



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

## SAFETY EVALUATION REPORT

Docket No. 71-9330  
Model No. ATR-FFSC Package  
Certificate of Compliance No. 9330  
Revision No. 13

### SUMMARY

By letter dated February 20, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19052A428), the Department of Energy (DOE or the applicant) requested an amendment of the Certificate of Compliance (CoC) No. 9330 for the Model No. ATR-FFSC package.

The applicant requested a simple content amendment necessary to transport experimental loose fuel plates to be irradiated in Belgium as part of DOE's Office of Materials Management and Minimization program. The applicant requested that the CoC be amended based on the letter request and in lieu of a revision to the Safety Analysis Report (SAR).

The submittal was evaluated against the regulatory standards in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71, including the general standards for all packages, standards for fissile material packages, and performance standards under normal conditions of transport and hypothetical accident conditions.

The certificate has been amended based on the statements and representations in the application. The staff agrees that the changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

### EVALUATION

In the effort to convert the High Flux Isotope Reactor (HFIR) research reactor from using highly enriched uranium (HEU) fuel to low enriched uranium (LEU) fuel, several experimental loose fuel plates were designed to aid in this process. The amendment proposes including the following four plates:

Fuel Plate Name	Bounded in CoC by
FUTURE-HFIR Mono	U-Mo foils
FUTURE-HFIR U <sub>3</sub> Si <sub>2</sub> Curved Profile (IFE-ALT1)	COBRA loose fuel
FUTURE-HFIR U <sub>3</sub> Si <sub>2</sub> (IFE) THIN	COBRA loose fuel
FUTURE-HFIR U <sub>3</sub> Si <sub>2</sub> (OFE) THICK	COBRA loose fuel

The four FUTURE-HFIR plates have a construction similar to the other loose plates already authorized by the CoC, having a central fuel region completely surrounded by aluminum alloy cladding. The Small Quantity payload, described in Section 1.2.2.4 of the ATR FFSC SAR, Revision 14, consists of a class of research and development plate-type fuels with U-235 as the fissile isotope (i.e., no U-233 or plutonium), with a bounding U-235 loading up to 400 g, and U-235 enrichment up to 94%. Fuel types that fall into the small quantity payload category include RINSC fuel elements, AFIP elements, U-Mo foils, DDEs, MIT loose fuel element plates,

MURR loose fuel element plates, and Cobra loose fuel element plates. Shipments of the four plates proposed in this amendment are being included in the definition of the Small Quantity payload.

To demonstrate that the four loose fuel plate types may be shipped in the ATR FFSC package under the Small Quantity payload category (defined in the CoC), the applicant provided tables comparing key physical and nucleonic characteristics of the four plates to payload descriptions currently authorized in Section 5.(b)(1) of the NRC CoC, Revision 12.

**FUTURE-HFIR Mono**

The FUTURE-HFIR Mono fuel type is bounded by the U-Mo foils loose plate subcategory. Details of that comparison are in Table 1 below.

**Table 1: Comparison of FUTURE-HFIR Mono Fuel Type to Currently Authorized Payload Descriptions**

<b>Fuel Designation</b>	<b>Fuel alloy &amp; matrix</b>	<b>Enrichment</b>	<b>Mass U-235</b>
FUTURE-HFIR Mono	U-Mo, U-10Mo matrix, zirconium coating	≤ 20%	22.58 g maximum per plate
CoC, revision 12, Section 5.(b)(1), paragraph 10	...uranium molybdenum alloy in an aluminum-silicon matrix or uranium molybdenum alloy and may contain a zirconium coating.	≤ 94%	160 g maximum in this category

**FUTURE-HFIR IFE-ALT1, FUTURE-HFIR IFE THIN, and FUTURE-HFIR OFE THICK**

The other three fuel types (FUTURE-HFIR IFE-ALT1, FUTURE-HFIR IFE THIN, and FUTURE-HFIR OFE THICK) are bounded by the COBRA loose fuel element subcategory.

**Table 2: Comparison of the Other Three FUTURE-HFIR Fuel Types to Currently Authorized Payload Descriptions**

<b>Fuel Designation</b>	<b>Fuel alloy &amp; matrix</b>	<b>Enrichment</b>	<b>Maximum Mass U-235</b>
FUTURE-HFIR IFE-ALT1	U <sub>3</sub> Si <sub>2</sub> – Aluminum dispersion	≤ 20%	19.00 g per plate
FUTURE-HFIR IFE THIN			9.07 g per plate
FUTURE-HFIR OFE THICK			24.77 g per plate
ATR FFSC CoC, rev 12 (Section 5.(b)(1))	Not directly specified. (COBRA LEU fuel is listed as U <sub>3</sub> Si <sub>2</sub> dispersed in aluminum powder.)	... may be HEU or LEU	400 g in this category

### Criticality Safety

The applicant request an amendment to the CoC for the Model No. ATR FFSC package to include additional loose fuel plate types in the list of allowable contents. Specifically, the applicant requested to modify condition 5.(b)(1) of the CoC to change:

1. The description of Small Quantity Payloads to include FUTURE-HFIR loose plates,
2. The description of U-Mo foils to include FUTURE-HFIR Mono loose plates, and
3. The description of COBRA loose fuel plates to include FUTURE-HFIR IFE-ALT1, FUTURE-HFIR IFE THIN, and FUTURE-HFIR OFE THICK loose plates.

The four FUTURE-HFIR contents are similar in construction to previously approved loose fuel plate contents (i.e., central fuel region clad in aluminum alloy). All new loose plate types must be transported as Small Quantity Payloads in the Small Quantity Payload Fuel Handling Enclosure, as shown in Drawing No. 60501-70, Rev. 0.

The FUTURE-HFIR Mono fuel plates consist of uranium enriched up to 20 weight percent in a uranium molybdenum alloy with a zirconium coating. This fuel type is bounded by the U-Mo foils category of contents currently listed under CoC condition 5.(b)(1), which limits enrichment to 94 weight percent and 160 grams total U-235.

The FUTURE-HFIR IFE-ALT1, FUTURE-HFIR IFE THIN, and FUTURE-HFIR OFE THICK fuel plates consist of uranium enriched up to 20 weight percent in a uranium silicide ( $U_3Si_2$ ) and aluminum matrix. These fuel types are bounded by the COBRA loose fuel element plates category of contents currently listed under CoC condition 5.(b)(1), which limits high enriched or low enriched uranium contents to 400 grams total U-235.

The applicant previously evaluated U-Mo foil and COBRA loose fuel element plate categories assuming the fuel is high enriched (94 weight percent U-235), and conservatively representing the contents as an optimally-moderated, homogenized mixture of uranium and water. Since the FUTURE-HFIR Mono, FUTURE-HFIR IFE-ALT1, FUTURE-HFIR IFE THIN, and FUTURE-HFIR OFE THICK fuel plates all consist of uranium enriched up to 20 weight percent, the previous analysis bounds these contents, provided the U-235 mass limits in the CoC are met.

Based on the discussion above, the staff found the applicant's proposed changes to the CoC, to include four new FUTURE-HFIR loose fuel plate contents, would not affect the ability of the Model No. ATR-FFSC package to meet the criticality safety requirements of 10 CFR Part 71.

### Conclusion

Based on the statements and representations in the application, and the conditions listed in the CoC, the staff concludes that the design has been adequately described and evaluated, and will continue to meet the requirements of 10 CFR Part 71 with the transport of the FUTURE-HFIR plates.

### **CONDITIONS**

The following changes are included in Revision No. 13 to Certificate of Compliance No. 9330:

Condition No. 5(b)(1) was revised in three places to include reference to the four FUTURE-HFIR plates. Reference was added to include:

1. the FUTURE-HFIR plates in the definition of Small Quantity Payloads,
2. the FUTURE-HFIR Mono loose plates in the description of the U-Mo Foils
3. the FUTURE-HFIR IFE-ALT1, FUTURE-HFIR IFE THIN, and FUTURE-HFIR OFE THICK loose plates in the description of the COBRA loose fuel element plates

Condition No. 11 authorizes the use of Revision No. 12 of this certificate for approximately one year.

In addition, the February 2019 application has been added to the references section of this certificate.

### **CONCLUSION**

Based on the statements and representations in the application, and the conditions listed above, the staff concludes that the Model No. ATR-FFSC package design has been adequately described and evaluated and that these changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9330, Revision No. 13, for the Model No. ATR-FFSC.