a Periodic Leak test has been performed on the cask's containment system within the past 12 months and a Pre-Shipment Leak test is performed in accordance with Paragraph 7.1.3.3."

   Add 2nd note to read, "Periodic and Maintenance Leak testing on casks prior to April 2016 may have been performed in accordance with the 1997 edition of ANSI N14.5."

Changes to the SAR have been completed and approved by AOS and concurred by LTS (re. AOS Document No. FM9006.1-042021-014); and are to be submitted as a

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request to USNRC for an amendment to the certificate of compliance (i.e., CoC 9316). These actions are identified by AOS Project Plan / Design Change Request Form, FM9003.2-032020-001, and therefore, do not preclude closure of the AOS CAPA document. Submittal of the request for amendment will be concurrent with the submission of this report.

e. Review applicable procedures to determine changes necessary to clarify any specific requirements relating to the periodic helium leak test; and complete the procedure revisions, as required.

Review and changes to the applicable leak testing procedures will be conducted by LTS upon completion of the SAR changes; and the request to USNRC as an amendment to the certificate of compliance (i.e., CoC 9316) has been accepted and revision issued. The procedure revisions will be submitted to AOS for review and approval as documented on a form FM9006.3, Non-AOS Document Approval and Tracking Form; and therefore, does not preclude closure of the AOS CAPA document.

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

There are no previous similar events involving the identified Packaging; and no other events are known or have been reported by the licensee or certificate holder.

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

Troy Hedger, President
Alpha-Omega Services, Inc.
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(7) *The extent of exposure of individuals to radiation or to radioactive materials without identification of individuals by name*.

There was no exposure of individuals to any radiation or radioactive material during this event; the Packagings were undergoing annual inspection and maintenance activities under the control of AOS; no shipping activities were being accomplished.

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Conclusion:

Overall, the difference in MSLD instrument sensitivity is considered technically insignificant. The importance of the test procedure sensitivity (or system sensitivity) far outweighs the instrument sensitivity because it is a direct indicator of test capability and already considers factors such as MSLD instrument sensitivity. However, both AOS and LTS acknowledge that not including the SAR Section 8.2.2(b) requirement in the applicable AOS-100 procedure and testing was an oversight that is being addressed by the appropriate quality program requirements.

The corrective actions outlined are in the process of being completed by both AOS and LTS in accordance with their respective quality assurance program requirements.

Therefore, this letter constitutes the final evaluation and report as required by §71.95(a)(3).