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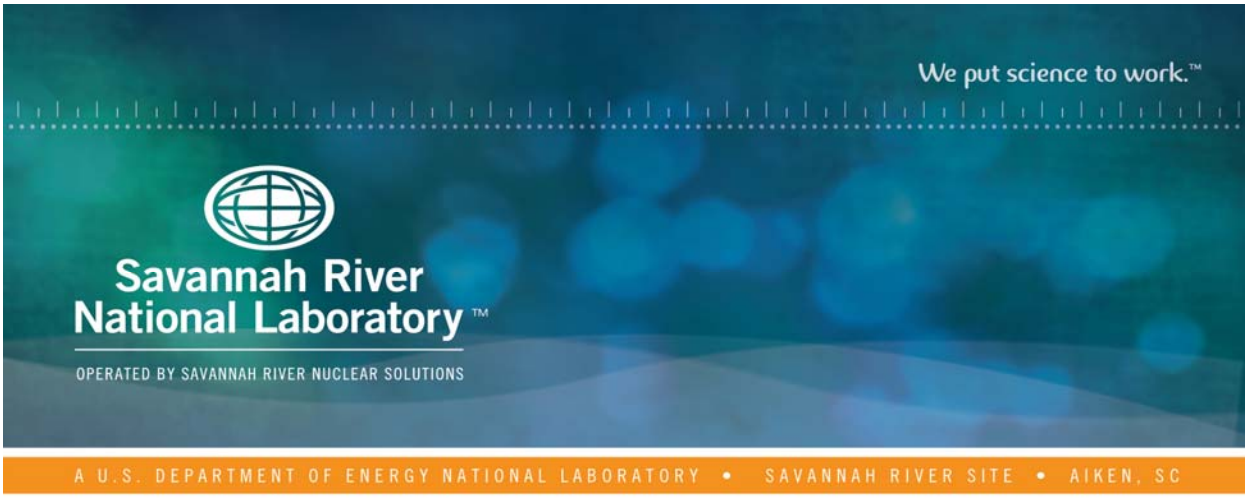

Analysis of Maximum Allowable Fragment Heights during Dissolution of High Flux Isotope Reactor Fuel in an H-Canyon Dissolver

W. E. Daniel

T. S. Rudisill

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REVIEWS AND APPROVALS

AUTHORS:

W. E. Daniel, Separations and Actinide Science Programs Date

T. S. Rudisill, Separations and Actinide Science Programs Date

TECHNICAL REVIEW:

N. M. Askew, Environmental Monitoring (reviewed per E7, 2.60) Date

W. H. Clifton Jr., H-Canyon Engineering Date

APPROVAL:

T. B. Brown, Manager Date
Separations and Actinide Science Programs

D. E. Dooley, Director Date
Chemical Processing Technologies

P. M. Palmer, Manager Date
H-Canyon/Outside Facilities Engineering

EXECUTIVE SUMMARY

As part of the Spent Nuclear Fuel (SNF) processing campaign, H-Canyon is planning to begin dissolving High Flux Isotope Reactor (HFIR) fuel in late FY17 or early FY18. Each HFIR fuel core contains inner and outer fuel elements which were fabricated from uranium oxide (U_3O_8) dispersed in a continuous Al phase using traditional powder metallurgy techniques. Fuels fabricated in this manner, like other SNF's processed in H-Canyon, dissolve by the same general mechanisms with similar gas generation rates and the production of H_2. The HFIR fuel cores will be dissolved using a flowsheet developed by the Savannah River National Laboratory (SRNL) in either the 6.4D or 6.1D dissolver using a unique insert. Multiple cores will be charged to the same dissolver solution maximizing the concentration of dissolved Al. The recovered U will be down-blended into low-enriched U for subsequent use as commercial reactor fuel.

During the development of the HFIR fuel dissolution flowsheet, the cycle time for the initial core was estimated at 28 to 40 h. Once the cycle is complete, H-Canyon personnel will open the dissolver and probe the HFIR insert wells to determine the height of any fuel fragments which did not dissolve. Before the next core can be charged to the dissolver, an analysis of the potential for H_2 gas generation must show that the combined surface area of the fuel fragments and the subsequent core will not generate H_2 concentrations in the dissolver offgas which exceeds 60% of the lower flammability limit (LFL) of H_2 at 200 °C. The objective of this study is to identify the maximum fuel fragment height as a function of the Al concentration in the dissolving solution which will provide criteria for charging successive HFIR cores to an H-Canyon dissolver.

A series of calculations was performed to estimate the maximum fragment height of HFIR fuel which can be present in the dissolver insert with the addition of the next core without exceeding 60% of the calculated H_2 LFL. The fuel fragment was assumed to be the maximum value measured in either the inner or outer element well of the dissolver insert. The offgas characterization data from the dissolution of an Al 1100 alloy coupon were used for the calculations. The data were generated during the development of the HFIR fuel dissolution flowsheet. Initially, the offgas data at dissolved Al concentrations from 0 to 1.7 M were used to calculate the maximum number of fractional HFIR cores which did not generate predicted H_2 concentrations which exceeded 60% of the LFL. The calculations showed that it was theoretically possible to charge at least two HFIR cores to the dissolver after reaching an Al concentration of 0.47 M. At Al concentrations greater than or equal to this value, it would not be necessary to measure the height of the fuel fragments prior to charging another HFIR core to address the potential for exceeding 60% of the H_2 LFL in the dissolver offgas.

For Al concentrations less than 0.47 M, calculations were performed to evaluate the maximum fuel fragment heights which can be present in the insert wells prior to charging the second and third cores. An Al concentration of 0.47 M is not achieved in the dissolver until some portion of the second core is dissolved. During this analysis, fragment heights from probing the dissolver insert well were used to define undissolved fractional HFIR cores. The volume of the fractional cores and a pseudo density of Al were used to calculate the concentrations of Al in the dissolver solution based on an assumed dissolver volume. When calculating the Al concentrations for fragment heights generated during the dissolution of the second HFIR core, the mass of Al in the first core was assumed to be dissolved in the solution. The calculated Al concentrations were used to define the maximum number of fractional HFIR cores that can be dissolved based on the calculations using the experimentally measured offgas generation data. If the fragment height plus one HFIR core was less than the maximum fractional cores which could be dissolved, then the next HFIR core could be charged. The maximum fragment heights associated with the charging of the second and third cores are provided for a range dissolver volumes.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

HFIR	High Flux Isotope Reactor
LFL	lower flammability limit
MS	mass spectrometer
SNF	spent nuclear fuel
SRNL	Savannah River National Laboratory
U_3O_8	uranium oxide

1.0 Introduction

As part of the SNF processing campaign, H-Canyon is planning to begin dissolving HFIR fuel in late FY17 or early FY18.[1,2] Irradiated HFIR fuel is currently stored in the L-Area basin. During the HFIR campaign, 200 fuel cores will be processed. Each HFIR fuel core contains an inner and an outer fuel element (Figure 1-1).[3] The fuel cores are fabricated as concentric cylinders with the fuel plates located in the annulus between the inner and outer cylinders. The fuel plates project radially outward from the inner cylinder to the outer cylinder. The plates are curved in the shape of an involute to maintain constant spacing between adjacent plate surfaces.

Figure 1-1. Inner and Outer HFIR Fuel Elements

The HFIR fuel cores will be dissolved in H-Canyon using a flowsheet developed by the SRNL.[4] The recovered U will be down-blended into low-enriched U for subsequent use as commercial reactor fuel. HFIR fuel was previously processed in H-Canyon using a unique insert in both the 6.1D and 6.4D dissolvers (Figure 1-2).[5] Multiple cores will be charged to the same dissolver solution. The number of cores dissolved in a batch will be dependent on the final Al concentration in the solution. Typically, H-Canyon does not exceed approximately 1.7 M $Al(NO_3)_3$ in the dissolver (at 2 M HNO_3), but higher $Al(NO_3)_3$ concentrations ($\leq$ 2 M) were considered in the HFIR flowsheet development.[4]

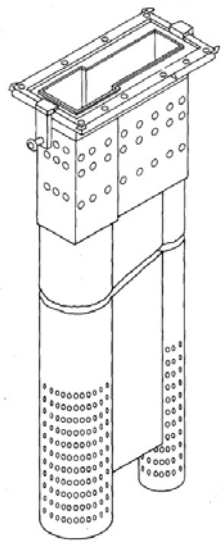

Figure 1-2. HFIR Insert

The estimated cycle time for the dissolution of the initial HFIR core is 28 to 40 h.[4] Once the cycle is complete, H-Canyon will open the dissolver and probe the HFIR insert wells to determine the height of any fuel fragments which did not dissolve. Before the next core can be charged to the dissolver, an analysis must show that the combined surface area of the fuel fragments and the subsequent core will not generate H_2 concentrations in the dissolver offgas which exceeds 60% of the LFL of H_2 at 200 °C.[6] The objective of this study was to identify the maximum fuel fragment height which can be present in the HFIR insert prior to charging the next core. To accomplish this task, offgas generation data from a small-scale Al dissolution performed to develop the HFIR flowsheet were used to estimate the H_2 concentration in the dissolver offgas as a function of the fragment height and the volume of the dissolver. This analysis including a discussion of the necessary assumptions is provided in the following sections.

2.0 Experimental Procedure

To evaluate the impact of fuel fragments remaining in the dissolver insert following the dissolution of a HFIR core, data from the original flowsheet development were used. In the original flowsheet work, Experiment 94 was performed to measure the offgas generation rate and characterize the offgas composition during the dissolution of an Al 1100 alloy coupon in a 7 M HNO_3 solution containing 0.002 M Hg. The Hg solution addition was started as soon as the solution reached the boiling point and the experiment targeted a final Al concentration of nominally 1.7 M. A series of scoping experiments had been previously performed demonstrating that the offgas and H_2 generation rates were bounded by the dissolution of the Al 1100 alloy.[4] Using this data and the physical dimensions of the inner and outer HFIR elements, an analysis was performed which provides the maximum fuel fragment height which can be present in a dissolver prior to charging the next core.

2.1 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in manual E7, 2.60. SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2.

3.0 Results and Discussion

3.1 Assessment Methodology

To estimate the maximum fragment height of HFIR fuel which can be combined with a subsequent core without generating H_2 concentrations which exceed 60% of the H_2 LFL, the surface area of the fuel (fragment plus new core) must be calculated at the solution Al concentration. The rate of flammable gas generation from the HFIR fuel is proportional to the surface area exposed to the dissolving solution. The surface areas and volumes of the inner and outer fuel elements and the carriers used to transport the fuel were calculated by Laurinat.[7] The calculation provides the surface area and volume at increasing heights from the bottom of the fuel elements and their respective carriers; therefore, at any remaining fragment height, the total surface area (and volume) of the inner and outer elements and carriers are provided by this calculation. The total surface area (fragment plus new core) can then be used to calculate the total offgas and H_2 generated by using the experimentally measured generation rates per unit surface area. For this task, the offgas generation data measured during Experiment 94 performed during the flowsheet development[4] was used since it models the HFIR fuel dissolution flowsheet and has low variability in the H_2 generation rate.

The H_2 generation rate for Experiment 94 is plotted as a function of the dissolved Al concentration in Figure 3-1.[4] The H_2 generation rate was calculated from the measured offgas generation rate, measured H_2 concentration, and the measured surface area of the Al 1100 alloy coupon. The concentration of Al in the dissolving solution as a function of time was estimated using the method described by Almond et al.[8] The figure shows that the H_2 generation rate surges after the start of the Hg addition and then decays.

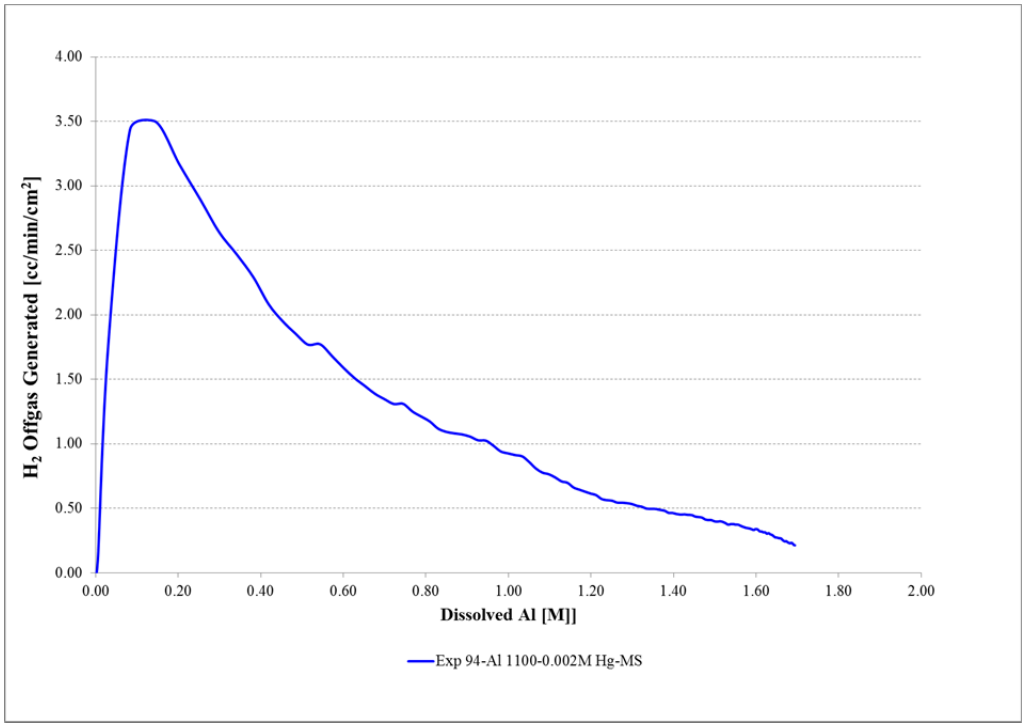

Figure 3-1. H_2 Generation Rate from the Dissolution of Al 1100 Alloy

For the HFIR fuel dissolution flowsheet, the H_2 generation rate calculated for Experiment 94 was used to estimate the H_2 concentration in the offgas stream during the dissolution of a single HFIR core (inner and outer elements including carriers) as a function of the Al concentration without exceeding 60% of the H_2 LFL. For this report the same methodology was used as described in the dissolution flowsheet report[4] except fractions of HFIR cores were examined.

To estimate the concentration of Al in the dissolver for a given fragment height, a pseudo density was used to calculate the undissolved Al mass. The mass of Al in a HFIR core (including the carriers) was calculated based on the HFIR Appendix A (DOE Spent Nuclear Fuel Acceptance Criteria) for the fuel[9] and the measured weight of the inner and outer carriers (Appendix A). The mass of Al associated with a complete core includes: 1.66 kg Al for the inner carrier, 4.647 kg Al for the outer carrier, 44.214 kg Al for the inner element, and 84.298 kg Al for the outer element for a total mass of 134.819 kg. Using a pseudo density of Al in a HFIR core equal to 43.40 g/in^3 and the total volume of the fuel and carriers (3,104.78 in^3)[7], the estimated mass of Al in a core is 134.747 kg. The estimated Al mass is slightly less than the actual total Al mass which results in less Al in solution after the HFIR core dissolution. The offgas generation rate is higher at lower Al concentrations, which adds a layer of conservatism to the calculations.

To calculate the maximum allowable height of any fragments remaining from a HFIR core (inner and outer elements including carriers) before charging the next core to the insert wells, several assumptions were made (see below).

- The fragment height of the fuel is the maximum value measured in either the inner element well or the outer element well.
- The volume of the dissolver varies between 6,000 and 18,000 L.

- The HFIR core is assumed to have a pseudo Al density of 2.65 g/cm^3 or 43.40 g/in^3.
- The maximum height of a HFIR core is 31.35 in.[7]
- The total volume of a HFIR core at its maximum height is 3,104.78 in^3.[7]
- The total mass of Al in a HFIR core is 134.747 kg based on the pseudo Al density and total volume at the maximum height.

The variables used in the calculations are:

h =	Maximum probe height measured in the inner or outer well (i.e., height of HFIR core fragment) (in)
h_{core} =	Height of one full HFIR core (31.35 in)
h_{max} =	Maximum height of a HFIR core allowed at a specified Al concentration based on the H_2 LFL (in)
$M_{Al,Diss}$ =	Mass of Al dissolved (kg)
$M_{Al,total}$ =	Mass of total Al in one HFIR core (inner and outer elements including carriers) at maximum height (134.747 kg)
$M_{Al,core}(h)$ =	Mass of Al left in fractional core based on probe height (h) (kg)
$V_{core}(h)$ =	Volume of fractional core based on probe height (h) (in^3)
V_{soln} =	Volume of the 6.4D dissolver (L)
$\rho_{Al,avg}$ =	Pseudo density of Al in HFIR core and carriers used for mass calculations (43.40 g/in^3)

The first step in the calculations is to determine the dissolved Al concentration as a function of the probe height (Al[M](h)).

$$M_{Al,\,Diss} = M_{Al,\,total} - M_{Al,\,core}(h) \tag{1}$$

$$M_{Al,core}(h) = V_{core}(h)\rho_{Al,avg}\left(\frac{1\text{ kg}}{1000\text{ g}}\right) \tag{2}$$

$$Al[M](h) = \left(\frac{M_{Al,\,Diss}}{V_{soln}}\right)\left(\frac{1000\text{ g}}{\text{kg}}\right)\left(\frac{1\text{ mol}}{27\text{ g}}\right) \tag{3}$$

By substituting Equations 1 and 2 into Equation 3, the dissolved Al[M] at a probe height h is:

$$Al[M](h) = \frac{\left(1000M_{Al,\,total} - V_{core}(h)\rho_{Al,\,avg}\right)}{27V_{soln}} \tag{4}$$

Substituting the values for the variables given above which are constants, Equation 4 becomes:

$$Al[M](h) = \frac{\left(137747 - 43.40V_{core}(h)\right)}{27V_{soln}} \tag{5}$$

3.2 Uncertainty in Offgas Analysis

The uncertainties associated with the H_2 generation rate during the dissolution of a HFIR core in an H-Canyon dissolver (at a given Hg concentration) were not evaluated in the HFIR fuel dissolution flowsheet report; however, the uncertainties associated with the offgas analyses were examined.[4] The

mass spectrometer (MS) was calibrated using National Institute of Standards and Technology-traceable standards before each experiment and the calibration gases checked prior to starting the experiment. The 2σ value or twice the standard deviation for the MS H_2 analysis was 0.38 vol %. A summary of the 2σ uncertainties for all calibrated gases is provided in Table 3-1. The 2σ uncertainties for the O_2 and NO_2 concentrations are artificially low due to adjustments to the MS calibration matrix so the 2σ values were conservatively assumed to be < 3 vol % similar to the NO and N_2O gases.[4]

Table 3-1. Two Sigma Uncertainties for Gas Concentrations Measured by Mass Spectrometry

Gas	2σ Uncertainty (vol %)
H_2	0.38
N_2	0.34
NO	2.14
O_2	0.67*
Ar	0.36
N_2O	1.93
NO_2	0.30*

* Assumed value of < 3 vol %

To account for the uncertainty in the offgas measurements, the H_2 concentrations measured in Experiment 94 were increased by 0.38 vol % (2σ uncertainty). This methodology is consistent with the manner in which the data were treated in the HFIR fuel dissolution flowsheet report.[4] In addition, several aspects of the calculations have built-in conservatisms which further address the uncertainty in the calculations. The calculated H_2 concentration in the offgas stream is compared to 60% of the LFL which provides a layer of conservatism. The saturated water vapor in the offgas stream is ignored and would further dilute the H_2 concentration. Given the conservative nature of the experimental design and the calculations performed, the prediction of the number of fractional HFIR cores that can be charged to an H-Canyon dissolver (using nominally 0.002 M Hg to catalyze the dissolution) adequately incorporates the many uncertainties associated with the experimental and modeling work.

3.3 Calculation of Maximum HFIR Fragment Height

The initial step in calculating the maximum fragment height which can be present in the HFIR insert prior to charging the next core is to estimate the maximum fractional number of cores which can be charged to a dissolver as a function of the Al concentration. The maximum fractional number of cores is a hypothetical calculation based on maintaining the predicted H_2 concentrations with air dilution less than 60% of the calculated LFL at all Al concentrations. Using the offgas data from Experiment 94[4] and the surface areas of the HFIR fuel elements and carriers,[7] a table was constructed showing the maximum fractional HFIR cores that can be charged for Al concentrations from 0 to 1.7 M that do not exceed 60% of the H_2 LFL (Appendix B). Although the offgas characterization data from Experiment 94 was not measured at Al concentrations which exceeded 1.7 M, any dissolved Al concentration greater than 1.7 M could use the predicted H_2 concentration at 1.7 M since the offgas and H_2 generation rates decreased beyond this point. The tabular data presented in Appendix B are summarized in Figure 3-2. The figure also shows the predicted H_2 concentration for the fractional number of HFIR cores (at each Al concentration) and 60% of the calculated H_2 LFL. The predicted H_2 concentration is always less than 60% of the LFL.

If the Al concentration is 0.47 M, Figure 3-2 and the data in Appendix B show that it is theoretically possible to charge at least two HFIR cores to the dissolver. At Al concentrations greater than or equal to this value, it would not be necessary measure the height of the fuel fragments prior to charging another HFIR core to address the potential for exceeding 60% of the H_2 LFL in the dissolver offgas. For Al

concentrations less than 0.47 M, calculations were performed to evaluate the maximum fragment height which can be present in the insert wells prior to charging the second and third cores. An Al concentration of 0.47 M is not achieved in the dissolver until some portion of the second core is dissolved. The Al concentration for a given fuel fragment height is also dependent on the volume of the dissolving solution.

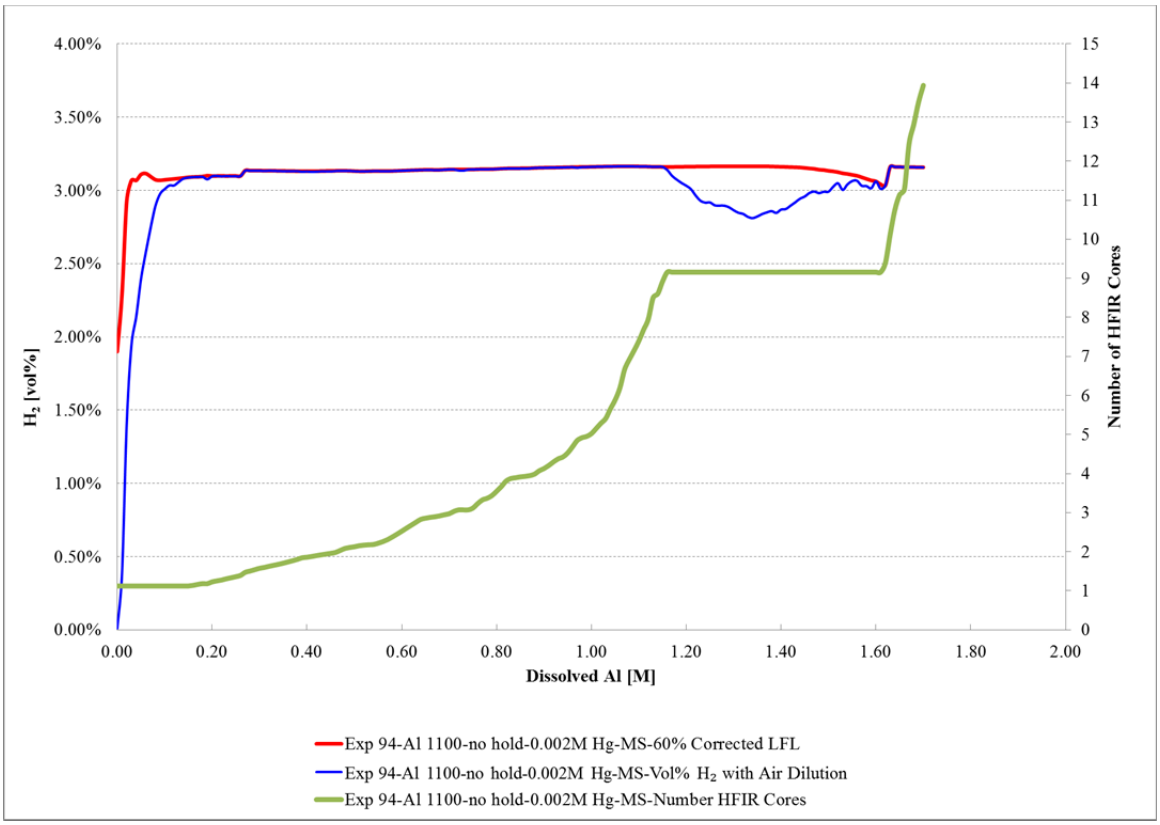

Figure 3-2. Maximum Number of HFIR Cores Allowed for Dissolution in an H-Canyon Dissolver

To determine if the next HFIR core can be charged for a given fragment height, the concentration of Al in the solution (Al[M](h)) was calculated using equation (5). When calculating the Al concentration for fragment heights generated from the dissolution of the second HFIR core, the mass of Al in the first core (134.747 kg) was assumed to be dissolved in the solution. The calculated Al concentration specifies the location on the x-axis of Figure 3-2 providing the maximum number of fractional HFIR cores that can be dissolved at that Al concentration. If the fragment height plus one HFIR core is less than the maximum fractional cores, then the next HFIR core can be charged. Following the methodology outlined above for a dissolver volume of 14,000 L, the additional number of HFIR cores that can be charged to the dissolver is greater than or equal to one when the fragment height is 10.4 inches or less. In other words, if the probed height of the HFIR fragment is 10.4 inches or less for both the inner and outer insert wells, then another HFIR core can be charged.

Appendix C shows the maximum fractional HFIR core calculations for a dissolver volume of 14,000 L as an example. The calculations described above were subsequently repeated for other dissolver volumes to evaluate the maximum fuel fragment height which can be present in the insert wells prior to charging the second and third HFIR cores. The maximum fragment heights associated with the charging of the second and third cores are shown in Table 3-2 and Table 3-3, respectively, for a range of dissolver volumes. If the actual dissolver volume is not listed in the tables, the maximum fragment height may be obtained by linear interpolation between the volumes provided.

Table 3-2. Maximum Fragment Heights which Allows Charging the Second HFIR Core for Various Solution Volumes

Dissolver Volume	Maximum Fragment Height of Remaining Core	Fraction of Core Remaining*	Al Conc. at Maximum Fragment Height	Maximum Number of Cores	Additional Cores Allowed
(kL)	(in)		(M)		
6.0	18.4	0.59	0.307	1.59	1.00
6.5	17.9	0.57	0.298	1.57	1.00
7.0	17.3	0.55	0.293	1.55	1.00
7.5	16.7	0.53	0.289	1.54	1.01
8.0	16.2	0.52	0.283	1.52	1.00
8.5	15.7	0.50	0.278	1.50	1.00
9.0	15.2	0.49	0.273	1.49	1.00
9.5	14.6	0.47	0.271	1.48	1.01
10.0	14.1	0.45	0.267	1.45	1.00
10.5	13.5	0.43	0.265	1.43	1.00
11.0	12.9	0.41	0.264	1.42	1.01
11.5	12.4	0.40	0.260	1.40	1.00
12.0	12.0	0.38	0.256	1.38	1.00
12.5	11.6	0.37	0.252	1.37	1.00
13.0	11.2	0.36	0.248	1.36	1.00
13.5	10.8	0.34	0.245	1.35	1.01
14.0	10.5	0.33	0.240	1.33	1.00
14.5	10.2	0.32	0.236	1.32	1.00
15.0	9.8	0.31	0.233	1.32	1.01
15.5	9.5	0.30	0.229	1.31	1.01
16.0	9.2	0.29	0.226	1.29	1.00
16.5	8.9	0.28	0.222	1.28	1.00
17.0	8.6	0.27	0.219	1.27	1.00
17.5	8.3	0.27	0.216	1.27	1.00
18.0	8.2	0.26	0.211	1.26	1.00

* Fraction of remaining core is based on the percentage of the remaining core height

Table 3-3. Maximum Fragment Heights which Allows Charging the Third HFIR Core for Various Solution Volumes

Dissolver Volume	Maximum Fragment Height of Remaining Core	Fraction of Core Remaining*	Al Conc. at Maximum Fragment Height	Maximum Number of Cores	Additional Cores Allowed
(kL)	(in)		(M)		
6.0	31.35	1.00	0.832	3.88	2.88
6.5	31.35	1.00	0.768	3.31	2.31
7.0	31.35	1.00	0.713	3.05	2.05
7.5	31.35	1.00	0.665	2.89	1.89
8.0	31.35	1.00	0.624	2.71	1.71
8.5	31.35	1.00	0.587	2.43	1.43
9.0	31.35	1.00	0.555	2.24	1.24
9.5	31.35	1.00	0.525	2.17	1.17
10.0	31.35	1.00	0.499	2.13	1.13
10.5	31.35	1.00	0.475	2.06	1.06
11.0	30.40	0.97	0.456	1.97	1.00
11.5	29.50	0.94	0.441	1.94	1.00
12.0	28.65	0.91	0.427	1.91	1.00
12.5	27.80	0.89	0.413	1.89	1.00
13.0	27.00	0.86	0.401	1.86	1.00
13.5	26.50	0.85	0.390	1.85	1.00
14.0	25.85	0.83	0.385	1.83	1.00
14.5	25.25	0.81	0.380	1.81	1.00
15.0	24.65	0.79	0.375	1.79	1.00
15.5	24.10	0.77	0.370	1.77	1.00
16.0	23.60	0.75	0.364	1.75	1.00
16.5	23.05	0.74	0.360	1.74	1.00
17.0	22.60	0.72	0.354	1.72	1.00
17.5	22.10	0.71	0.350	1.71	1.00
18.0	21.65	0.69	0.345	1.69	1.00

* Fraction of remaining core is based on the percentage of the remaining core height

4.0 Conclusions

Calculations were performed to estimate the maximum fragment height of HFIR fuel which can be present in the dissolver insert with the addition of the next core without exceeding 60% of the calculated H_2 LFL. Offgas characterization data from the dissolution of an Al 1100 alloy coupon used to define the HFIR dissolution flowsheet were used for the calculations.[4] Initially, the offgas data at dissolved Al concentrations from 0 to 1.7 M were used to calculate the maximum number of fractional HFIR cores which did not generate a predicted H_2 concentration exceeding 60% of the calculated LFL. The calculations showed that it was theoretically possible to charge at least two HFIR cores to the dissolver after reaching an Al concentration of 0.47 M. At Al concentrations greater than or equal to this value, it would not be necessary to measure the height of the fuel fragments prior to charging another HFIR core to address the potential for exceeding 60% of the H_2 LFL in the dissolver offgas.

For Al concentrations less than 0.47 M, calculations were performed to evaluate the maximum fuel fragment height which can be present in the insert wells prior to charging the second and third cores. In this analysis, the fragment height from probing the dissolver insert well was used to define an undissolved fractional HFIR core. The volume of the fractional core[7] and a pseudo density of Al were used to calculate the concentration of Al in the dissolver solution based on an assumed dissolver volume. When calculating the Al concentration for fragment heights generated during the dissolution of the second HFIR core, the mass of Al in the first core was assumed to be dissolved in the solution. The calculated Al concentration was used to define the maximum number of fractional HFIR cores that can be dissolved based on the previous calculations. If the fragment height plus one HFIR core was less than the maximum fractional cores which could be dissolved, then the next HFIR core could be charged. The maximum fragment heights associated with the charging of the second and third cores are provided in Table 3-2 and Table 3-3, respectively, for a range dissolver volumes.

5.0 Recommendations

The flowsheet recommendations for the dissolution of HFIR fuel in either the 6.4D or 6.1D dissolver still apply.[4] Additionally, based on this work, the maximum fragment height from probing the dissolver insert wells for the inner and outer elements must be less than or equal to the values given in Table 3-2 and Table 3-3 prior to charging the second and third HFIR cores, respectively.

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Appendix A. Inner and Outer Carrier Masses

Table A-1. Measured Inner Carrier Mass

ID	L-Area HFIR Inner Carrier	Mass	
		(lbs)	(kg)
L1	POAC14149A-17	3.60	1.633
L2	AC14186A-10	3.80	1.724
L3	AC14186A-33	3.80	1.724
L4	POAC14149A-7	3.60	1.633
L5	POAC14149A-22	3.60	1.633
L6	POAC14149A-29	3.60	1.633
L7	POAC14149A-1	3.60	1.633
L8	POAC14149A-12	3.60	1.633
L9	POAC14149A-6	3.60	1.633
L10	AB86957A-6	3.80	1.724
	Average	3.66	1.660

Table A-2. Measured Outer Carrier Mass

ID	L-Area HFIR Outer Carrier	Mass	
		(lbs)	(kg)
L101	AC14186A-19	10.40	4.717
L102	AC14186A-15	10.40	4.717
L103	POAC14149A-3	10.20	4.627
L104	AC14186A-11	10.40	4.717
L105	POAC14149A-4	10.20	4.627
L106	POAC14149A-19	10.00	4.536
L107	AC14186A-7	10.20	4.627
L108	POAC14149A-13	10.00	4.536
L109	AC14186A-34	10.40	4.717
	Average	10.24	4.647

Appendix B. Maximum Fractional HFIR Cores Allowed for Dissolution in H-Canyon

Table B-1 lists the maximum number of fractional HFIR cores which can be dissolved at Al concentrations from 0 to 1.7 M. The predicted H_2 concentration is below 60% of the calculated H_2 LFL at 200 °C. For Al concentrations greater than 1.7 M, the values calculated at 1.70 M Al can be used since the offgas rates decrease as the concentration of dissolved Al increases beyond this point. In some places in the table, the predicted H_2 concentration appears to be equal to the calculated H_2 LFL due to rounding, but mathematically, the predicted H_2 concentration is always less than the calculated LFL for all concentrations of Al.

Table B-1. Maximum Fractional HFIR Cores from Experiment 94 Data

Est. Al Conc.	Fractional HFIR Cores	Max. HFIR Core Height	Total Outer Surface Area	60% of Corrected H_2 LFL	Predicted H_2 with Air Dilution
(M)		(in)	(ft^2)	(vol %)	(vol %)
0.00	1.12	35.20	25.680	1.90	0.01
0.01	1.12	35.20	25.680	2.29	0.38
0.02	1.12	35.20	25.680	2.93	1.41
0.03	1.12	35.20	25.680	3.07	1.94
0.04	1.12	35.20	25.680	3.07	2.14
0.05	1.12	35.20	25.680	3.11	2.39
0.06	1.12	35.20	25.680	3.12	2.57
0.07	1.12	35.20	25.680	3.10	2.74
0.08	1.12	35.20	25.680	3.07	2.89
0.09	1.12	35.20	25.680	3.07	2.97
0.10	1.12	35.20	25.680	3.07	3.01
0.11	1.12	35.20	25.680	3.08	3.03
0.12	1.12	35.20	25.680	3.08	3.03
0.13	1.12	35.20	25.680	3.08	3.06
0.14	1.12	35.20	25.680	3.09	3.08
0.15	1.12	35.20	25.680	3.09	<3.09
0.16	1.14	35.70	25.983	3.09	<3.09
0.17	1.16	36.50	26.466	3.09	<3.09
0.18	1.18	37.10	26.829	3.10	3.09
0.19	1.18	37.10	26.829	3.10	3.08
0.20	1.23	38.50	27.676	3.10	<3.10
0.21	1.25	39.30	28.160	3.10	<3.10
0.22	1.28	40.00	28.583	3.10	<3.10
0.23	1.31	41.00	29.188	3.10	<3.10
0.24	1.33	41.80	29.672	3.10	<3.10
0.25	1.36	42.70	30.216	3.10	<3.10
0.26	1.39	43.70	30.821	3.10	<3.10
0.27	1.47	46.20	32.333	3.14	<3.14
0.28	1.51	47.20	32.938	3.14	3.13

Est. Al Conc.	Fractional HFIR Cores	Max. HFIR Core Height	Total Outer Surface Area	60% of Corrected H_2 LFL	Predicted H_2 with Air Dilution
(M)		(in)	(ft^2)	(vol %)	(vol %)
0.29	1.54	48.30	33.604	3.14	3.13
0.30	1.58	49.40	34.269	3.14	<3.14
0.31	1.60	50.10	34.692	3.13	<3.13
0.32	1.63	51.00	35.237	3.13	<3.13
0.33	1.65	51.80	35.720	3.13	<3.13
0.34	1.68	52.60	36.204	3.13	<3.13
0.35	1.71	53.50	36.749	3.13	<3.13
0.36	1.74	54.50	37.354	3.13	<3.13
0.37	1.77	55.50	37.958	3.13	<3.13
0.38	1.81	56.60	38.624	3.13	<3.13
0.39	1.85	57.90	39.410	3.13	<3.13
0.40	1.86	58.30	40.472	3.13	<3.13
0.41	1.88	58.90	41.467	3.13	<3.13
0.42	1.90	59.60	42.629	3.13	<3.13
0.43	1.92	60.20	43.625	3.13	<3.13
0.44	1.94	60.80	44.626	3.13	<3.13
0.45	1.96	61.40	45.609	3.13	<3.13
0.46	1.98	62.10	46.561	3.13	<3.13
0.47	2.03	63.70	47.400	3.13	<3.13
0.48	2.08	65.30	48.174	3.13	<3.13
0.49	2.11	66.10	48.816	3.13	<3.13
0.50	2.13	66.70	49.179	3.13	<3.13
0.51	2.15	67.50	49.663	3.13	<3.13
0.52	2.17	68.00	49.965	3.13	<3.13
0.53	2.18	68.30	50.147	3.13	<3.13
0.54	2.19	68.50	50.268	3.13	<3.13
0.55	2.22	69.50	50.873	3.13	<3.13
0.56	2.26	70.80	51.659	3.13	<3.13
0.57	2.31	72.40	52.627	3.13	<3.13
0.58	2.38	74.50	53.897	3.13	<3.13
0.59	2.45	76.80	55.288	3.13	<3.13
0.60	2.53	79.20	56.740	3.14	3.13
0.61	2.60	81.60	58.191	3.14	3.14
0.62	2.68	84.00	59.643	3.14	3.14
0.63	2.76	86.40	61.095	3.14	3.14
0.64	2.83	88.70	62.486	3.14	3.14
0.65	2.86	89.60	63.797	3.14	<3.14
0.66	2.88	90.30	64.959	3.14	<3.14
0.67	2.90	90.80	65.789	3.14	<3.14

Est. Al Conc.	Fractional HFIR Cores	Max. HFIR Core Height	Total Outer Surface Area	60% of Corrected H_2 LFL	Predicted H_2 with Air Dilution
(M)		(in)	(ft^2)	(vol %)	(vol %)
0.68	2.92	91.50	66.950	3.14	<3.14
0.69	2.95	92.40	68.414	3.14	<3.14
0.70	2.97	93.20	69.793	3.14	<3.14
0.71	3.03	95.10	70.836	3.14	<3.14
0.72	3.07	96.30	71.486	3.14	<3.14
0.73	3.07	96.30	71.486	3.14	<3.14
0.74	3.07	96.30	71.486	3.14	<3.14
0.75	3.12	97.70	72.376	3.14	<3.14
0.76	3.23	101.30	74.553	3.14	<3.14
0.77	3.33	104.30	76.368	3.15	3.14
0.78	3.37	105.60	77.154	3.14	<3.14
0.79	3.44	107.70	78.424	3.15	3.14
0.80	3.55	111.20	80.541	3.15	<3.15
0.81	3.67	115.00	82.840	3.15	<3.15
0.82	3.81	119.40	85.501	3.15	<3.15
0.83	3.88	121.50	88.118	3.15	<3.15
0.84	3.89	122.10	89.114	3.15	<3.15
0.85	3.92	122.80	90.276	3.15	<3.15
0.86	3.93	123.20	90.939	3.15	<3.15
0.87	3.95	123.80	91.909	3.15	<3.15
0.88	3.99	125.00	93.488	3.15	<3.15
0.89	4.07	127.70	94.922	3.15	<3.15
0.90	4.13	129.50	96.056	3.16	3.15
0.91	4.21	131.90	97.508	3.16	<3.16
0.92	4.30	134.80	99.262	3.16	<3.16
0.93	4.38	137.30	100.774	3.16	<3.16
0.94	4.43	138.80	101.681	3.16	<3.16
0.95	4.53	142.00	103.617	3.16	<3.16
0.96	4.69	146.90	106.581	3.16	<3.16
0.97	4.85	152.00	109.665	3.16	<3.16
0.98	4.92	154.20	113.767	3.16	<3.16
0.99	4.95	155.30	115.575	3.16	<3.16
1.00	5.02	157.50	117.490	3.16	<3.16
1.01	5.15	161.60	119.918	3.16	<3.16
1.02	5.29	165.80	122.459	3.16	<3.16
1.03	5.41	169.60	124.757	3.16	<3.16
1.04	5.66	177.40	129.475	3.16	<3.16
1.05	5.89	184.50	135.433	3.16	<3.16
1.06	6.19	194.10	144.022	3.16	<3.16

Est. Al Conc.	Fractional HFIR Cores	Max. HFIR Core Height	Total Outer Surface Area	60% of Corrected H_2 LFL	Predicted H_2 with Air Dilution
(M)		(in)	(ft^2)	(vol %)	(vol %)
1.07	6.67	209.00	153.034	3.16	<3.16
1.08	6.93	217.10	160.915	3.16	<3.16
1.09	7.15	224.20	166.674	3.16	<3.16
1.10	7.40	231.90	171.332	3.16	<3.16
1.11	7.68	240.90	176.775	3.16	<3.16
1.12	7.96	249.50	186.059	3.16	<3.16
1.13	8.50	266.50	196.706	3.16	<3.16
1.14	8.61	269.80	198.702	3.16	<3.16
1.15	8.92	279.60	207.400	3.16	<3.16
1.16	9.16	287.10	213.612	3.16	3.14
1.17	9.16	287.10	213.612	3.16	3.10
1.18	9.16	287.10	213.612	3.16	3.07
1.19	9.16	287.10	213.612	3.16	3.05
1.20	9.16	287.10	213.612	3.16	3.03
1.21	9.16	287.10	213.612	3.16	3.01
1.22	9.16	287.10	213.612	3.16	2.96
1.23	9.16	287.10	213.612	3.16	2.93
1.24	9.16	287.10	213.612	3.16	2.92
1.25	9.16	287.10	213.612	3.16	2.92
1.26	9.16	287.10	213.612	3.16	2.90
1.27	9.16	287.10	213.612	3.16	2.90
1.28	9.16	287.10	213.612	3.16	2.90
1.29	9.16	287.10	213.612	3.16	2.89
1.30	9.16	287.10	213.612	3.16	2.86
1.31	9.16	287.10	213.612	3.16	2.85
1.32	9.16	287.10	213.612	3.16	2.84
1.33	9.16	287.10	213.612	3.16	2.82
1.34	9.16	287.10	213.612	3.16	2.81
1.35	9.16	287.10	213.612	3.16	2.82
1.36	9.16	287.10	213.612	3.16	2.84
1.37	9.16	287.10	213.612	3.16	2.85
1.38	9.16	287.10	213.612	3.16	2.86
1.39	9.16	287.10	213.612	3.16	2.85
1.40	9.16	287.10	213.612	3.16	2.87
1.41	9.16	287.10	213.612	3.16	2.87
1.42	9.16	287.10	213.612	3.16	2.90
1.43	9.16	287.10	213.612	3.16	2.92
1.44	9.16	287.10	213.612	3.16	2.94
1.45	9.16	287.10	213.612	3.15	2.96

Est. Al Conc.	Fractional HFIR Cores	Max. HFIR Core Height	Total Outer Surface Area	60% of Corrected H_2 LFL	Predicted H_2 with Air Dilution
(M)		(in)	(ft^2)	(vol %)	(vol %)
1.46	9.16	287.10	213.612	3.15	2.98
1.47	9.16	287.10	213.612	3.15	2.99
1.48	9.16	287.10	213.612	3.14	2.98
1.49	9.16	287.10	213.612	3.14	2.99
1.50	9.16	287.10	213.612	3.13	2.99
1.51	9.16	287.10	213.612	3.13	3.03
1.52	9.16	287.10	213.612	3.13	3.05
1.53	9.16	287.10	213.612	3.12	3.00
1.54	9.16	287.10	213.612	3.11	3.04
1.55	9.16	287.10	213.612	3.11	3.06
1.56	9.16	287.10	213.612	3.10	3.07
1.57	9.16	287.10	213.612	3.09	3.03
1.58	9.16	287.10	213.612	3.08	3.03
1.59	9.16	287.10	213.612	3.07	3.01
1.60	9.16	287.10	213.612	3.06	<3.06
1.61	9.16	287.10	213.612	3.04	3.01
1.62	9.39	294.50	218.088	3.03	3.03
1.63	10.12	317.20	236.264	3.16	<3.16
1.64	10.75	337.10	248.301	3.16	<3.16
1.65	11.14	349.20	260.066	3.16	<3.16
1.66	11.28	353.70	262.788	3.16	<3.16
1.67	12.45	390.30	289.371	3.16	<3.16
1.68	12.95	406.00	302.670	3.16	<3.16
1.69	13.52	423.70	314.020	3.16	<3.16
1.70	13.94	437.00	325.526	3.16	<3.16

Appendix C. Allowed Additional Fractional HFIR Cores for a 14,000 L Dissolver Volume

The assumptions used to develop Table C-1 are:

- The probe or fragment height of the fuel is the maximum value measured in either the inner core well or the outer core well.
- The volume of the dissolver is 14,000 L.
- The HFIR core is assumed to have a pseudo density of 43.40 g/in^3.
- The maximum height of a HFIR core is 31.35 in.[7]
- The total volume of a HFIR core at its maximum height is 3,104.78 in^3.[7]
- The total mass of Al in a HFIR core is 134.747 kg based on the Al density and total volume at the maximum height.

Examples

If the probe height is 0 inches (i.e., the entire HFIR core dissolved) which results in an Al concentration of 0.36 M in 14,000 L and the maximum HFIR cores allowed to be charged is 1.73 then 1.73 – 0 or 1.73 HFIR cores could be charged next.

If the probe height is 15 inches or about half of the prior HFIR core was dissolved which results in an Al concentration of 0.18 M in 14,000 L and the maximum HFIR cores allowed to be charged is 1.18 then 1.18 - 0.48 or 0.70 HFIR cores could be charged next. Note that three significant figures are carried in the tables for the HFIR cores to distinguish the values, but one may round down as needed.

Table C-1. Probe Height and Fractional HFIR Cores Allowed to Charge

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
0.00	0.00	0	134.747	0.356	1.727	0.000	1.727
0.05	2.02	0.088	134.660	0.356	1.726	0.002	1.724
0.10	4.04	0.175	134.572	0.356	1.725	0.003	1.722
0.15	6.05	0.263	134.485	0.356	1.724	0.005	1.719
0.20	8.07	0.350	134.397	0.356	1.724	0.006	1.717
0.25	10.09	0.438	134.310	0.355	1.723	0.008	1.715
0.30	11.64	0.505	134.242	0.355	1.722	0.010	1.713
0.35	13.19	0.572	134.175	0.355	1.723	0.011	1.712
0.40	14.74	0.640	134.108	0.355	1.722	0.013	1.710
0.45	16.28	0.707	134.041	0.355	1.722	0.014	1.707
0.50	17.83	0.774	133.974	0.354	1.721	0.016	1.705
0.55	19.38	0.841	133.906	0.354	1.721	0.018	1.703
0.60	20.93	0.908	133.839	0.354	1.720	0.019	1.701
0.65	22.48	0.976	133.772	0.354	1.719	0.021	1.699
0.70	24.02	1.042	133.705	0.354	1.719	0.022	1.697
0.75	25.57	1.110	133.638	0.354	1.718	0.024	1.694

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
0.80	27.12	1.177	133.570	0.353	1.718	0.026	1.692
0.85	28.67	1.244	133.503	0.353	1.717	0.027	1.690
0.90	30.22	1.312	133.436	0.353	1.717	0.029	1.688
0.95	31.77	1.379	133.369	0.353	1.716	0.030	1.686
1.00	33.31	1.446	133.302	0.353	1.715	0.032	1.683
1.05	34.86	1.513	133.235	0.352	1.715	0.033	1.681
1.10	36.41	1.580	133.167	0.352	1.714	0.035	1.679
1.15	37.96	1.647	133.100	0.352	1.714	0.037	1.677
1.20	39.51	1.715	133.033	0.352	1.713	0.038	1.675
1.25	41.05	1.782	132.966	0.352	1.712	0.040	1.672
1.30	42.60	1.849	132.899	0.352	1.712	0.041	1.670
1.35	44.15	1.916	132.831	0.351	1.711	0.043	1.668
1.40	45.70	1.983	132.764	0.351	1.711	0.045	1.666
1.45	47.25	2.051	132.697	0.351	1.710	0.046	1.664
1.50	48.79	2.117	132.630	0.351	1.709	0.048	1.662
1.55	50.34	2.185	132.563	0.351	1.709	0.049	1.659
1.60	51.89	2.252	132.495	0.351	1.708	0.051	1.657
1.65	53.44	2.319	132.428	0.350	1.708	0.053	1.655
1.70	54.99	2.387	132.361	0.350	1.707	0.054	1.653
1.75	56.54	2.454	132.294	0.350	1.706	0.056	1.651
1.80	58.08	2.521	132.227	0.350	1.706	0.057	1.649
1.85	59.63	2.588	132.160	0.350	1.705	0.059	1.646
1.90	61.18	2.655	132.092	0.349	1.705	0.061	1.644
1.95	62.73	2.722	132.025	0.349	1.704	0.062	1.642
2.00	64.28	2.790	131.958	0.349	1.704	0.064	1.640
2.05	65.82	2.857	131.891	0.349	1.703	0.065	1.638
2.10	67.37	2.924	131.824	0.349	1.703	0.067	1.636
2.15	68.92	2.991	131.756	0.349	1.702	0.069	1.633
2.20	70.47	3.058	131.689	0.348	1.702	0.070	1.631
2.25	72.02	3.126	131.622	0.348	1.701	0.072	1.629
2.30	73.57	3.193	131.555	0.348	1.700	0.073	1.627
2.35	75.11	3.260	131.488	0.348	1.700	0.075	1.625
2.40	76.23	3.308	131.439	0.348	1.699	0.077	1.623
2.45	76.91	3.338	131.410	0.348	1.699	0.078	1.621
2.50	77.60	3.368	131.380	0.348	1.699	0.080	1.619
2.55	78.13	3.391	131.357	0.348	1.699	0.081	1.617
2.60	78.52	3.408	131.340	0.347	1.699	0.083	1.616
2.65	80.83	3.508	131.239	0.347	1.698	0.085	1.613
2.70	85.07	3.692	131.055	0.347	1.696	0.086	1.610

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
2.75	89.31	3.876	130.871	0.346	1.695	0.088	1.607
2.80	93.55	4.060	130.687	0.346	1.694	0.089	1.604
2.85	97.79	4.244	130.503	0.345	1.692	0.091	1.601
2.90	102.91	4.466	130.281	0.345	1.692	0.093	1.599
2.95	108.90	4.726	130.021	0.344	1.690	0.094	1.596
3.00	114.89	4.986	129.761	0.343	1.688	0.096	1.592
3.05	120.88	5.246	129.501	0.343	1.686	0.097	1.588
3.10	126.87	5.506	129.241	0.342	1.683	0.099	1.585
3.15	132.86	5.766	128.981	0.341	1.681	0.100	1.581
3.20	138.85	6.026	128.721	0.341	1.679	0.102	1.577
3.25	144.85	6.286	128.461	0.340	1.677	0.104	1.574
3.30	150.84	6.546	128.201	0.339	1.675	0.105	1.570
3.35	156.83	6.806	127.941	0.338	1.674	0.107	1.567
3.40	162.82	7.066	127.681	0.338	1.672	0.108	1.563
3.45	168.81	7.326	127.421	0.337	1.670	0.110	1.560
3.50	174.80	7.586	127.161	0.336	1.668	0.112	1.556
3.55	180.80	7.847	126.901	0.336	1.666	0.113	1.553
3.60	186.79	8.107	126.641	0.335	1.664	0.115	1.550
3.65	192.78	8.367	126.381	0.334	1.664	0.116	1.548
3.70	198.77	8.627	126.121	0.334	1.662	0.118	1.544
3.75	204.76	8.887	125.861	0.333	1.660	0.120	1.541
3.80	210.75	9.147	125.601	0.332	1.658	0.121	1.537
3.85	216.74	9.407	125.341	0.332	1.657	0.123	1.534
3.90	222.74	9.667	125.081	0.331	1.655	0.124	1.530
3.95	228.73	9.927	124.821	0.330	1.653	0.126	1.527
4.00	234.72	10.187	124.561	0.330	1.651	0.128	1.523
4.05	240.71	10.447	124.301	0.329	1.649	0.129	1.520
4.10	246.70	10.707	124.041	0.328	1.647	0.131	1.517
4.15	252.69	10.967	123.781	0.327	1.645	0.132	1.513
4.20	258.68	11.227	123.521	0.327	1.644	0.134	1.510
4.25	264.68	11.487	123.260	0.326	1.642	0.136	1.506
4.30	270.67	11.747	123.000	0.325	1.640	0.137	1.503
4.35	276.66	12.007	122.740	0.325	1.640	0.139	1.501
4.40	282.65	12.267	122.480	0.324	1.638	0.140	1.497
4.45	288.64	12.527	122.220	0.323	1.636	0.142	1.494
4.50	294.63	12.787	121.961	0.323	1.634	0.144	1.491
4.55	300.62	13.047	121.701	0.322	1.632	0.145	1.487
4.60	306.62	13.307	121.440	0.321	1.630	0.147	1.484
4.65	312.61	13.567	121.180	0.321	1.628	0.148	1.480

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
4.70	318.60	13.827	120.920	0.320	1.626	0.150	1.477
4.75	324.59	14.087	120.660	0.319	1.624	0.152	1.473
4.80	330.58	14.347	120.400	0.319	1.622	0.153	1.469
4.85	336.57	14.607	120.140	0.318	1.620	0.155	1.466
4.90	342.57	14.868	119.880	0.317	1.618	0.156	1.462
4.95	348.56	15.128	119.620	0.316	1.616	0.158	1.458
5.00	354.55	15.387	119.360	0.316	1.614	0.159	1.455
5.05	360.54	15.647	119.100	0.315	1.612	0.161	1.451
5.10	366.53	15.907	118.840	0.314	1.611	0.163	1.448
5.15	372.52	16.167	118.580	0.314	1.609	0.164	1.445
5.20	378.51	16.427	118.320	0.313	1.607	0.166	1.441
5.25	384.51	16.688	118.060	0.312	1.605	0.167	1.437
5.30	390.50	16.948	117.800	0.312	1.603	0.169	1.434
5.35	396.49	17.208	117.540	0.311	1.601	0.171	1.430
5.40	402.48	17.468	117.280	0.310	1.599	0.172	1.427
5.45	408.47	17.728	117.020	0.310	1.597	0.174	1.423
5.50	414.46	17.988	116.760	0.309	1.595	0.175	1.420
5.55	420.45	18.248	116.500	0.308	1.594	0.177	1.417
5.60	426.45	18.508	116.240	0.308	1.592	0.179	1.413
5.65	432.44	18.768	115.980	0.307	1.590	0.180	1.410
5.70	438.43	19.028	115.720	0.306	1.589	0.182	1.407
5.75	444.42	19.288	115.460	0.305	1.587	0.183	1.404
5.80	450.41	19.548	115.200	0.305	1.587	0.185	1.402
5.85	456.40	19.808	114.940	0.304	1.586	0.187	1.399
5.90	462.39	20.068	114.680	0.303	1.584	0.188	1.396
5.95	468.39	20.328	114.419	0.303	1.583	0.190	1.393
6.00	474.38	20.588	114.159	0.302	1.581	0.191	1.390
6.05	480.37	20.848	113.899	0.301	1.579	0.193	1.386
6.10	486.36	21.108	113.639	0.301	1.578	0.195	1.383
6.15	492.35	21.368	113.379	0.300	1.576	0.196	1.379
6.20	498.34	21.628	113.119	0.299	1.573	0.198	1.376
6.25	504.34	21.888	112.859	0.299	1.571	0.199	1.372
6.30	510.33	22.148	112.599	0.298	1.568	0.201	1.367
6.35	516.32	22.408	112.339	0.297	1.566	0.203	1.363
6.40	522.31	22.668	112.079	0.297	1.563	0.204	1.359
6.45	528.30	22.928	111.819	0.296	1.561	0.206	1.355
6.50	534.29	23.188	111.559	0.295	1.558	0.207	1.351
6.55	540.28	23.448	111.299	0.294	1.557	0.209	1.348
6.60	546.28	23.709	111.039	0.294	1.555	0.211	1.344

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
6.65	552.27	23.969	110.779	0.293	1.552	0.212	1.340
6.70	558.26	24.228	110.519	0.292	1.549	0.214	1.336
6.75	564.25	24.488	110.259	0.292	1.547	0.215	1.332
6.80	570.24	24.748	109.999	0.291	1.544	0.217	1.327
6.85	576.23	25.008	109.739	0.290	1.542	0.219	1.323
6.90	582.22	25.268	109.479	0.290	1.539	0.220	1.319
6.95	588.22	25.529	109.219	0.289	1.537	0.222	1.315
7.00	594.21	25.789	108.959	0.288	1.534	0.223	1.311
7.05	600.20	26.049	108.699	0.288	1.532	0.225	1.307
7.10	606.19	26.309	108.439	0.287	1.529	0.226	1.303
7.15	612.18	26.569	108.179	0.286	1.527	0.228	1.298
7.20	618.17	26.829	107.919	0.285	1.524	0.230	1.294
7.25	624.16	27.089	107.659	0.285	1.523	0.231	1.292
7.30	630.16	27.349	107.399	0.284	1.521	0.233	1.288
7.35	636.15	27.609	107.139	0.283	1.518	0.234	1.284
7.40	642.14	27.869	106.879	0.283	1.516	0.236	1.280
7.45	648.13	28.129	106.619	0.282	1.513	0.238	1.275
7.50	654.12	28.389	106.359	0.281	1.511	0.239	1.271
7.55	660.11	28.649	106.099	0.281	1.508	0.241	1.267
7.60	666.11	28.909	105.838	0.280	1.506	0.242	1.263
7.65	672.10	29.169	105.578	0.279	1.503	0.244	1.259
7.70	678.09	29.429	105.318	0.279	1.501	0.246	1.255
7.75	684.08	29.689	105.058	0.278	1.498	0.247	1.251
7.80	690.07	29.949	104.798	0.277	1.496	0.249	1.247
7.85	696.06	30.209	104.538	0.277	1.494	0.250	1.243
7.90	702.05	30.469	104.278	0.276	1.492	0.252	1.240
7.95	708.05	30.729	104.018	0.275	1.489	0.254	1.236
8.00	714.04	30.989	103.758	0.274	1.491	0.255	1.236
8.05	720.03	31.249	103.498	0.274	1.489	0.257	1.232
8.10	726.02	31.509	103.238	0.273	1.486	0.258	1.228
8.15	732.01	31.769	102.978	0.272	1.484	0.260	1.224
8.20	738.00	32.029	102.718	0.272	1.481	0.262	1.220
8.25	743.99	32.289	102.458	0.271	1.479	0.263	1.216
8.30	749.99	32.550	102.198	0.270	1.476	0.265	1.211
8.35	755.98	32.810	101.938	0.270	1.472	0.266	1.205
8.40	761.97	33.069	101.678	0.269	1.467	0.268	1.199
8.45	767.96	33.329	101.418	0.268	1.461	0.270	1.192
8.50	773.95	33.589	101.158	0.268	1.456	0.271	1.185
8.55	779.94	33.849	100.898	0.267	1.450	0.273	1.177

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
8.60	785.93	34.109	100.638	0.266	1.444	0.274	1.170
8.65	791.93	34.370	100.378	0.266	1.439	0.276	1.163
8.70	797.92	34.630	100.118	0.265	1.433	0.278	1.155
8.75	803.91	34.890	99.858	0.264	1.427	0.279	1.148
8.80	809.90	35.150	99.598	0.263	1.421	0.281	1.140
8.85	815.89	35.410	99.338	0.263	1.415	0.282	1.133
8.90	821.88	35.670	99.078	0.262	1.410	0.284	1.126
8.95	827.88	35.930	98.817	0.261	1.404	0.285	1.119
9.00	833.87	36.190	98.557	0.261	1.399	0.287	1.112
9.05	839.86	36.450	98.298	0.260	1.394	0.289	1.106
9.10	845.85	36.710	98.038	0.259	1.391	0.290	1.100
9.15	851.84	36.970	97.778	0.259	1.388	0.292	1.096
9.20	857.83	37.230	97.518	0.258	1.385	0.293	1.092
9.25	863.82	37.490	97.258	0.257	1.383	0.295	1.088
9.30	869.82	37.750	96.997	0.257	1.380	0.297	1.084
9.35	875.81	38.010	96.737	0.256	1.378	0.298	1.080
9.40	881.80	38.270	96.477	0.255	1.376	0.300	1.076
9.45	887.79	38.530	96.217	0.255	1.377	0.301	1.076
9.50	893.78	38.790	95.957	0.254	1.375	0.303	1.072
9.55	899.77	39.050	95.697	0.253	1.373	0.305	1.068
9.60	905.76	39.310	95.437	0.252	1.370	0.306	1.064
9.65	911.76	39.570	95.177	0.252	1.368	0.308	1.060
9.70	917.75	39.830	94.917	0.251	1.366	0.309	1.056
9.75	923.74	40.090	94.657	0.250	1.363	0.311	1.052
9.80	929.73	40.350	94.397	0.250	1.361	0.313	1.049
9.85	935.72	40.610	94.137	0.249	1.359	0.314	1.045
9.90	941.71	40.870	93.877	0.248	1.357	0.316	1.041
9.95	947.70	41.130	93.617	0.248	1.355	0.317	1.037
10.00	953.70	41.391	93.357	0.247	1.353	0.319	1.034
10.05	959.69	41.651	93.097	0.246	1.351	0.321	1.030
10.10	965.68	41.911	92.837	0.246	1.349	0.322	1.026
10.15	971.67	42.170	92.577	0.245	1.348	0.324	1.024
10.20	977.66	42.430	92.317	0.244	1.346	0.325	1.021
10.25	983.65	42.690	92.057	0.244	1.344	0.327	1.017
10.30	989.65	42.951	91.797	0.243	1.342	0.329	1.013
10.35	995.64	43.211	91.537	0.242	1.340	0.330	1.010
10.40	1001.63	43.471	91.277	0.241	1.338	0.332	1.006
10.45	1007.62	43.731	91.017	0.241	1.336	0.333	1.002
10.50	1013.61	43.991	90.757	0.240	1.334	0.335	0.999

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
10.55	1019.60	44.251	90.497	0.239	1.332	0.337	0.995
10.60	1025.59	44.511	90.237	0.239	1.330	0.338	0.992
10.65	1031.59	44.771	89.976	0.238	1.328	0.340	0.988
10.70	1037.58	45.031	89.716	0.237	1.326	0.341	0.985
10.75	1043.57	45.291	89.457	0.237	1.324	0.343	0.981
10.80	1049.56	45.551	89.197	0.236	1.322	0.344	0.978
10.85	1055.55	45.811	88.937	0.235	1.321	0.346	0.974
10.90	1061.54	46.071	88.677	0.235	1.320	0.348	0.973
10.95	1067.53	46.331	88.417	0.234	1.319	0.349	0.969
11.00	1073.53	46.591	88.156	0.233	1.317	0.351	0.966
11.05	1079.52	46.851	87.896	0.233	1.315	0.352	0.962
11.10	1085.51	47.111	87.636	0.232	1.313	0.354	0.959
11.15	1091.50	47.371	87.376	0.231	1.311	0.356	0.955
11.20	1097.49	47.631	87.116	0.230	1.309	0.357	0.952
11.25	1103.48	47.891	86.856	0.230	1.307	0.359	0.948
11.30	1109.47	48.151	86.596	0.229	1.305	0.360	0.944
11.35	1115.47	48.411	86.336	0.228	1.303	0.362	0.941
11.40	1121.46	48.671	86.076	0.228	1.300	0.364	0.937
11.45	1127.45	48.931	85.816	0.227	1.298	0.365	0.933
11.50	1133.44	49.191	85.556	0.226	1.296	0.367	0.929
11.55	1139.43	49.451	85.296	0.226	1.294	0.368	0.925
11.60	1145.42	49.711	85.036	0.225	1.292	0.370	0.922
11.65	1151.42	49.972	84.776	0.224	1.290	0.372	0.918
11.70	1157.41	50.232	84.516	0.224	1.288	0.373	0.914
11.75	1163.40	50.492	84.256	0.223	1.285	0.375	0.910
11.80	1169.39	50.752	83.996	0.222	1.283	0.376	0.907
11.85	1175.38	51.011	83.736	0.222	1.281	0.378	0.903
11.90	1181.37	51.271	83.476	0.221	1.278	0.380	0.899
11.95	1187.36	51.531	83.216	0.220	1.276	0.381	0.895
12.00	1193.36	51.792	82.956	0.219	1.274	0.383	0.892
12.05	1199.35	52.052	82.696	0.219	1.273	0.384	0.888
12.10	1205.34	52.312	82.436	0.218	1.271	0.386	0.885
12.15	1211.33	52.572	82.176	0.217	1.269	0.388	0.882
12.20	1217.32	52.832	81.916	0.217	1.268	0.389	0.879
12.25	1223.31	53.092	81.656	0.216	1.266	0.391	0.875
12.30	1229.30	53.352	81.396	0.215	1.265	0.392	0.872
12.35	1235.30	53.612	81.135	0.215	1.265	0.394	0.871
12.40	1241.29	53.872	80.875	0.214	1.263	0.396	0.868
12.45	1247.28	54.132	80.616	0.213	1.261	0.397	0.864

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
12.50	1253.27	54.392	80.356	0.213	1.260	0.399	0.861
12.55	1259.26	54.652	80.096	0.212	1.258	0.400	0.858
12.60	1265.25	54.912	79.836	0.211	1.257	0.402	0.855
12.65	1271.24	55.172	79.576	0.211	1.255	0.404	0.851
12.70	1277.24	55.432	79.315	0.210	1.253	0.405	0.848
12.75	1283.23	55.692	79.055	0.209	1.251	0.407	0.845
12.80	1289.22	55.952	78.795	0.208	1.250	0.408	0.841
12.85	1295.21	56.212	78.535	0.208	1.248	0.410	0.838
12.90	1301.20	56.472	78.275	0.207	1.246	0.411	0.834
12.95	1307.19	56.732	78.015	0.206	1.244	0.413	0.831
13.00	1313.19	56.992	77.755	0.206	1.242	0.415	0.828
13.05	1319.18	57.252	77.495	0.205	1.240	0.416	0.824
13.10	1325.17	57.512	77.235	0.204	1.241	0.418	0.823
13.15	1331.16	57.772	76.975	0.204	1.239	0.419	0.819
13.20	1337.15	58.032	76.715	0.203	1.237	0.421	0.816
13.25	1343.14	58.292	76.455	0.202	1.235	0.423	0.812
13.30	1349.13	58.552	76.195	0.202	1.233	0.424	0.809
13.35	1355.13	58.813	75.935	0.201	1.231	0.426	0.805
13.40	1361.12	59.073	75.675	0.200	1.229	0.427	0.801
13.45	1367.11	59.333	75.415	0.200	1.226	0.429	0.797
13.50	1373.10	59.593	75.155	0.199	1.223	0.431	0.792
13.55	1379.09	59.853	74.895	0.198	1.220	0.432	0.788
13.60	1385.08	60.112	74.635	0.197	1.217	0.434	0.783
13.65	1391.07	60.372	74.375	0.197	1.214	0.435	0.778
13.70	1397.07	60.633	74.115	0.196	1.210	0.437	0.773
13.75	1403.06	60.893	73.855	0.195	1.207	0.439	0.769
13.80	1409.05	61.153	73.595	0.195	1.203	0.440	0.763
13.85	1415.04	61.413	73.335	0.194	1.200	0.442	0.758
13.90	1421.03	61.673	73.075	0.193	1.197	0.443	0.754
13.95	1427.02	61.933	72.815	0.193	1.194	0.445	0.749
14.00	1433.01	62.193	72.555	0.192	1.191	0.447	0.744
14.05	1439.01	62.453	72.294	0.191	1.188	0.448	0.740
14.10	1445.00	62.713	72.034	0.191	1.185	0.450	0.735
14.15	1450.99	62.973	71.774	0.190	1.183	0.451	0.732
14.20	1456.98	63.233	71.515	0.189	1.182	0.453	0.729
14.25	1462.97	63.493	71.255	0.189	1.182	0.455	0.727
14.30	1468.96	63.753	70.995	0.188	1.181	0.456	0.725
14.35	1474.96	64.013	70.734	0.187	1.181	0.458	0.724
14.40	1480.95	64.273	70.474	0.186	1.181	0.459	0.722

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
14.45	1486.94	64.533	70.214	0.186	1.181	0.461	0.720
14.50	1492.93	64.793	69.954	0.185	1.182	0.463	0.719
14.55	1498.92	65.053	69.694	0.184	1.184	0.464	0.720
14.60	1504.91	65.313	69.434	0.184	1.184	0.466	0.719
14.65	1510.90	65.573	69.174	0.183	1.184	0.467	0.717
14.70	1516.90	65.833	68.914	0.182	1.184	0.469	0.715
14.75	1522.89	66.093	68.654	0.182	1.184	0.470	0.714
14.80	1528.88	66.353	68.394	0.181	1.184	0.472	0.712
14.85	1534.87	66.613	68.134	0.180	1.184	0.474	0.710
14.90	1540.86	66.873	67.874	0.180	1.183	0.475	0.708
14.95	1546.85	67.133	67.614	0.179	1.182	0.477	0.705
15.00	1552.84	67.393	67.354	0.178	1.181	0.478	0.703
15.05	1558.84	67.654	67.094	0.177	1.179	0.480	0.699
15.10	1564.83	67.914	66.834	0.177	1.178	0.482	0.696
15.15	1570.82	68.174	66.574	0.176	1.176	0.483	0.693
15.20	1576.81	68.434	66.314	0.175	1.175	0.485	0.690
15.25	1582.80	68.694	66.054	0.175	1.174	0.486	0.688
15.30	1588.79	68.953	65.794	0.174	1.173	0.488	0.685
15.35	1594.79	69.214	65.534	0.173	1.171	0.490	0.682
15.40	1600.78	69.474	65.274	0.173	1.170	0.491	0.679
15.45	1606.77	69.734	65.014	0.172	1.169	0.493	0.676
15.50	1612.76	69.994	64.754	0.171	1.167	0.494	0.673
15.55	1618.75	70.254	64.494	0.171	1.166	0.496	0.670
15.60	1624.74	70.514	64.234	0.170	1.164	0.498	0.666
15.65	1630.73	70.774	63.974	0.169	1.162	0.499	0.663
15.70	1636.73	71.034	63.713	0.169	1.161	0.501	0.660
15.75	1642.72	71.294	63.453	0.168	1.159	0.502	0.656
15.80	1648.71	71.554	63.193	0.167	1.157	0.504	0.653
15.85	1654.70	71.814	62.933	0.166	1.155	0.506	0.650
15.90	1660.69	72.074	62.674	0.166	1.153	0.507	0.646
15.95	1666.68	72.334	62.414	0.165	1.151	0.509	0.643
16.00	1672.67	72.594	62.154	0.164	1.150	0.510	0.640
16.05	1678.67	72.854	61.893	0.164	1.148	0.512	0.636
16.10	1684.66	73.114	61.633	0.163	1.147	0.514	0.633
16.15	1690.65	73.374	61.373	0.162	1.145	0.515	0.630
16.20	1696.64	73.634	61.113	0.162	1.143	0.517	0.626
16.25	1702.63	73.894	60.853	0.161	1.141	0.518	0.623
16.30	1708.62	74.154	60.593	0.160	1.139	0.520	0.620
16.35	1714.61	74.414	60.333	0.160	1.138	0.522	0.616

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
16.40	1720.61	74.674	60.073	0.159	1.137	0.523	0.614
16.45	1726.60	74.934	59.813	0.158	1.135	0.525	0.611
16.50	1732.59	75.194	59.553	0.158	1.134	0.526	0.608
16.55	1738.58	75.454	59.293	0.157	1.133	0.528	0.605
16.60	1744.57	75.714	59.033	0.156	1.132	0.530	0.602
16.65	1750.56	75.974	58.773	0.155	1.131	0.531	0.600
16.70	1756.56	76.235	58.513	0.155	1.130	0.533	0.597
16.75	1762.55	76.495	58.253	0.154	1.129	0.534	0.595
16.80	1768.54	76.755	57.993	0.153	1.128	0.536	0.592
16.85	1774.53	77.015	57.733	0.153	1.127	0.537	0.589
16.90	1780.52	77.275	57.473	0.152	1.126	0.539	0.587
16.95	1786.51	77.535	57.213	0.151	1.125	0.541	0.584
17.00	1792.50	77.795	56.953	0.151	1.124	0.542	0.581
17.05	1798.50	78.055	56.693	0.150	1.123	0.544	0.579
17.10	1804.49	78.315	56.433	0.149	1.122	0.545	0.577
17.15	1810.48	78.575	56.173	0.149	1.122	0.547	0.575
17.20	1816.47	78.835	55.913	0.148	1.122	0.549	0.573
17.25	1822.46	79.095	55.653	0.147	1.122	0.550	0.572
17.30	1828.45	79.355	55.393	0.147	1.122	0.552	0.570
17.35	1834.44	79.615	55.133	0.146	1.122	0.553	0.569
17.40	1840.44	79.875	54.872	0.145	1.122	0.555	0.567
17.45	1846.43	80.135	54.612	0.144	1.123	0.557	0.566
17.50	1852.42	80.395	54.352	0.144	1.123	0.558	0.565
17.55	1858.41	80.655	54.092	0.143	1.123	0.560	0.563
17.60	1864.40	80.915	53.832	0.142	1.123	0.561	0.561
17.65	1870.39	81.175	53.573	0.142	1.123	0.563	0.560
17.70	1876.38	81.435	53.313	0.141	1.123	0.565	0.558
17.75	1882.38	81.695	53.052	0.140	1.123	0.566	0.557
17.80	1888.37	81.955	52.792	0.140	1.123	0.568	0.555
17.85	1894.36	82.215	52.532	0.139	1.123	0.569	0.553
17.90	1900.35	82.475	52.272	0.138	1.123	0.571	0.552
17.95	1906.34	82.735	52.012	0.138	1.123	0.573	0.550
18.00	1912.33	82.995	51.752	0.137	1.123	0.574	0.549
18.05	1918.33	83.256	51.492	0.136	1.123	0.576	0.547
18.10	1924.32	83.515	51.232	0.136	1.123	0.577	0.545
18.15	1930.31	83.775	50.972	0.135	1.123	0.579	0.544
18.20	1936.30	84.035	50.712	0.134	1.123	0.581	0.542
18.25	1942.29	84.295	50.452	0.133	1.123	0.582	0.541
18.30	1948.28	84.555	50.192	0.133	1.123	0.584	0.539

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
18.35	1954.27	84.815	49.932	0.132	1.123	0.585	0.537
18.40	1960.27	85.076	49.672	0.131	1.123	0.587	0.536
18.45	1966.26	85.336	49.412	0.131	1.123	0.589	0.534
18.50	1972.25	85.596	49.152	0.130	1.123	0.590	0.533
18.55	1978.24	85.856	48.892	0.129	1.123	0.592	0.531
18.60	1984.23	86.116	48.632	0.129	1.123	0.593	0.530
18.65	1990.22	86.376	48.372	0.128	1.123	0.595	0.528
18.70	1996.21	86.636	48.112	0.127	1.123	0.596	0.526
18.75	2002.21	86.896	47.852	0.127	1.123	0.598	0.525
18.80	2008.20	87.156	47.592	0.126	1.123	0.600	0.523
18.85	2014.19	87.416	47.332	0.125	1.123	0.601	0.522
18.90	2020.18	87.676	47.072	0.125	1.123	0.603	0.520
18.95	2026.17	87.936	46.812	0.124	1.123	0.604	0.518
19.00	2032.16	88.196	46.552	0.123	1.123	0.606	0.517
19.05	2038.15	88.456	46.292	0.122	1.123	0.608	0.515
19.10	2044.15	88.716	46.031	0.122	1.123	0.609	0.514
19.15	2050.14	88.976	45.771	0.121	1.123	0.611	0.512
19.20	2056.13	89.236	45.511	0.120	1.123	0.612	0.510
19.25	2062.12	89.496	45.251	0.120	1.123	0.614	0.509
19.30	2068.11	89.756	44.991	0.119	1.123	0.616	0.507
19.35	2074.10	90.016	44.732	0.118	1.123	0.617	0.506
19.40	2080.10	90.276	44.471	0.118	1.123	0.619	0.504
19.45	2086.09	90.536	44.211	0.117	1.123	0.620	0.502
19.50	2092.08	90.796	43.951	0.116	1.123	0.622	0.501
19.55	2098.07	91.056	43.691	0.116	1.123	0.624	0.499
19.60	2104.06	91.316	43.431	0.115	1.123	0.625	0.498
19.65	2110.05	91.576	43.171	0.114	1.123	0.627	0.496
19.70	2116.04	91.836	42.911	0.114	1.123	0.628	0.494
19.75	2122.04	92.097	42.651	0.113	1.123	0.630	0.493
19.80	2128.03	92.357	42.391	0.112	1.123	0.632	0.491
19.85	2134.02	92.616	42.131	0.111	1.123	0.633	0.490
19.90	2140.01	92.876	41.871	0.111	1.123	0.635	0.488
19.95	2146.00	93.136	41.611	0.110	1.123	0.636	0.486
20.00	2151.99	93.396	41.351	0.109	1.123	0.638	0.485
20.05	2157.98	93.656	41.091	0.109	1.123	0.640	0.483
20.10	2163.98	93.917	40.831	0.108	1.123	0.641	0.482
20.15	2169.97	94.177	40.571	0.107	1.123	0.643	0.480
20.20	2175.96	94.437	40.311	0.107	1.123	0.644	0.478
20.25	2181.95	94.697	40.051	0.106	1.123	0.646	0.477

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
20.30	2187.94	94.957	39.791	0.105	1.123	0.648	0.475
20.35	2193.93	95.217	39.531	0.105	1.123	0.649	0.474
20.40	2199.92	95.477	39.271	0.104	1.123	0.651	0.472
20.45	2205.92	95.737	39.011	0.103	1.123	0.652	0.470
20.50	2211.91	95.997	38.751	0.103	1.123	0.654	0.469
20.55	2217.90	96.257	38.491	0.102	1.123	0.656	0.467
20.60	2223.89	96.517	38.231	0.101	1.123	0.657	0.466
20.65	2229.88	96.777	37.971	0.100	1.123	0.659	0.464
20.70	2235.87	97.037	37.711	0.100	1.123	0.660	0.463
20.75	2241.87	97.297	37.450	0.099	1.123	0.662	0.461
20.80	2247.86	97.557	37.190	0.098	1.123	0.663	0.459
20.85	2253.85	97.817	36.930	0.098	1.123	0.665	0.458
20.90	2259.84	98.077	36.670	0.097	1.123	0.667	0.456
20.95	2265.83	98.337	36.410	0.096	1.123	0.668	0.455
21.00	2271.82	98.597	36.150	0.096	1.123	0.670	0.453
21.05	2277.81	98.857	35.890	0.095	1.123	0.671	0.451
21.10	2283.81	99.117	35.630	0.094	1.123	0.673	0.450
21.15	2289.80	99.377	35.370	0.094	1.123	0.675	0.448
21.20	2295.79	99.637	35.110	0.093	1.123	0.676	0.447
21.25	2301.78	99.897	34.850	0.092	1.123	0.678	0.445
21.30	2307.77	100.157	34.590	0.092	1.123	0.679	0.443
21.35	2313.76	100.417	34.330	0.091	1.123	0.681	0.442
21.40	2319.75	100.677	34.070	0.090	1.123	0.683	0.440
21.45	2325.75	100.938	33.810	0.089	1.123	0.684	0.439
21.50	2331.74	101.198	33.550	0.089	1.123	0.686	0.437
21.55	2337.73	101.457	33.290	0.088	1.123	0.687	0.435
21.60	2343.72	101.717	33.030	0.087	1.123	0.689	0.434
21.65	2349.71	101.977	32.770	0.087	1.123	0.691	0.432
21.70	2355.70	102.237	32.510	0.086	1.123	0.692	0.431
21.75	2361.69	102.497	32.250	0.085	1.123	0.694	0.429
21.80	2367.69	102.758	31.990	0.085	1.123	0.695	0.427
21.85	2373.68	103.018	31.730	0.084	1.123	0.697	0.426
21.90	2379.67	103.278	31.470	0.083	1.123	0.699	0.424
21.95	2385.66	103.538	31.210	0.083	1.123	0.700	0.423
22.00	2391.65	103.798	30.950	0.082	1.123	0.702	0.421
22.05	2397.64	104.058	30.690	0.081	1.123	0.703	0.419
22.10	2403.64	104.318	30.429	0.081	1.123	0.705	0.418
22.15	2409.63	104.578	30.170	0.080	1.123	0.707	0.416
22.20	2415.62	104.838	29.910	0.079	1.123	0.708	0.415

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
22.25	2421.61	105.098	29.650	0.078	1.123	0.710	0.413
22.30	2427.60	105.358	29.390	0.078	1.123	0.711	0.411
22.35	2433.59	105.618	29.130	0.077	1.123	0.713	0.410
22.40	2439.58	105.878	28.870	0.076	1.123	0.715	0.408
22.45	2445.58	106.138	28.609	0.076	1.123	0.716	0.407
22.50	2451.57	106.398	28.349	0.075	1.123	0.718	0.405
22.55	2457.56	106.658	28.089	0.074	1.123	0.719	0.404
22.60	2463.55	106.918	27.829	0.074	1.123	0.721	0.402
22.65	2469.54	107.178	27.569	0.073	1.123	0.722	0.400
22.70	2475.53	107.438	27.309	0.072	1.123	0.724	0.399
22.75	2481.52	107.698	27.049	0.072	1.123	0.726	0.397
22.80	2487.52	107.958	26.789	0.071	1.123	0.727	0.396
22.85	2493.51	108.218	26.529	0.070	1.123	0.729	0.394
22.90	2499.50	108.478	26.269	0.069	1.123	0.730	0.392
22.95	2505.49	108.738	26.009	0.069	1.123	0.732	0.391
23.00	2511.48	108.998	25.749	0.068	1.123	0.734	0.389
23.05	2517.47	109.258	25.489	0.067	1.123	0.735	0.388
23.10	2523.46	109.518	25.229	0.067	1.123	0.737	0.386
23.15	2529.46	109.779	24.969	0.066	1.123	0.738	0.384
23.20	2535.45	110.039	24.709	0.065	1.123	0.740	0.383
23.25	2541.44	110.298	24.449	0.065	1.123	0.742	0.381
23.30	2547.43	110.558	24.189	0.064	1.123	0.743	0.380
23.35	2553.42	110.818	23.929	0.063	1.123	0.745	0.378
23.40	2559.41	111.078	23.669	0.063	1.123	0.746	0.376
23.45	2565.41	111.339	23.409	0.062	1.123	0.748	0.375
23.50	2571.40	111.599	23.149	0.061	1.123	0.750	0.373
23.55	2577.39	111.859	22.889	0.061	1.123	0.751	0.372
23.60	2583.38	112.119	22.629	0.060	1.123	0.753	0.370
23.65	2589.37	112.379	22.369	0.059	1.123	0.754	0.368
23.70	2595.36	112.639	22.109	0.058	1.123	0.756	0.367
23.75	2601.35	112.899	21.849	0.058	1.123	0.758	0.365
23.80	2607.35	113.159	21.588	0.057	1.123	0.759	0.364
23.85	2613.34	113.419	21.328	0.056	1.123	0.761	0.362
23.90	2619.33	113.679	21.069	0.056	1.123	0.762	0.360
23.95	2625.32	113.939	20.809	0.055	1.123	0.764	0.359
24.00	2631.31	114.199	20.549	0.054	1.123	0.766	0.357
24.05	2637.30	114.459	20.289	0.054	1.123	0.767	0.356
24.10	2643.29	114.719	20.029	0.053	1.123	0.769	0.354
24.15	2649.29	114.979	19.768	0.052	1.123	0.770	0.352

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
24.20	2655.28	115.239	19.508	0.052	1.123	0.772	0.351
24.25	2661.27	115.499	19.248	0.051	1.123	0.774	0.349
24.30	2667.26	115.759	18.988	0.050	1.123	0.775	0.348
24.35	2673.25	116.019	18.728	0.050	1.123	0.777	0.346
24.40	2679.24	116.279	18.468	0.049	1.123	0.778	0.344
24.45	2685.23	116.539	18.208	0.048	1.123	0.780	0.343
24.50	2691.23	116.799	17.948	0.047	1.123	0.781	0.341
24.55	2697.22	117.059	17.688	0.047	1.123	0.783	0.340
24.60	2703.21	117.319	17.428	0.046	1.123	0.785	0.338
24.65	2709.20	117.579	17.168	0.045	1.123	0.786	0.337
24.70	2715.19	117.839	16.908	0.045	1.123	0.788	0.335
24.75	2721.18	118.099	16.648	0.044	1.123	0.789	0.333
24.80	2727.18	118.360	16.388	0.043	1.123	0.791	0.332
24.85	2733.17	118.620	16.128	0.043	1.123	0.793	0.330
24.90	2739.16	118.880	15.868	0.042	1.123	0.794	0.329
24.95	2745.15	119.140	15.608	0.041	1.123	0.796	0.327
25.00	2751.14	119.399	15.348	0.041	1.123	0.797	0.325
25.05	2757.13	119.659	15.088	0.040	1.123	0.799	0.324
25.10	2763.12	119.919	14.828	0.039	1.123	0.801	0.322
25.15	2769.12	120.180	14.568	0.039	1.123	0.802	0.321
25.20	2775.11	120.440	14.308	0.038	1.123	0.804	0.319
25.25	2781.10	120.700	14.048	0.037	1.123	0.805	0.317
25.30	2787.09	120.960	13.788	0.036	1.123	0.807	0.316
25.35	2793.08	121.220	13.528	0.036	1.123	0.809	0.314
25.40	2799.07	121.480	13.268	0.035	1.123	0.810	0.313
25.45	2805.06	121.740	13.008	0.034	1.123	0.812	0.311
25.50	2811.06	122.000	12.747	0.034	1.123	0.813	0.309
25.55	2817.05	122.260	12.487	0.033	1.123	0.815	0.308
25.60	2823.04	122.520	12.228	0.032	1.123	0.817	0.306
25.65	2829.03	122.780	11.968	0.032	1.123	0.818	0.305
25.70	2835.02	123.040	11.708	0.031	1.123	0.820	0.303
25.75	2841.01	123.300	11.448	0.030	1.123	0.821	0.301
25.80	2847.00	123.560	11.188	0.030	1.123	0.823	0.300
25.85	2853.00	123.820	10.927	0.029	1.123	0.825	0.298
25.90	2858.99	124.080	10.667	0.028	1.123	0.826	0.297
25.95	2864.98	124.340	10.407	0.028	1.123	0.828	0.295
26.00	2870.97	124.600	10.147	0.027	1.123	0.829	0.293
26.05	2876.96	124.860	9.887	0.026	1.123	0.831	0.292
26.10	2882.95	125.120	9.627	0.025	1.123	0.833	0.290

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
26.15	2888.95	125.380	9.367	0.025	1.123	0.834	0.289
26.20	2894.94	125.640	9.107	0.024	1.123	0.836	0.287
26.25	2900.93	125.900	8.847	0.023	1.123	0.837	0.285
26.30	2906.92	126.160	8.587	0.023	1.123	0.839	0.284
26.35	2912.91	126.420	8.327	0.022	1.123	0.841	0.282
26.40	2918.90	126.680	8.067	0.021	1.123	0.842	0.281
26.45	2924.89	126.940	7.807	0.021	1.123	0.844	0.279
26.50	2930.89	127.201	7.547	0.020	1.123	0.845	0.278
26.55	2936.88	127.461	7.287	0.019	1.123	0.847	0.276
26.60	2942.87	127.721	7.027	0.019	1.123	0.848	0.274
26.65	2947.53	127.923	6.825	0.018	1.123	0.850	0.273
26.70	2950.86	128.067	6.680	0.018	1.123	0.852	0.271
26.75	2954.18	128.211	6.536	0.017	1.123	0.853	0.270
26.80	2957.51	128.356	6.392	0.017	1.123	0.855	0.268
26.85	2960.84	128.500	6.247	0.017	1.123	0.856	0.266
26.90	2963.37	128.610	6.137	0.016	1.123	0.858	0.265
26.95	2965.12	128.686	6.061	0.016	1.123	0.860	0.263
27.00	2966.86	128.762	5.986	0.016	1.123	0.861	0.262
27.05	2968.61	128.838	5.910	0.016	1.123	0.863	0.260
27.10	2970.35	128.913	5.834	0.015	1.123	0.864	0.258
27.15	2972.10	128.989	5.758	0.015	1.123	0.866	0.257
27.20	2973.84	129.065	5.683	0.015	1.123	0.868	0.255
27.25	2975.59	129.141	5.607	0.015	1.123	0.869	0.254
27.30	2977.33	129.216	5.531	0.015	1.123	0.871	0.252
27.35	2979.08	129.292	5.455	0.014	1.123	0.872	0.250
27.40	2980.82	129.368	5.380	0.014	1.123	0.874	0.249
27.45	2982.56	129.443	5.304	0.014	1.123	0.876	0.247
27.50	2984.31	129.519	5.228	0.014	1.123	0.877	0.246
27.55	2986.05	129.595	5.153	0.014	1.123	0.879	0.244
27.60	2987.80	129.671	5.077	0.013	1.123	0.880	0.242
27.65	2989.54	129.746	5.001	0.013	1.123	0.882	0.241
27.70	2991.29	129.822	4.925	0.013	1.123	0.884	0.239
27.75	2993.03	129.898	4.850	0.013	1.123	0.885	0.238
27.80	2994.78	129.973	4.774	0.013	1.123	0.887	0.236
27.85	2996.52	130.049	4.698	0.012	1.123	0.888	0.234
27.90	2998.27	130.125	4.623	0.012	1.123	0.890	0.233
27.95	3000.01	130.200	4.547	0.012	1.123	0.892	0.231
28.00	3001.75	130.276	4.472	0.012	1.123	0.893	0.230
28.05	3003.50	130.352	4.396	0.012	1.123	0.895	0.228

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
28.10	3005.24	130.427	4.320	0.011	1.123	0.896	0.226
28.15	3006.99	130.503	4.244	0.011	1.123	0.898	0.225
28.20	3008.73	130.579	4.169	0.011	1.123	0.900	0.223
28.25	3010.48	130.655	4.093	0.011	1.123	0.901	0.222
28.30	3012.22	130.730	4.017	0.011	1.123	0.903	0.220
28.35	3013.97	130.806	3.941	0.010	1.123	0.904	0.219
28.40	3015.71	130.882	3.866	0.010	1.123	0.906	0.217
28.45	3017.46	130.958	3.790	0.010	1.123	0.907	0.215
28.50	3019.20	131.033	3.714	0.010	1.123	0.909	0.214
28.55	3020.94	131.109	3.639	0.010	1.123	0.911	0.212
28.60	3022.69	131.185	3.563	0.009	1.123	0.912	0.211
28.65	3024.43	131.260	3.487	0.009	1.123	0.914	0.209
28.70	3026.18	131.336	3.411	0.009	1.123	0.915	0.207
28.75	3027.92	131.412	3.336	0.009	1.123	0.917	0.206
28.80	3029.67	131.488	3.260	0.009	1.123	0.919	0.204
28.85	3031.41	131.563	3.184	0.008	1.123	0.920	0.203
28.90	3033.16	131.639	3.108	0.008	1.123	0.922	0.201
28.95	3034.90	131.715	3.033	0.008	1.123	0.923	0.199
29.00	3036.64	131.790	2.957	0.008	1.123	0.925	0.198
29.05	3038.39	131.866	2.881	0.008	1.123	0.927	0.196
29.10	3040.13	131.942	2.806	0.007	1.123	0.928	0.195
29.15	3041.88	132.018	2.730	0.007	1.123	0.930	0.193
29.20	3043.62	132.093	2.654	0.007	1.123	0.931	0.191
29.25	3045.37	132.169	2.578	0.007	1.123	0.933	0.190
29.30	3047.11	132.245	2.503	0.007	1.123	0.935	0.188
29.35	3048.86	132.321	2.427	0.006	1.123	0.936	0.187
29.40	3050.60	132.396	2.351	0.006	1.123	0.938	0.185
29.45	3052.48	132.478	2.270	0.006	1.123	0.939	0.183
29.50	3054.29	132.556	2.191	0.006	1.123	0.941	0.182
29.55	3055.53	132.610	2.137	0.006	1.123	0.943	0.180
29.60	3056.76	132.663	2.084	0.006	1.123	0.944	0.179
29.65	3058.00	132.717	2.030	0.005	1.123	0.946	0.177
29.70	3059.87	132.798	1.949	0.005	1.123	0.947	0.175
29.75	3061.81	132.883	1.865	0.005	1.123	0.949	0.174
29.80	3063.75	132.967	1.781	0.005	1.123	0.951	0.172
29.85	3065.69	133.051	1.697	0.004	1.123	0.952	0.171
29.90	3067.63	133.135	1.612	0.004	1.123	0.954	0.169
29.95	3069.57	133.219	1.528	0.004	1.123	0.955	0.167
30.00	3071.52	133.304	1.443	0.004	1.123	0.957	0.166

Probe Height	Total Vol. of Fuel Fragment	Total Mass as Al left in HFIR Core	Mass of Dissolved Al	Concentration of Dissolved Al	Max. Fractional HFIR Cores	HFIR Cores Present	Additional HFIR Cores Allowed to Charge
(in)	(in^3)	(kg)	(kg)	(M)	---	---	---
30.05	3073.46	133.388	1.359	0.004	1.123	0.959	0.164
30.10	3075.40	133.472	1.275	0.003	1.123	0.960	0.163
30.15	3077.34	133.557	1.191	0.003	1.123	0.962	0.161
30.20	3079.28	133.641	1.107	0.003	1.123	0.963	0.159
30.25	3081.22	133.725	1.023	0.003	1.123	0.965	0.158
30.30	3083.16	133.809	0.938	0.002	1.123	0.967	0.156
30.35	3085.10	133.893	0.854	0.002	1.123	0.968	0.155
30.40	3087.05	133.978	0.769	0.002	1.123	0.970	0.153
30.45	3088.99	134.062	0.685	0.002	1.123	0.971	0.152
30.50	3090.93	134.146	0.601	0.002	1.123	0.973	0.150
30.55	3091.95	134.191	0.557	0.001	1.123	0.974	0.148
30.60	3092.95	134.234	0.513	0.001	1.123	0.976	0.147
30.65	3093.95	134.277	0.470	0.001	1.123	0.978	0.145
30.70	3094.95	134.321	0.427	0.001	1.123	0.979	0.144
30.75	3095.82	134.359	0.389	0.001	1.123	0.981	0.142
30.80	3096.64	134.394	0.353	0.001	1.123	0.982	0.140
30.85	3097.45	134.429	0.318	0.001	1.123	0.984	0.139
30.90	3098.26	134.464	0.283	0.001	1.123	0.986	0.137
30.95	3099.07	134.500	0.248	0.001	1.123	0.987	0.136
31.00	3099.88	134.535	0.213	0.001	1.123	0.989	0.134
31.05	3100.65	134.568	0.179	0.000	1.123	0.990	0.132
31.10	3101.36	134.599	0.148	0.000	1.123	0.992	0.131
31.15	3102.06	134.629	0.118	0.000	1.123	0.994	0.129
31.20	3102.77	134.660	0.087	0.000	1.123	0.995	0.128
31.25	3103.48	134.691	0.056	0.000	1.123	0.997	0.126
31.30	3104.18	134.721	0.026	0.000	1.123	0.998	0.124
31.35	3104.78	134.747	0.000	0.000	1.123	1.000	0.123