UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION REPORT
U.S. Department of Transportation
Canadian Approval Certificate No. CDN/2078/B(U), Revision 11
2018 Edition Upgrade
Docket No. 71-3076
Certificate of Compliance No. 3076
Model No. F-458

SUMMARY

By letter dated August 21, 2025 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML25241A349), the U.S. Department of Transportation (DOT) requested that the U.S. Nuclear Regulatory Commission (NRC) staff perform a review of the Canadian Certificate of Approval CDN/2078/B(U), Revision 11, for the Model No. F-458 transport package and make a recommendation concerning the revalidation of the package for import and export use.

In this safety evaluation report (SER), the NRC has reviewed the safety analysis report (SAR) and accompanying documentation associated with the F-458 transportation package in accordance with the requirements in International Atomic Energy Agency (IAEA) SSR-6, "Regulations for the Safe Transport of Radioactive Material," 2018 Edition. Specifically, the staff is issuing this recommendation against the aging management requirements in paragraphs 503(e), 613A and 809(k), and related paragraphs only.

Based on the statements and representations in the application, as supplemented, staff recommends revalidation of the Canadian Package Design Certificate No. CDN/2078/B(U), Revision 11 for import and export use in the United States.

1.0 GENERAL INFORMATION

This review is focused exclusively on paragraphs 503(e), 613A, and 809(k), and related paragraphs of IAEA SSR-6, 2018 edition, which establish expectations for identifying, evaluating, and managing aging mechanisms that may affect the long-term integrity and performance of package components important to safety. The staff examined the applicant's descriptions of materials, design features, service conditions, and proposed aging-management measures to determine whether they provide reasonable assurance that the package will continue to meet applicable regulatory functions throughout its intended service life. This SER documents the NRC's independent technical assessment and resulting findings limited to these aging-management requirements.

On May 21, 2026 (ADAMS Accession No. ML26113A187), the NRC staff completed a review of the package against all the requirements of IAEA SSR-6, 2018 edition with the exception of the paragraphs reviewed in this SER (for the purposes of expediting the review for a planned shipment). Prior to that, the NRC staff previously reviewed the revalidation application for the F-458 package family against an earlier edition of the IAEA regulations for safe transport of radioactive material (IAEA Safety Standards Series No. TS-R-1, 1996 Edition) and recommended DOT revalidation of the package. The staff's revalidation recommendation and

technical review of the earlier versions of the F-458 package application are documented in its April 24, 2006, and December 19, 2008, letters and public SERs (ADAMS Accession Nos. ML061140468 and ML083540226).

Based on a review of the statements and representations in the application, the staff concludes the contents have been adequately described and evaluated to meet the requirements in IAEA SSR-6, 2018 Edition.

2.0 STRUCTURAL EVALUATION

By letter dated August 21, 2025, the DOT requested a recommendation from the NRC to revalidate the Canadian Nuclear Safety Commission's F-458 transport package competent authority certificate. The NRC staff reviewed the structural aspects of the transport package and evaluated them in accordance with IAEA SSR-6, 2018 Edition. The primary objective of the evaluation was to verify that the structural performance of the F-458 package satisfies the requirements of IAEA SSR-6, 2018 Edition.

2.1. Structural Performance of the F-458 Package under Routine Conditions of Transport

2.1.1. Lifting Test

The applicant, BWXT Medical Ltd., performed a lifting test on the F-458 package under routine conditions of transport in accordance with paragraph 608 of IAEA SSR-6, 2018 Edition. This paragraph requires that the package be designed so that its lifting attachments will not fail when used as intended. If an attachment were to fail, the package must nevertheless remain capable of meeting the other requirements of SSR-6, 2018 Edition. The design must also incorporate appropriate safety factors to account for snatch lifting.

The applicant calculated that a load of 513 kg was required to withstand the 3-g snatch load specified for the F-458 overpack lifting aperture. A load of 558 kg was applied to the lifting aperture, representing approximately 9 percent more than the required load. The test results were provided in Appendix 10.2, "F-458 Overpack Lifting Test," of the engineering assessment report (ML25241A348).

Based on the test results, the applicant concluded that no changes to the overall dimensions of the F-458 overpack or to the lifting-aperture dimensions were necessary because the aperture had a factor of safety greater than the required value of 1.0. Accordingly, the applicant concluded that the F-458 package meets the requirements of paragraph 608 of IAEA SSR-6, 2018 Edition.

The NRC staff reviewed the applicant's analysis and test results and confirmed these conclusions. Therefore, the staff determined that the F-458 package meets the requirements of paragraph 608 of IAEA SSR-6, 2018 Edition.

2.2. Structural Performance of the Package under Normal Conditions of Transport

2.2.1. Water Spray Test

Paragraph 721 of IAEA SSR-6, 2018 Edition, requires the F-458 package to undergo a water spray test simulating rainfall of approximately 5 cm per hour for at least one hour. The applicant did not perform this test. However, the applicant stated that the F-458 package may not require a water-spray test because it is constructed of stainless steel and incorporates a neoprene gasket and plastic plugs that prevent water ingress. The applicant therefore concluded that water retention or a significant increase in mass was highly unlikely and that the water-spray test was not necessary.

The NRC staff reviewed the applicant's rationale and found it acceptable. The staff determined that the F-458 package meets the requirements of paragraph 721 of IAEA SSR-6, 2018 Edition.

2.2.2. Free Drop Test

The applicant performed a free drop test on the F-458 package under normal conditions of transport (NCT) in accordance with paragraph 722 of IAEA SSR-6, 2018 Edition. The drop height and impact position were selected to produce the most severe condition, consisting of a 1.2-meter free drop onto the side of the specimen.

The applicant documented the test results in Appendix K, "F-458 Serial #4 Drop Test," of Appendix 4, "F-458/F-251 Package Drop Test Report," of the engineering assessment report (ML25241A348). The report included photographs and observations from the test.

The applicant reported that damage to the F-458 package was limited to minor surface deformation and abrasion at and around the impact area. The package surface was not penetrated, the contents were not exposed, and the cover remained securely in place. Based on the results of the free drop test under NCT, the applicant concluded that the F-458 package meets the requirements of paragraph 722 of IAEA SSR-6, 2018 Edition.

The NRC staff reviewed the test results and determined that the applicant demonstrated that the F-458 package has adequate strength to meet the requirements of paragraph 722 of IAEA SSR-6, 2018 Edition.

2.2.3. Stacking Test

The applicant performed a stacking test on the F-458 package in accordance with paragraph 723 of IAEA SSR-6, 2018 Edition. This paragraph requires the specimen to be subjected, for 24 hours, to a compressive load equal to the greater of:

(a) The equivalent of 5 times the maximum weight of the package; or

(b) The equivalent of 13 kPa multiplied by the vertically projected area of the package.

The applicant calculated compressive loads of 855 kg and 169 kg for conditions (a) and (b), respectively. Accordingly, condition (a) governed the test.

A compressive load of 1,105 kg was applied to the F-458 package for 24 hours. This load was approximately 29 percent greater than the required load of 855 kg. The applicant provided the results in Appendix 10.1, "F-458 Overpack Stacking Test," of the engineering assessment report (ML25241A348). The applicant reported that the test produced no deformation or buckling of the F-458 overpack. Based on the stacking-test results under NCT, the applicant concluded that the F-458 package meets the requirements of paragraph 723 of IAEA SSR-6, 2018 Edition.

The NRC staff reviewed the test results and determined that the applicant demonstrated that the F-458 package has adequate strength to meet the stacking requirements of paragraph 723 of IAEA SSR-6, 2018 Edition.

2.2.4. Penetration Test

The applicant performed a series of penetration tests to demonstrate compliance with paragraph 724 of IAEA SSR-6, 2018 Edition. The test consisted of dropping a 6-kg bar onto the F-458 package from a height of 1.7 meters in multiple orientations. The package was tested in three orientations (top, bottom, and side) to identify the orientation that produced the greatest damage. The side orientation was determined to be the most severe.

The applicant provided the test results in Appendix 4, “F-458/F-251 Package Drop Test Report,” and Appendix 10.3, “Penetration Tests of the F-458 Transport Package,” of the engineering assessment report (ML25241A348).

The applicant reported that the outer stainless-steel skin of the F-458 package was not breached. The test produced an indentation approximately 3 mm deep; however, the damage did not penetrate the outer skin. Based on the penetration-test results under NCT, the applicant concluded that the F-458 package meets the requirements of paragraph 724 of IAEA SSR-6, 2018 Edition.

The NRC staff reviewed the test results and determined that the applicant demonstrated that the F-458 package has adequate strength to meet the penetration requirements of paragraph 724 of IAEA SSR-6, 2018 Edition.

2.3. Structural Analysis under Accident Conditions of Transport

2.3.1. Free Drop Test

The applicant performed a series of free-drop model tests on the F-458 package under accident conditions of transport (ACT) in accordance with paragraph 727 of IAEA SSR-6, 2018 Edition. Detailed information concerning the test plan, drop tests, inspections, and assessments was provided in Chapter 4, “Test Report on Accident Conditions of Transport,” of Appendix 4, “F-458/F-251 Package Drop Test Report,” of the engineering assessment report (ML25241A348).

The applicant summarized the test results as follows:

- Damage to the F-458 container was limited to surface deformation at and immediately surrounding the impact areas.
- The top and bottom 9-meter drops typically produced approximately 20 cm of rolling and flattening at the top or bottom chime.
- F-458 container Specimen #7, which was dropped horizontally onto its side, sustained damage along the full length of the container over an approximately 18 cm wide area.
- None of the container surfaces were penetrated.
- The contents were not exposed.
- The cover remained securely in place in all cases.
- No visible surface damage was observed on the shielding vessels. Damage assessments for each shielding vessel were provided in Appendices H, I, J, and K of Appendix 4, “F-458/F-251 Package Drop Test Report,” of the engineering assessment report (ML25241A348).
- No visible surface damage or dimensional change was observed in the F-320 leakproof insert as a result of the drop model tests.

Based on the results of the free drop model tests under ACT, the applicant concluded that the

F-458 package meets the requirements of paragraph 727 of IAEA SSR-6, 2018 Edition.

The NRC staff reviewed the results of the drop model tests and determined that the applicant demonstrated that the F-458 package has adequate strength to meet the requirements of paragraph 727 of IAEA SSR-6, 2018 Edition.

2.3.2. Tie-Down Test

The applicant performed a tie-down test in accordance with paragraph 638 of IAEA SSR-6, 2018 Edition. This paragraph requires that tie-down attachments be designed so that, under normal and accident conditions of transport, the forces applied to the attachments do not impair the package's ability to meet the requirements of SSR-6, 2018 Edition.

The applicant provided the test results in Appendix 10.4, "F-458 Overpack Tie-Down Test," of the engineering assessment report (ML25241A348). The diameter and height of the F-458 package were measured before and after the test. The measurements showed no change in the package dimensions, and no deformation or damage was observed on the F-458 overpack.

The applicant therefore concluded that the F-458 package meets the requirements of paragraph 638 of IAEA SSR-6, 2018 Edition.

The NRC staff reviewed the test results and determined that the applicant demonstrated that the F-458 package has adequate strength to meet the requirements of paragraph 638 of IAEA SSR-6, 2018 Edition.

2.3.3. Water Immersion Test

The applicant performed a structural analysis of the F-458 package under a water immersion condition of 150 kPa in accordance with paragraph 629 of IAEA SSR-6, 2018 Edition. This paragraph requires that a package be immersed under a head of water of at least 15 meters for a period of not less than eight hours in the orientation that produces the greatest damage. For demonstration purposes, an external gauge pressure of at least 150 kPa may be used to represent this condition.

The applicant provided the water immersion analysis in Chapter 6, "Water Immersion Test," of Appendix 4, "F-458/F-251 Package Drop Test Report," of the engineering assessment report (ML25241A348). The applicant reported that the calculated maximum hoop stress was approximately 800 psi and that the compressive stress on the bottom circular plate of the shielding vessel was approximately 33,050 psi. Both values were below the ultimate tensile strength of 70,000 psi for the stainless-steel material used in the package.

The applicant stated that the analysis provided a substantial margin against failure and was conservative because it did not account for the additional strength provided by the depleted-uranium casting supporting the stainless-steel shell from the inside. The applicant therefore concluded that the package would not sustain damage under water immersion conditions and that the F-458 package meets the requirements of paragraph 629 of IAEA SSR-6, 2018 Edition.

The NRC staff reviewed the structural analysis and determined that the applicant demonstrated that the F-458 package has adequate strength to meet the water immersion requirements of paragraph 629 of IAEA SSR-6, 2018 Edition.

2.4. Evaluation Findings

Based on the information provided in the applicant's engineering assessment report, IS/TR 1791 F458 (ML25241A348), and referenced information that addresses the model tests, the NRC staff finds that the F-458 transport package, as presented, conforms to the structural requirements of IAEA SSR-6, 2018 Edition.

3.0 THERMAL EVALUATION

A thermal evaluation was not needed to assure compliance with paragraphs 503(e), 613A and 809(k) of IAEA SSR-6, 2018 Edition, as such, no thermal evaluation was completed.

4.0 CONTAINMENT EVALUATION

A containment evaluation was not needed to assure compliance with paragraphs 503(e), 613A and 809(k) of IAEA SSR-6, 2018 Edition, as such, no containment evaluation was completed.

5.0 SHIELDING EVALUATION

A shielding evaluation was not needed to assure compliance with paragraphs 503(e), 613A and 809(k) of IAEA SSR-6, 2018 Edition, as such, no shielding evaluation was completed.

6.0 CRITICALITY EVALUATION

There are no fissile contents in the Model No. F-458, thus, no criticality review was needed.

7.0 MATERIALS EVALUATION

The staff reviewed the applicant's description and evaluation of materials for the F-458 package family to ensure compliance with IAEA SSR-6, "Regulations for the Safe Transport of Radioactive Material," 2018 Edition. The staff previously reviewed earlier versions of the revalidation application for the F-458 package family against an earlier edition of the IAEA regulations for safe transport of radioactive material (IAEA Safety Standards Series No. TS-R-1, 1996 Edition) and recommended DOT revalidation of the package. The staff's revalidation recommendation and technical review of the earlier versions of the application for the F-458 package family are documented in its April 24, 2006, and December 19, 2008, letters and public SERs (ADAMS Accession Nos. ML061140468 and ML083540226).

The F-458 package family includes several packaging design configurations for shipping Type B quantities of non-fissile radioisotopes in solid form and in liquid (aqueous) solutions. The F-458 package family generally includes a single design of protective overpack (F-458 overpack); several different designs of shielding vessel (F-245, F-247, F-251, F-318, and F-448 shielding vessels) located inside the overpack; and several different designs of containment vessel, referred to as leakproof inserts (F-242, F-248, F-256, and F-320 leakproof inserts), located inside the shielding vessel. A specific packaging design configuration within the F-458 family includes a specific type of leakproof insert housed inside a specific type of shielding vessel housed within the F-458 overpack. Permissible activities for specified radioisotopes are authorized for shipment inside specific packaging configurations, in accordance with the design specifications and the conditions specified in the certificate of approval.

There are no changes to the design of packaging components or their materials of construction and no changes to service conditions that affect material properties from the earlier revalidation applications. The staff's safety evaluation of the chemical and physical form of the new radioisotopes and the potential for content reactions was provided in a revalidation recommendation issued on June 4, 2026 (ML26113A187).

The package application includes proposed updates that would bring the application into compliance with the 2018 Edition of IAEA SSR-6. With respect to packaging materials performance, the application includes new information on the evaluation of material aging mechanisms to meet the additional requirement of Paragraph 613A in the 2018 Edition of IAEA SSR-6, specifying that the design of the package shall take into account aging mechanisms. The staff's review in this section addressed the proposed application updates to bring the application into compliance with Paragraph 613A in the 2018 Edition of IAEA SSR-6.

7.1. Evaluation of Aging

The application provided an aging management program that describes the evaluation of aging mechanisms for the packaging components. The application also included a set of maintenance and inspection requirements, including criteria for visual inspections, tests, repairs, and replacements of components, to ensure the condition of packaging components is acceptable for continued service. The staff reviewed this information to determine whether the application meets the requirements in Paragraph 613A of IAEA SSR-6, 2018 Edition and associated guidance in paragraphs 613A.1 and 613A.3 of IAEA SSG-26, 2018 Edition. The staff's review covered the following topics:

- List of safety-related packaging components and their materials of construction subject to aging evaluation;

- Evaluation of packaging component aging mechanisms due to heat, radiation, chemical reactions, and fatigue;

- Inspection and maintenance criteria for managing the effects of aging mechanisms on the safety performance of packaging components.

7.1.1. Packaging Components and Materials

The application includes a list of packaging components and their materials of construction that are included in the scope of the aging evaluation. The staff confirmed that the scope of the applicant's aging evaluation includes all long-lived reusable packaging components that perform a safety function. Materials for long-lived reusable packaging components are mostly 300 series austenitic stainless steel. The F-458 overpack also includes rigid polyurethane foam for impact protection and thermal protection, low alloy steel threaded fasteners, aluminum alloy components for radiation shielding and heat dissipation, and replaceable polymer and elastomer items to protect against wear and water ingress. In addition to 300 series austenitic stainless steel, the shielding vessel materials also include depleted uranium and lead clad in 300 series austenitic stainless steel for radiation shielding, low alloy steel threaded fasteners, and replaceable elastomer gaskets and O-rings for secondary containment. In addition to 300 series austenitic stainless steel, the leak proof insert materials also include 400 series martensitic stainless steel and replaceable elastomer O-rings for containment. The staff found that the applicant's identification of packaging components and materials that are subject to aging evaluation is acceptable since all long-lived reusable packaging components that perform a safety function are included in the evaluation.

7.1.2. Evaluation of Aging Mechanisms

The application specifies the environmental and loading conditions that are considered in the evaluation of aging mechanisms for a service period of up to 40 years. These conditions include high ambient temperatures for normal service, radiation from the contents, metal corrosion; and metal fatigue. The applicant evaluated each of these conditions to determine aging mechanisms that could potentially lead to package component degradation during the 40-year period. To assist in performing its review of the applicant's aging evaluation, the NRC staff applied the NRC guidance in NUREG-2214, "Managing Aging Processes in Storage (MAPS) Report", July 2019 (ADAMS Accession No. ML19214A111).

The staff confirmed that thermal aging due to steady state high temperatures, including deterioration of polyurethane foam and adverse changes in mechanical properties for martensitic stainless steel and precipitation hardened aluminum alloys, are not a concern since these materials are not subjected to normal service temperatures that are high enough to cause such changes. The staff also confirmed that radiation-induced degradation is not a concern since gamma radiation from package contents does significantly affect the properties and performance of any packaging material. Therefore, the staff found that the applicant's evaluation of potential material aging due heat and radiation to be acceptable.

The staff reviewed the applicant's evaluation of corrosion mechanisms for the stainless steel packaging components, and noted that stainless steel passivity adequately inhibits general corrosion in outdoor ambient environments. The staff identified that stainless steel is susceptible to localized corrosion effects (i.e., pitting and crevice corrosion) and chloride-induced stress corrosion cracking (SCC) when exposed to outdoor air and water environments during transport since these environments have aqueous electrolytes and chemical species that can gradually degrade the passive film that protects the stainless steel surface. The staff also identified that

low alloy steel threaded fasteners (i.e., screws, bolts, and nuts) are susceptible to general and localized corrosion, and galvanic corrosion when in contact with stainless steel components. The staff's evaluation of the applicant's maintenance criteria for managing the effects of corrosion mechanisms and SCC for stainless steel components and low alloy steel threaded fasteners is addressed below.

The depleted uranium shielding, the lead shielding, and the polyurethane foam impact absorber are all encased in stainless steel. The staff determined that these items are adequately protected against metal corrosion and moisture-induced deterioration provided that the stainless steel shell remains intact and does not allow for ingress of aqueous electrolytes from the outside environment. The aluminum alloy components are located in the interior of the overpack and are generally not exposed to aqueous electrolytes from outdoor air and water. Therefore, since the aluminum alloy has sufficient resistance to general and localized corrosion mechanisms in a dry air environment, the staff determined that these items are adequately protected against general and localized corrosion.

The application included information on cyclic loading of structural components to demonstrate that fatigue failure is not a concern for packaging components. Based on review of fatigue design curves for austenitic stainless steel structural material in the ASME Boiler and Pressure Vessel Code, Section III, the staff confirmed that cyclic loading of stainless steel structural components during normal package surface is unlikely to cause significant metal fatigue that could challenge component structural integrity during a 40-year service life. The details of the staff's evaluation of the applicant's structural fatigue assessment are addressed in Section 2.0 of this SER.

7.1.3. Criteria for Managing Effects of Aging Mechanisms on Packaging Components

The inspection and maintenance criteria require the F-458 packaging components, including the F-458 overpack, shielding vessels, and leakproof inserts to be subjected to a routine visual inspection prior to each shipment and a detailed inspection once a year, or more frequently if a routine inspection identifies a defect. The criteria specify that inspections shall be performed by trained personnel following formal procedures. The results of inspections shall be documented, and the inspection history of packaging components shall be recorded. Repairs to damaged packaging components shall be in accordance with the standards for manufacturing new components, and repairs shall be documented and re-inspected.

The applicant described its visual inspection requirements and acceptance criteria for ensuring the absence of significant indications of localized corrosion (including localized pitting and crevice corrosion) and SCC for stainless steel base metal and welds exposed to outdoor air and water environments. The staff reviewed this information and verified that the applicant specified adequate visual inspection requirements and acceptance criteria for ensuring no unacceptable indications of pitting, crevice corrosion, and SCC on stainless steel surfaces exposed to the outdoor environment. The staff also confirmed that the applicant described adequate visual inspection requirements for ensuring that alloy steel threaded fasteners do not have significant indications of corrosion. The application notes that elastomer seals and gaskets are short-lived components that are subject to routine replacement. To ensure their functionality, elastomer seals and gaskets are routinely inspected for degradation, including cuts, cracks, blisters, gouges, and signs stretching and discoloration, and replaced as needed.

Based on its review of the information in the application, the staff determined that the applicant's description of inspection and maintenance activities will ensure adequate management of

credible aging effects for F-458 packaging components, such that component safety functions are adequately maintained during the 40-year service period.

7.2. Materials Evaluation Findings

Based on its review of the applicant's evaluation of aging mechanisms and associated maintenance criteria for managing credible aging effects for packaging components, the staff determined that the application for the F-458 package family adequately describes how the design of the package takes into account ageing mechanisms in accordance with Paragraph 613A of IAEA SSR-6. Therefore, based on its review of the statements in the application, the staff concludes that the package meets the requirements of IAEA SSR-6, 2018 Edition.

8.0 QUALITY MANAGEMENT SYSTEM EVALUATION

The purpose of the quality assurance (QA) review is to verify that the package design meets the requirements of the IAEA SSR-6, 2018 Edition. The staff reviewed the description of the QA program for the Model No. F-458 package against the standards in the IAEA SSR-6, 2018 Edition.

8.1. Evaluation of the Quality Assurance Program

The applicant developed and described a QA program for activities associated with transportation packaging for radioactive materials. These activities include design, procurement, fabrication, assembly, testing, modification, maintenance, repair, and use. The applicant described the QA organization, which includes those responsible for the supplier qualification process. The applicant's description of the QA program meets the applicable requirements of IAEA SSR-6, 2018 Edition, and is based on International Organization for ISO Standardization, Standard No. 9001, "Quality management systems – Requirements," National Standard of Canada, CSA N299.2, "Quality Assurance Program -Category 2," and other applicable standards. The staff finds the QA program description acceptable as it allows implementation of the associated QA program for the design, procurement, fabrication, assembly, testing, modification, maintenance, repair, and use of the Model No. F-458 transportation package.

The staff finds, with reasonable assurance, that the QA program for the F-458 transportation packaging:

- meets the requirements in IAEA SSR-6, 2018 Edition, and
- encompasses design controls, materials and services procurement controls, records and document controls, fabrication and maintenance controls, nonconformance and corrective actions controls, an audit program, and operations or programs controls, as appropriate.

8.2. Evaluation Findings

Based on review of the statements and representations in the F-458 transportation packaging application and as discussed in this SER section, the staff has reasonable assurance that the Model No. F-458 package meets the requirements in IAEA SSR-6, 2018 Edition.

CONCLUSIONS

Based on the statements and representations contained in the application, as supplemented, the staff concludes the Model No. F-458 package design, with the above stated condition, meets the aging management requirements in IAEA SSR-6, 2018 Edition, specifically paragraphs 503(e), 613A and 809(k). Therefore, the staff recommends revalidation of Canadian Competent Authority Certificate CDN/2078/B(U), Revision 11 for import and export use in the U.S.

Issued with the letter to R. Vierling, DOT.