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VISUAL EXAMINATIONS OF K WEST FUEL ELEMENTS

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Abstract: Over 250 fuel assemblies stored in sealed canisters in the K West Basin were extracted and visually examined for damage. Substantial damage was expected based on high cesium levels previously measured in water samples taken from these canisters. About 11% of the inner elements and 45% of the outer elements were found to be failed in these examinations. Canisters that had cesium levels of 1 curie or more generally had multiple instances of major fuel damage.

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VISUAL EXAMINATIONS OF K WEST FUEL ELEMENTS

1.0 SUMMARY

Over 250 fuel assemblies stored in sealed canisters in the K West Basin were extracted and visually examined for damage. These canisters contained a corrosion inhibitor, and relative levels of corroded fuel and sludge inventories appeared to be less intense than observed in similar examinations of fuel stored in open canisters in the K East Basin. Nonetheless, substantial levels of fuel element damage were found in these examinations. Earlier measurements of cesium levels in the K West canisters were used to identify candidates with the potential for high fuel element damage and sludge levels for laboratory evaluations. The fuel conditions found in this sampling were as follows:

	Inners	Outers
Intact	89%	55%
Minor Damage	8%	21%
Major Damage	3%	24%

Thus, about 11% of the inner elements and 45% of the outer elements in these "high cesium" canisters were found to be failed, with about one-fourth of the outer elements showing major damage such as split cladding or broken segments. One canister with low cesium (<0.1 Ci) that was examined contained basically intact fuel. Canister barrels that had cesium levels of 1 Ci or greater generally had multiple instances of major fuel damage and maximum sludge indications, but the observations for canisters with lower cesium levels were highly variable, ranging from no significant damage to high levels of damage. These inconsistencies could be due to faulty cesium level measurements, the variability of actual damage within the "major damage" category, or both.

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2.0 INTRODUCTION

A campaign was conducted in the K West fuel storage basin where selected canisters were opened and the fuel elements individually extracted for visual examination. The examinations were performed in a manner similar to that applied in earlier examinations of K East fuel (Pitner 1997). A total of 24 canisters in K West were examined, with 21 of the canisters each containing 14 individual fuel assemblies and 3 of the canisters containing known fragmented fuel pieces. Approximately equal numbers of Mark I and Mark II canisters were examined in this campaign.

Prior to the visual examinations, about 50 canisters in the basin were subjected to gas and liquid sampling. A primary measurement in this process was the cesium curie content in the sample, presumably an indication of the relative level of fuel damage in each canister barrel. A major objective of the visual examinations was to select candidate canisters for obtaining fuel and sludge samples for detailed laboratory examination. Since damaged fuel elements and substantial sludge samples were desired for laboratory evaluations, canisters with relatively high cesium levels were mostly targeted for the visual examinations. Thus, it was anticipated that substantial levels of fuel damage and sludge quantities would be encountered in the visual examinations.

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3.0 PROCEDURE

The procedure used to examine the K West fuel elements was basically the same as applied in the K East fuel examination campaign. Since the fuel is stored in encapsulated canisters in K West as opposed to open canisters in K East, additional steps of lid removal and replacement were required for the K West examinations. After moving a candidate canister to the inspection station (south loadout pit), the lid of one barrel was removed, ultrasonic measurements of sludge depths performed, the individual inner and outer fuel elements temporarily extracted and examined, and the lid replaced. The other barrel of the canister was examined in like manner, and the canister was then returned to its basin storage location. All steps of the examination process were recorded on videotape.

The Mark II lids were relatively easily removed by loosening the locking bar nut and lifting the lid. This process is relatively benign and causes little disturbance of the canister contents. The Mark I canisters, however, utilize a circumferential grafoil seal, and the lids were removed by internal water pressurization through the center valve. This process typically caused significant disruption of the sludge inventory in the canister, often resulting in a substantial sludge cloud release when the lid was removed. Figure 1 shows an example of the sludge cloud generated as the lid is removed from a Mark I canister. The "M" designation in the canister barrel identifier indicates this is the barrel with the marked lid. A "U" designation would signify the barrel with the unmarked lid.

Each fuel element was examined for the following conditions. For the top end, each element was placed in at least one of the five categories described (on a few occasions the element had both a loose end cap and split cladding). For the sides and bottom ends, features were noted as appropriate.

Top End

Intact -	No evidence of cladding failure. All the elements shown in Figure 2 are basically intact on the top end, with the exception of the inner and outer elements in the 1 o'clock location which showed indications of incipient breach upon closeup examination.
Incip. Breach -	An indication of possible loss of cladding integrity, but with no exposed fuel evident. Figure 3 shows an example of incipient breach on the top of an inner fuel element.
Rupture -	A definite breach in the cladding which provides a pathway for fuel-water contact. Figure 4 shows a breach on the top end of an outer element.
Loose End Cap -	The end cap is separated from the zircaloy cladding. The end cap is missing from the center outer element in Figure 5.

Split Cladding - The cladding is peeled open, presumably from the volume expansion associated with the uranium-water reaction. Figure 6 shows fuel voiding where the cladding has split open at the top of an outer element. Both the inner and outer elements shown in Figure 7 have split cladding on the top end.

Side

Cracks - Visible cracks along the side of the element. The cracks shown in Figure 8 are relatively minor in nature, while those shown in Figure 9 are more severe and open.

Hole - A hole in the cladding along the side of an element. No instances of side holes were found in these K West fuel element examinations.

Blisters - Rust blisters from the corrosion of the carbon steel shoes on the spacer clips of the outer elements. In Figure 10, the two bottom spacers visible are seen to be rusted, and there is also a rust blister between them where the element contacted an adjacent element spacer.

Broken - The element is broken into two (or more) parts at some lower axial level. The outer element shown in Figure 11 is seen to be broken about 8 inches down from the top as it is extracted from the canister. The outer element shown in Figure 12 actually broke during the inspection process at a point where there was a major circumferential crack.

Bottom End

Sludge Ring Hgt - The estimated height of the dark band sometimes seen around the bottom of fuel elements, presumably a consequence of being buried in canister sludge. Figure 13 shows a band at the bottom of an outer element that reflects a tapered sludge profile.

Rupture - Same as for top end. Figure 14 shows a bottom end rupture on the left side of an outer element.

Loose End Cap - Same as for top end. The outer element shown in Figure 15 has the bottom end cap missing.

Split Cladding - Same as for top end. The element with a loose end cap shown in Figure 15 also has split cladding on the bottom end.

4.0 OBSERVATIONS

When the canisters were opened during these examinations, there were generally substantial volumes of gas released. All these canisters were presumably purged with water during the earlier gas and liquid sampling campaign, so the gas release observed here is believed to be indicative of fuel corrosion that transpired since that sampling campaign (about two months previous).

When fuel was placed in the sealed K West canisters for storage, a corrosion inhibitor (potassium nitrite) was added to each canister barrel. A general observation made during these K West fuel examinations was that the gross mushrooming of reacted fuel often seen in failed elements in K East (Pitner 1995) was not evident here. Also, indications of canister sludge were not as intense in K West as they were in the K East examinations. Either or both of these observations may reflect the effectiveness of the corrosion inhibitor. Nevertheless, substantial levels of damage were found in the K West fuel examined, as discussed below.

Nearly all the fuel elements examined in this campaign were found to have some kind of coating on the exterior. In some cases, the coating was similar in appearance to that seen in K East fuel examinations (Pitner 1997). However, often a heavier type of coating was noted on the K West fuel. It is speculated that these type of deposits may have come from the potassium nitrite inhibitor. Application of the inhibitor was apparently not precisely controlled, and the level of coating varied accordingly. Figure 16 shows an example of a medium level of coating typically observed on the fuel elements. The outer element shown is from a longer type Mark IV assembly, and the upper uncoated portion was apparently above the water level in the canister. The element also exhibits a top end rupture and a spiral cladding crack. An example of heavier coating is shown in Figure 17. The coating on the inner element is crystalline in appearance, while the outer element coating has a poured icing-like appearance. Rust blisters observed on many of the K West fuel elements examined generally were absent on elements with heavy coating. These heavier coatings would sometimes flake off during handling of the fuel elements. In Figure 18, two pieces of the translucent coating are seen lying atop separate fuel assemblies. In one case only, all the elements in a canister barrel had an orange coating, as shown in Figure 19. The fuel elements in the other barrel of this canister had the normal grayish-white coating. General coating observations for each canister barrel are given in Table 1. The level of coating (medium or heavy) is identified along with the observed coloration of the coating.

Attempts were made to measure sludge depth levels in the canister using an ultrasonic probe. While this technique worked well in K East, the results obtained in K West were inconclusive. Many measurements corresponded to the bottom of the canister. This could indicate a transparency of the K West sludge to the ultrasonic signal, or that sludge levels were relatively shallow. Significant non-zero depth measurements obtained in K West were actually believed to be from foreign material, such as grafoil pieces from the lid seal or other debris. Relatively few occasions of sludge rings at

the bottom of K West fuel were noted, in contrast to the common occurrences of sludge rings observed in K East. Nonetheless, definite visual indications of sludge presence were noted in K West. Sludge clouds often were released when the lids were removed, and sludge frequently trailed the fuel elements as they were extracted from the canisters. A qualitative estimate of the sludge level in each canister barrel was made from these visual observations. Three categories were used to describe the sludge evidence: Minimal, Moderate, and Maximum. Figure 20 shows a "Maximum" incidence of dark colored sludge trailing an outer element, while Figure 21 depicts a "Maximum" case of orange colored sludge. The "Minimal" category refers to only trace amounts of sludge, while the "Moderate" category is intermediate to the other two. The sludge level indications for each canister barrel are also presented in Table 1, along with the observed coloration of the sludge. Observations such as gas bubbles released from the canister sludge during fuel element manipulations are included as comments in Table 1 as well.

After the fuel elements were all extracted from each canister barrel and examined, the camera was often positioned overhead for a straight down view prior to replacing the center assembly in the barrel. Invariably, a swirling, flocculent sludge cloud was observed in the center of the barrel. Not once was the bottom of the canister visible. Figure 22 shows a typical overhead view in this regard.

Three canisters designated "chip cans" which contained known fragmented fuel were also examined. These canisters typically had high cesium levels of several curies. Figure 23 shows an example of a chip can. Broken fuel elements with open ends were common in these canisters. None of these fragmented fuel pieces were extracted for examination.

One unusual incident did occur during the K West Fuel examinations. When the lid was lifted from the barrel of one Mark I canister, three fuel elements wedged laterally across the inside of the lid were lifted with it (Figure 24). Apparently corrosion-induced swelling of the fuel caused this situation. No further examination of this fuel was performed because of its precarious condition. The lid on the other barrel of this canister could not be lifted after loosening, also implying a stuck fuel situation. The barrel that the lid was lifted from had a cesium level of 0.88 Ci, while that in the other barrel was 0.49 Ci.

The recorded results of the visual inspections are presented in Table 2. The type of canister and the measured cesium curie content in each canister barrel are included in the canister identification column. The element numbering sequence used was to specify the assembly nearest the top canister trunnion as No. 1, and then proceed clockwise from there. The No. 7 assembly was in the center position in the canister barrel. The number of incidences of defects defined in the "Procedure" section above are given for each element examined. For the "Cracks" category, an "X" indication signifies minor cracking (Figure 8) and an "X+" indication signifies major cracking (Figure 9). When no information is given for a particular element, it indicates that it was not extracted for visual examination, usually due to grappling difficulties.

At the end of Table 2, totals are given for the number of elements examined and the frequency of defects observed. A total of 252 inner elements and 263 outer elements were inspected in this campaign. In general, defect frequencies were greater for outer elements than for inner elements. This is to be expected considering their higher vulnerability to damage during reactor discharge. Top and bottom defect frequencies were generally comparable, although the number of top end defects detected were usually somewhat greater, probably because of their higher visibility. Over one-fourth of the outer elements were found to be cracked along their sides, and about three-fourths of them had rust blisters in the vicinity of the spacer clips. The occasion of split cladding for the inner elements was near zero, but around one-fifth of the outer elements were found to have split cladding on one end or the other (both ends on a few occasions). About 2% of the inner elements and 6% of the outer elements in this sample population were found to be broken at some intermediate axial level.

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5.0 DAMAGE ASSESSMENT

Assessments of overall damage levels observed in the K West fuel examinations were made based on relative degrees of minor and major damage. Minor damage in this evaluation included incidences of cladding rupture as defined in the "Procedure" section above and recorded in Table 2, and also occasions of minor cladding cracking as depicted in Figure 8. These are occurrences where definite breach of fuel element integrity is indicated, but the communication path between fuel and water is limited with respect to the potential for fuel corrosion and sludge generation. While incidences of incipient breach also suggest some damage (usually dented end cap), no loss of integrity is apparent and these occurrences were not included in tallying minor damage frequencies. A condition of major damage included loose end cap, split cladding, broken element, or open cracks along the side of the cladding as depicted in Figure 9. These are situations more prone to fuel corrosion and sludge generation within the canister barrel.

The results of this assessment are presented in Table 3. For each canister barrel examined, the measured cesium curie content is given, along with the canister type, fuel type, and key date of the fuel. The number of inner and outer elements examined in each canister barrel are given along with the frequencies of minor and major damage. The relative sludge levels observed in the examinations are also included. Damage frequency totals are given at the bottom of the table.

It is seen that 11% of the inner elements in these fuel examinations were found to be failed, with 3% falling in the major damage category. The failure frequency for the outer elements was found to be 45%, with 24% being in the major damage category. Interestingly, the 45% outer element failure frequency observed for K West is comparable to the 42% level projected for K East based on a basin wide visual survey (Pitner 1995). However, the level of major damage here (24%) is substantially greater than observed in the overall K East survey (~5%). This can probably be attributed to the fact that K West canisters with suspected damaged fuel (high cesium levels) were selected for examination here. When 26 outer elements from canisters containing highly damaged fuel in K East were subjected to full length examinations (Pitner 1997), about 60% of them were found to have split cladding and nearly one-third were found to be broken. Thus, higher levels of major damage can be expected when canister selections are biased in this direction.

It might be expected that there should be a correlation between the cesium curie level and the degree of fuel damage in a canister barrel. In Figure 25, the number of elements (both inner and outer) with major damage found in the canisters are plotted against the corresponding curie levels. Multiple instances of major damage are indicated for high curie readings, but there is considerable variation in damage levels for the low curie canister barrels. Even with the wide degree of scatter in the data, some general observations can be made. Canister barrels contained no fuel elements with major damage only when the cesium level was less than about 0.5 Ci. If the cesium level were greater than 0.5 Ci, at least one fuel element with major damage resided in the barrel. For cesium levels greater than 1 Ci, there were generally two or more badly damaged fuel elements in the barrel. Confusing

the issue, however, is the wide variation at the lower curie levels. For barrels with measured cesium levels of about 1 Ci or less, the number of highly damaged fuel elements ranged from none to four. This variability could be due in part to inaccurate measurements of cesium levels, possibly due to losses from leaking cans (e.g., cans with broken locking bars). Alternately, the actual damage level within the category of "major" damage can vary considerably. For example, an element with a split open end and voided fuel would be expected to release more cesium than a fuel element with one or two major cracks in the side of the cladding. The variability in the damage-cesium level correlation may well be combination of these factors.

The correlation between sludge level indications and cesium levels is shown in Figure 26. Some general correlations are once again evident. For minimal sludge indications, the cesium level must be less than about 1 Ci. Between 1 and 2 Ci, the sludge level is at least moderate. And for cesium levels above 2 Ci, maximum sludge levels were the rule. Once again, however, there was considerable variability at cesium levels below 1 Ci, with the full spectrum of sludge levels observed in this range. This variability may be due to the same factors cited above for variability in fuel damage levels.

6.0 REFERENCES

- Pitner, A. L., 1995, *K East Basin Underwater Visual Survey*, WHC-SD-SNF-TI-012, Rev. 0, February 1995.
- Pitner, A. L., 1997, *Visual Examinations of K East Fuel Elements*, HNF-SD-SNF-TI-045, Rev. 0, January 1997.

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Table 1. Coating and Sludge Observations.

ID	CI	Coating		Sludge		Comment
		Level	Color	Level	Color	
6214 M	0.12	Medium	Gray/White	Minimal	Black	
6214 U	0.12	Medium	Gray/White	Minimal	Black	
0315 M	0.12	Medium	Gray/White	Minimal	Black	Some crystalline coating
0315 U	0.14	Medium	Gray/White	Moderate	Brown	
1497 M	0.36	Medium	Gray/White	Minimal	Gray	
1497 U	4.06	---	---	Maximum	Black	No elements extracted
2660 M	2.80	Medium	Gray/White	Maximum	Orange	Bubbles from sludge
2660 U	0.17	Medium	Gray/White	Maximum	Orange	Orange deposits at top
5744 M	0.73	Medium	Gray/White	Maximum	Black	
5744 U	1.05	Medium	Gray/White	Moderate	Gray	
6743 M	0.81	Medium	Gray/White	Minimal	Gray	
6743 U	?	Medium	Gray/White	Maximum	Brown	
0161 M	1.00	Heavy	Gray/White	Moderate	Gray	Flaking coating
0161 U	0.49	Heavy	Gray/White	Moderate	Gray	Flaking coating
1226 M	0.93	Medium	Gray/White	Moderate	Gray	
1226 U	0.15	Medium	Gray/White	Moderate	Brown	
1860 M	0.25	Heavy	Gray/White	Minimal	Gray	Top 1" uncoated-spots in coating
1860 U	0.91	Heavy	Gray/White	Maximum	Black	Top 1/2" uncoated-spots in coating
6513 M	3.52	Medium	Gray/White	Maximum	Brown	Bubbles from sludge
6513 U	1.44	Medium	Gray/White	Maximum	Gray	Bubbles from sludge
2667 M	3.41	Medium	Gray/White	Maximum	Brown	
2667 U	0.80	Medium	Orange	Maximum	Orange	Bare patches (no coating)
6603 M	0.66	Medium	Gray/White	Maximum	Black	Some crystalline coating
6603 U	0.20	Medium	Light Green	Minimal	Gray	
7913 M	0.35	Medium	Gray/White	Minimal	Gray	
7913 U	0.97	Medium	Gray/White	Maximum	Black	
1164 M	1.61	Medium	Gray/White	Moderate	Brown	
1164 U	0.54	Medium	Gray/White	Moderate	Brown	
0091 M	0.61	Medium	Light Green	Maximum	Orange	Top 1" uncoated
0091 U	0.57	Medium	Gray/White	Maximum	Orange	Top 1-1/2" uncoated
1560 M	0.18	Heavy	Gray/White	Moderate	Gray	Some crystalline and flaking coating
1560 U	1.24	Heavy	Gray/White	Moderate	Gray	Flaking coating / bare patches
6641 M	0.08	Medium	Gray/White	Minimal	Gray	
6641 U	0.09	Medium	Gray/White	Minimal	Gray	
0102 M	0.62	Medium	Gray/White	Moderate	Gray	
0102 U	0.40	Medium	Gray/White	Moderate	Gray	
1512 M	0.77	Medium	Light Green	Maximum	Orange	
1512 U	0.25	Medium	Light Green	Maximum	Orange	
1265 M	0.40	Medium	Gray/White	Minimal	Orange	
1265 U	0.70	Medium	Gray/White	Minimal	Brown	

Table 2. Survey Results.

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
6214 M Mk II SS 0.12 Ci	No. 1 Inner	X									0			
	No. 1 Outer			X			X				0			
	No. 2 Inner	X									0			
	No. 2 Outer	X									0	X		
	No. 3 Inner	X									0.25			
	No. 3 Outer	X									0			
	No. 4 Inner	X									0			
	No. 4 Outer	X									0			
	No. 5 Inner	X									0			
	No. 5 Outer	X									0			
	No. 6 Inner	X									0			
	No. 6 Outer			X							0			
	No. 7 Inner	X									0			
	No. 7 Outer		X				X				0			
6214 U Mk II SS 0.12 Ci	No. 1 Inner	X									0			
	No. 1 Outer	X									0			
	No. 2 Inner	X									0			
	No. 2 Outer	X								X				
	No. 3 Inner	X									0			
	No. 3 Outer	X					X			X				
	No. 4 Inner	X									0.5			
	No. 4 Outer	X									0			
	No. 5 Inner	X									0			
	No. 5 Outer			X			X				0			
	No. 6 Inner	X									0			
	No. 6 Outer	X									0			
	No. 7 Inner	X								X				
	No. 7 Outer	X							X		0			

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incp. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
0315 M Mk I AI 0.12 Ci	No. 1 Inner	X									0			
	No. 1 Outer	X							X		0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner	X									0			
	No. 3 Outer		X						X		0			
	No. 4 Inner	X									0	X		
	No. 4 Outer	X							X		0	X		
	No. 5 Inner	X									0			
	No. 5 Outer			X					X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			
	No. 7 Inner	X									0			
	No. 7 Outer	X							X		0			
0315 U Mk I AI 0.14 Ci	No. 1 Inner	X									0	X		
	No. 1 Outer		X						X		0			
	No. 2 Inner	X									0			
	No. 2 Outer		X						X		0			
	No. 3 Inner	X									0			
	No. 3 Outer	X							X		0			
	No. 4 Inner	X									0			
	No. 4 Outer	X					X		X		0			
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		0	X		
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			
	No. 7 Inner	X									0			
	No. 7 Outer	X							X		0			

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
1497 M Mk I SS 0.36 Ci	No. 1 Inner	X									0			
	No. 1 Outer	X							X		0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner													
	No. 3 Outer			X					X		0	X		
	No. 4 Inner													
	No. 4 Outer			X			X		X		0			
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			
	No. 7 Inner													
	No. 7 Outer	X							X		0			
1497 U Mk I SS 4.06 Ci	No. 1 Inner													
	No. 1 Outer													
	No. 2 Inner													
	No. 2 Outer													
	No. 3 Inner													
	No. 3 Outer													
	No. 4 Inner													
	No. 4 Outer				X	X								
	No. 5 Inner													
	No. 5 Outer				X	X								
	No. 6 Inner													
	No. 6 Outer													
	No. 7 Inner													
	No. 7 Outer													

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side			Bottom End				
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
2660 M Mk I SS 2.80 Ci	No. 1 Inner	X									0			
	No. 1 Outer				X		X				0.5			
	No. 2 Inner	X									1.0			
	No. 2 Outer	X						X			0			
	No. 3 Inner	X									0			
	No. 3 Outer	X							X		0			
	No. 4 Inner	X									0			
	No. 4 Outer	X						X			0			
	No. 5 Inner	X									1.0			
	No. 5 Outer	X							X		0.5			
	No. 6 Inner	X									1.0			
	No. 6 Outer				X		X+		X	-X	1.0			
	No. 7 Inner	X									1.0			
	No. 7 Outer	X							X		0.5			
2660 U Mk I SS 0.17 Ci	No. 1 Inner		X								0			
	No. 1 Outer			X			X		X		0			
	No. 2 Inner	X									0			
	No. 2 Outer	X						X			0			
	No. 3 Inner	X									0			
	No. 3 Outer		X						X		0			
	No. 4 Inner	X									0			
	No. 4 Outer		X					X			0			
	No. 5 Inner	X									0.25			
	No. 5 Outer		X						X		0			
	No. 6 Inner		X								0			
	No. 6 Outer		X						X		0			
	No. 7 Inner		X								0			
	No. 7 Outer		X						X		0			

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
5744 M Mk II SS 0.72 Cl	No. 1 Inner			X							0			
	No. 1 Outer		X				X		X		0			
	No. 2 Inner	X								X				
	No. 2 Outer													
	No. 3 Inner	X							X		0			
	No. 3 Outer	X									0	X		
	No. 4 Inner	X								0				
	No. 4 Outer	X					X		X		0	X		
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		0			
	No. 6 Inner	X									0			
	No. 6 Outer				X		X		X		0			X
	No. 7 Inner	X									0			
	No. 7 Outer		X					X	X		0			X
5744 U Mk II SS 1.06 Cl	No. 1 Inner	X					X		X		0			X
	No. 1 Outer		X								0			
	No. 2 Inner	X					X		X		0			
	No. 2 Outer			X					X		0			
	No. 3 Inner	X								0				
	No. 3 Outer	X							X		0			
	No. 4 Inner	X								0				
	No. 4 Outer				X		X		X	0.5				
	No. 5 Inner	X								1.0				
	No. 5 Outer	X					X		X	0				
	No. 6 Inner	X								0	X			
	No. 6 Outer		X				X+		X	0				
	No. 7 Inner		X							0.25				
	No. 7 Outer	X					X							

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side			Bottom End				
		Intact	Incp. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
6743 M Mk II SS 0.81 Cl	No. 1 Inner	X									0			
	No. 1 Outer	X					X +		X		0			
	No. 2 Inner													
	No. 2 Outer													
	No. 3 Inner		X								0			
	No. 3 Outer	X					X		X		0			X
	No. 4 Inner	X									0			
	No. 4 Outer	X							X		0			
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		0			
	No. 6 Inner	X									0			
	No. 6 Outer					X			X		0			
	No. 7 Inner	X									0			
	No. 7 Outer	X							X		0			
6743 U Mk II SS 7 Cl	No. 1 Inner	X									0			
	No. 1 Outer	X							X		0			
	No. 2 Inner	X								1.0				
	No. 2 Outer					X	X		X		0			
	No. 3 Inner	X								0				
	No. 3 Outer	X						X		0				
	No. 4 Inner													
	No. 4 Outer	X						X		0				
	No. 5 Inner	X								0				
	No. 5 Outer	X					X		X	1.0				
	No. 6 Inner	X								0				
	No. 6 Outer	X					X +		X	0			X	
	No. 7 Inner	X								0				
	No. 7 Outer	X							X	0				

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
0161 M Mk I AI 1.00 Ci	No. 1 Inner	X									0			
	No. 1 Outer			X			X				0			
	No. 2 Inner	X									0			
	No. 2 Outer			X			X				0			
	No. 3 Inner	X									0			
	No. 3 Outer		X				X+			~X	0			
	No. 4 Inner	X									0			
	No. 4 Outer	X					X+			~X	0			
	No. 5 Inner	X									0			
	No. 5 Outer	X									0			
	No. 6 Inner	X									0			
	No. 6 Outer					X	X+				0			X
	No. 7 Inner	X									0			
	No. 7 Outer		X				X				0			
0161 U Mk I AI 0.49 Ci	No. 1 Inner	X									0			
	No. 1 Outer	X									0			
	No. 2 Inner	X									0			
	No. 2 Outer	X									0			
	No. 3 Inner	X									0			
	No. 3 Outer	X									0			
	No. 4 Inner	X									0			
	No. 4 Outer	X					X+			~X	0			
	No. 5 Inner	X									0			
	No. 5 Outer			X			X		X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X									0			
	No. 7 Inner	X									0			
	No. 7 Outer	X					X			X				

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incp. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
1226 M Mk I SS 0.93 Cl	No. 1 Inner	X									0	X		
	No. 1 Outer	X							X		0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner	X									0			
	No. 3 Outer					X	X		X		0			
	No. 4 Inner													
	No. 4 Outer					X	X		X		0			
	No. 5 Inner													
	No. 5 Outer	X							X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			
	No. 7 Inner	X									0			
	No. 7 Outer	X							X		0			
1226 U Mk I SS 0.15 Cl	No. 1 Inner	X									0			
	No. 1 Outer	X					X		X		0			X
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0	X		
	No. 3 Inner	X									0			
	No. 3 Outer	X							X		0			
	No. 4 Inner	X									0			
	No. 4 Outer	X							X		0			
	No. 5 Inner		X								0			
	No. 5 Outer	X							X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			
	No. 7 Inner	X									0			
	No. 7 Outer	X							X		0			

Table 2. Survey Results. (Continued)

Canister	Element	Top End										Side					Bottom End				
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding							
1860 M	No. 1 Inner	X																			
	No. 1 Outer	X																			
	No. 2 Inner		X																		
	No. 2 Outer		X																		
	No. 3 Inner		X																		
	No. 3 Outer		X																		
	No. 4 Inner		X																		
	No. 4 Outer		X																		
	No. 5 Inner		X																		
	No. 5 Outer		X																		
	No. 6 Inner		X																		
	No. 6 Outer		X																		
	No. 7 Inner		X																		
	No. 7 Outer		X																		
1860 U	No. 1 Inner	X																			
	No. 1 Outer	X																			
	No. 2 Inner		X																		
	No. 2 Outer																				
	No. 3 Inner																				
	No. 3 Outer																				
	No. 4 Inner																				
	No. 4 Outer																				
	No. 5 Inner																				
	No. 5 Outer																				
	No. 6 Inner																				
	No. 6 Outer																				
	No. 7 Inner																				
	No. 7 Outer																				
0.91 CI	Mk I AI																				
	No. 1 Inner																				
	No. 1 Outer																				
	No. 2 Inner																				
	No. 2 Outer																				
	No. 3 Inner																				
	No. 3 Outer																				
	No. 4 Inner																				
	No. 4 Outer																				
	No. 5 Inner																				
	No. 5 Outer																				
	No. 6 Inner																				
	No. 6 Outer																				
	No. 7 Inner																				
No. 7 Outer																					

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
6513 M Mk II SS 3.52 Ci	No. 1 Inner	X									0			
	No. 1 Outer	X					X +		X		0			X
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner	X									1.0			
	No. 3 Outer	X							X		1.0			
	No. 4 Inner			X							1.0			
	No. 4 Outer	X					X		X		0			X
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		1.0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		1.0			
	No. 7 Inner		X								1.0			
	No. 7 Outer				X	X								
6513 U Mk II SS 1.44 Ci	No. 1 Inner	X									1.0			
	No. 1 Outer	X							X		0			
	No. 2 Inner	X									0			
	No. 2 Outer	X					X		X		0			
	No. 3 Inner	X									0			
	No. 3 Outer	X							X		0			
	No. 4 Inner													
	No. 4 Outer			X			X		X		0			
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		0			
	No. 6 Inner													
	No. 6 Outer					X	X +		X	-X				
	No. 7 Inner		X								0			
	No. 7 Outer	X							X		0			

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
6603 M Mk II SS 0.66 Ci	No. 1 Inner		X								0			
	No. 1 Outer	X									0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner			X							0			
	No. 3 Outer					X								
	No. 4 Inner	X									0			
	No. 4 Outer	X					X		X		0			
	No. 5 Inner		X								0			
	No. 5 Outer	X					X		X		0			X
	No. 6 Inner	X									0			
	No. 6 Outer	X					X		X		0			
	No. 7 Inner	X									0			
	No. 7 Outer			X			X+		X	X				
6603 U Mk II SS 0.20 Ci	No. 1 Inner	X									0			
	No. 1 Outer			X					X		0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner	X									0			
	No. 3 Outer	X							X		0			
	No. 4 Inner	X									0			
	No. 4 Outer		X						X		0			
	No. 5 Inner	X							X		0			
	No. 5 Outer			X					X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			
	No. 7 Inner	X									0			
	No. 7 Outer			X			X		X		0			

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Indip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
6603 M Mk II SS 0.66 Cl	No. 1 Inner		X								0			
	No. 1 Outer	X									0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner			X							0			
	No. 3 Outer					X								
	No. 4 Inner	X									0			
	No. 4 Outer	X					X		X		0			
	No. 5 Inner	X	X								0			
	No. 5 Outer	X					X		X		0			X
	No. 6 Inner	X									0			
	No. 6 Outer	X					X		X		0			
	No. 7 Inner	X									0			
	No. 7 Outer			X			X+		X	X				
6603 U Mk II SS 0.20 Cl	No. 1 Inner	X									0			
	No. 1 Outer			X					X		0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner	X									0			
	No. 3 Outer	X							X		0			
	No. 4 Inner	X									0			
	No. 4 Outer		X						X		0			
	No. 5 Inner	X									0			
	No. 5 Outer			X					X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			
	No. 7 Inner	X									0			
	No. 7 Outer			X			X		X		0			

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incl. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
7913 M Mk II SS 0.35 Ci	No. 1 Inner	X									0			
	No. 1 Outer	X									0			
	No. 2 Inner	X									0			
	No. 2 Outer	X									0			
	No. 3 Inner	X									0			
	No. 3 Outer	X							X		0			
	No. 4 Inner	X									0			
	No. 4 Outer	X					X+		X	-X	0	X		
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X					X				0			X
	No. 7 Inner	X									0			
	No. 7 Outer	X							X		0			
7913 U Mk II SS 0.97 Ci	No. 1 Inner	X									0			
	No. 1 Outer					X					0			
	No. 2 Inner	X									1.0			
	No. 2 Outer	X							X		0			
	No. 3 Inner	X									1.0			
	No. 3 Outer	X					X+		X		0	X		
	No. 4 Inner	X									0			
	No. 4 Outer	X					X+				0			X
	No. 5 Inner	X							X		0			
	No. 5 Outer	X									0			
	No. 6 Inner	X							X		0		X	X
	No. 6 Outer	X									0			
	No. 7 Inner	X							X		0			
	No. 7 Outer	X									0			

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
1164 M Mk I SS 1.61 Ci	No. 1 Inner													
	No. 1 Outer													
	No. 2 Inner	X									0			
	No. 2 Outer					X			X		0		X	X
	No. 3 Inner			X							0			
	No. 3 Outer			X			X		X		0			X
	No. 4 Inner	X									0			
	No. 4 Outer	X					X		X		0			
	No. 5 Inner													
	No. 5 Outer		X				X+		X		0			
	No. 6 Inner	X									0			
	No. 6 Outer		X				X		X		0			
	No. 7 Inner	X									0			
	No. 7 Outer	X					X		X		0			
1164 U Mk I SS 0.54 Ci	No. 1 Inner	X									0			
	No. 1 Outer	X					X+		X		0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner	X							X		0			
	No. 3 Outer	X									0			
	No. 4 Inner	X									0			
	No. 4 Outer	X							X		0			
	No. 5 Inner	X									0			
	No. 5 Outer		X						X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			
	No. 7 Inner	X									0			
	No. 7 Outer	X							X		0			

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
0091 M Mk II SS 0.61 Ci	No. 1 Inner		X								0			
	No. 1 Outer	X							X		0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner			X							0			
	No. 3 Outer			X			X							
	No. 4 Inner			X							1.0			
	No. 4 Outer					X	X							
	No. 5 Inner		X								0			
	No. 5 Outer			X			X+		X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			X
	No. 7 Inner		X								0			
	No. 7 Outer					X	X+		X		0			
0091 U Mk II SS 0.57 Ci	No. 1 Inner			X							0			
	No. 1 Outer					X								
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner		X								0			
	No. 3 Outer	X							X		0			
	No. 4 Inner			X							0			
	No. 4 Outer	X							X		0			
	No. 5 Inner		X								0			
	No. 5 Outer		X						X		0			
	No. 6 Inner			X							1.0			
	No. 6 Outer			X			X		X		0			
	No. 7 Inner			X							0	X		
	No. 7 Outer			X			X							

Table 2. Survey Results. (Continued)

Canister	Element	Top End							Side							Bottom End			
		Intact	Insp. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding					
1560 M	No. 1 Inner	X																	
	No. 1 Outer	X																	
	No. 2 Inner	X																	
	No. 2 Outer				X														
	No. 3 Inner																		
	No. 3 Outer					X													
	No. 4 Inner	X																	
	No. 4 Outer					X													
	No. 5 Inner			X															
	No. 5 Outer	X																	
	No. 6 Inner	X																	
	No. 6 Outer	X																	
1560 U	No. 7 Outer										X								
	No. 1 Inner	X																	
	No. 1 Outer	X																	
	No. 2 Inner	X																	
	No. 2 Outer	X																	
	No. 3 Inner	X																	
	No. 3 Outer	X																	
	No. 4 Inner	X																	
	No. 4 Outer	X																	
	No. 5 Inner	X																	
	No. 5 Outer	X																	
	No. 6 Inner	X																	
MK I AI	No. 7 Inner										X								
	No. 1 Inner	X																	
	No. 1 Outer	X																	
	No. 2 Inner	X																	
	No. 2 Outer																		
	No. 3 Inner																		
	No. 3 Outer				X														
	No. 4 Inner	X																	
	No. 4 Outer					X													
	No. 5 Inner																		
	No. 5 Outer	X																	
	No. 6 Inner	X																	
1.24 Ci	No. 6 Outer	X																	
	No. 7 Inner	X																	
	No. 7 Outer																		
	No. 1 Inner	X																	
	No. 1 Outer	X																	
	No. 2 Inner	X																	
	No. 2 Outer																		
	No. 3 Inner																		
	No. 3 Outer					X													
	No. 4 Inner	X																	
	No. 4 Outer																		
	No. 5 Inner																		
No. 5 Outer	X																		
No. 6 Inner	X																		
No. 6 Outer	X																		
No. 7 Inner	X																		
No. 7 Outer	X																		
MK I AI	No. 1 Inner	X																	
	No. 1 Outer	X																	
	No. 2 Inner	X																	
	No. 2 Outer																		
	No. 3 Inner																		
	No. 3 Outer					X													
	No. 4 Inner	X																	
	No. 4 Outer	X																	
	No. 5 Inner	X																	
	No. 5 Outer	X																	
	No. 6 Inner	X																	
	No. 6 Outer	X																	
No. 7 Inner	X																		
No. 7 Outer	X																		
1.24 Ci	No. 7 Outer	X																	
	No. 7 Inner	X																	
	No. 6 Outer	X																	
	No. 6 Inner	X																	
	No. 5 Outer	X																	
	No. 5 Inner	X																	
	No. 4 Outer	X																	
	No. 4 Inner	X																	
	No. 3 Outer	X																	
	No. 3 Inner	X																	
	No. 2 Outer																		
	No. 2 Inner	X																	
No. 1 Outer	X																		
No. 1 Inner	X																		

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
6641 M Mk II SS 0.08 Ci	No. 1 Inner	X									0.5	X		
	No. 1 Outer	X									0.5			
	No. 2 Inner		X								0.25			
	No. 2 Outer		X								0.25			
	No. 3 Inner	X									0.25			
	No. 3 Outer	X									0.5			
	No. 4 Inner	X									0.5			
	No. 4 Outer	X									0			
	No. 5 Inner	X									0.25			
	No. 5 Outer	X									0.5	X		
	No. 6 Inner	X									0			
	No. 6 Outer	X									0.25			
	No. 7 Inner	X									0.5			
	No. 7 Outer	X									0			
6641 U Mk II SS 0.09 Ci	No. 1 Inner	X									0			
	No. 1 Outer	X									0			
	No. 2 Inner	X									0			
	No. 2 Outer			X							0.5			
	No. 3 Inner	X									0			
	No. 3 Outer	X									0			
	No. 4 Inner	X									0			
	No. 4 Outer	X									0			
	No. 5 Inner	X									0			
	No. 5 Outer		X								0.25			
	No. 6 Inner		X								0			
	No. 6 Outer		X								0.5			
	No. 7 Inner	X									0.25			
	No. 7 Outer		X								0.25			

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
0102 M Mk I SS 0.62 Ci	No. 1 Inner	X									0			
	No. 1 Outer			X			X		X		0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner	X									0			
	No. 3 Outer	X					X		X		0	X		
	No. 4 Inner	X									0			
	No. 4 Outer			X					X		0			
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			
	No. 7 Inner	X									0			
	No. 7 Outer			X			X		X		0	X		
0102 U Mk I SS 0.40 Ci	No. 1 Inner	X									0			
	No. 1 Outer	X					X		X		0	X		
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner													
	No. 3 Outer													
	No. 4 Inner	X									0			
	No. 4 Outer			X			X		X		1.0			
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X							X		0			
	No. 7 Inner	X									0			
	No. 7 Outer	X							X		0			X

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
1512 M Mk II SS 0.77 Ci	No. 1 Inner		X								0.5	X		
	No. 1 Outer			X							0			X
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0.25			
	No. 3 Inner	X									0			
	No. 3 Outer	X							X		0.25			
	No. 4 Inner	X									0			
	No. 4 Outer	X							X		0			
	No. 5 Inner	X									0	X		
	No. 5 Outer	X							X		0	X		
	No. 6 Inner					X					0			
	No. 6 Outer					X								
	No. 7 Inner	X									0			
	No. 7 Outer	X							X		0			
1512 U Mk II SS 0.25 Ci	No. 1 Inner	X									1.0			
	No. 1 Outer	X									0			
	No. 2 Inner	X							X		0			
	No. 2 Outer			X					X		0			
	No. 3 Inner	X									1.0			
	No. 3 Outer			X			X		X		0.75			
	No. 4 Inner	X									1.0			
	No. 4 Outer	X							X		1.0	X		
	No. 5 Inner	X									0.5			
	No. 5 Outer	X							X		0.5			
	No. 6 Inner	X									0.5			
	No. 6 Outer	X							X		0.5			
	No. 7 Inner		X								0.5			
	No. 7 Outer			X					X	X				

Table 2. Survey Results. (Continued)

Canister	Element	Top End					Side				Bottom End			
		Intact	Incip. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
1265 M Mk II SS 0.40 Ci	No. 1 Inner	X									0			
	No. 1 Outer	X							X		0			
	No. 2 Inner	X									0			
	No. 2 Outer			X			X		X		0	X		
	No. 3 Inner	X									0			
	No. 3 Outer	X							X		0			
	No. 4 Inner	X									0			
	No. 4 Outer	X							X		0			
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		0	X		
	No. 6 Inner	X									0			
	No. 6 Outer		X						X		0			
	No. 7 Inner	X									0			
	No. 7 Outer	X							X		0			X
1265 U Mk II SS 0.70 Ci	No. 1 Inner	X									0			
	No. 1 Outer			X							0			
	No. 2 Inner	X									0			
	No. 2 Outer	X							X		0			
	No. 3 Inner		X								0			
	No. 3 Outer		X						X		0			
	No. 4 Inner	X									0			
	No. 4 Outer	X					X		X		0			X
	No. 5 Inner	X									0			
	No. 5 Outer	X							X		0			
	No. 6 Inner	X									0			
	No. 6 Outer	X					X		X		0			
	No. 7 Inner	X								X				
	No. 7 Outer			X										

Table 2. Survey Results. (Continued)

	Elements	Top End					Side				Bottom End			
		Intact	Inclp. Breach	Rupture	Loose End Cap	Split Cladding	Cracks	Hole	Blisters	Broken	Sludge Ring Height (in)	Rupture	Loose End Cap	Split Cladding
TOTALS														
Inners	252	216 (86%)	24 (10%)	11 (4%)	0 (0%)	1 (~0%)	0 (0%)	0 (0%)	0 (0%)	6 (2%)	0-1.0	10 (4%)	0 (0%)	0 (0%)
Outers	263	175 (67%)	28 (11%)	34 (13%)	4 (2%)	26 (10%)	73 (28%)	0 (0%)	191 (73%)	16 (6%)	0-1.0	17 (6%)	2 (1%)	20 (8%)

Table 3. Damage Assessment Summary.

ID	Ci	Can	Fuel	Key	Inners			Outers			Sludge [*]
					No. Exam	Min Dam	Maj Dam	No. Exam	Min Dam	Maj Dam	
6214 M	0.12	Mk II SS	MIA	11540	7	0	0	7	4	0	1
6214 U	0.12				7	0	1	7	1	2	1
0315 M	0.12	Mk I AI	MIV	12852	7	1	0	7	2	0	1
0315 U	0.14				7	1	0	7	2	0	2
1497 M	0.36	Mk I SS	MIA	11979	4	0	0	7	2	0	1
1497 U	4.06				0	0	0	2	0	2	3
2660 M	2.80	Mk I SS	MIA	13016	7	0	0	7	0	2	3
2660 U	0.17				7	0	0	7	1	0	3
5744 M	0.73	Mk II SS	MIA	11183	7	1	1	6	3	2	3
5744 U	1.05				7	1	0	7	3	3	2
6743 M	0.81	Mk II SS	MIA	10982	6	0	0	6	0	3	1
6743 U	?				6	0	0	7	1	2	3
0161 M	1.00	Mk I AI	MIA	10832	7	0	0	7	3	3	2
0161 U	0.49				7	0	0	7	1	2	2
1226 M	0.93	Mk I SS	MIA	11897	5	1	0	7	0	2	2
1226 U	0.15				7	0	0	7	1	1	2
1860 M	0.25	Mk I AI	Nat	13015	7	1	0	7	0	1	1
1860 U	0.91				6	1	2	4	0	1	3
6513 M	3.52	Mk II SS	MIA	11109	7	1	0	7	0	3	3
6513 U	1.44				5	0	0	7	2	1	3
2667 M	3.41	Mk I SS	MIA	13371	1	0	0	3	0	3	3
2667 U	0.80				6	0	0	7	0	1	3
6603 M	0.66	Mk II SS	MIV	11540	7	1	0	7	2	3	3
6603 U	0.20				7	0	0	7	3	0	1
7913 M	0.35	Mk II SS	MIA	10350	7	0	0	7	0	2	1
7913 U	0.97				7	0	0	7	0	4	3
1164 M	1.61	Mk I SS	MIA	12127	5	1	0	6	3	3	2
1164 U	0.54				7	0	0	7	0	1	2
0091 M	0.61	Mk II SS	MIV	13858	7	2	0	7	1	4	3
0091 U	0.57				7	4	0	7	2	1	3
1560 M	0.18	Mk I AI	MIV	12852	6	1	1	6	1	3	2
1560 U	1.24				7	0	0	7	1	2	2
6641 M	0.08	Mk II SS	MIV	12565	7	1	0	7	1	0	1
6641 U	0.09				7	0	0	7	1	0	1
0102 M	0.62	Mk I SS	MIA	11806	7	0	0	7	4	0	2
0102 U	0.40				6	0	0	6	2	1	2
1512 M	0.77	Mk II SS	MIV	13858	7	2	1	7	1	2	3
1512 U	0.25				7	0	0	7	3	1	3
1265 M	0.40	Mk II SS	MIA	12639	7	0	0	7	2	1	1
1265 U	0.70				7	0	1	7	3	1	1
TOTALS					252	20 (8%)	7 (3%)	263	56 (21%)	63 (24%)	

* 1 = Minimal 2 = Moderate 3 = Maximum

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Figure 1. Sludge Cloud Generated During Mark I Canister Lid Removal (2667 M)

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Figure 2. Fuel Elements with Intact Top Ends (6241 M).

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Figure 3. Incipient Breach on the Top of an Inner Element (0091 U)

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Figure 4 Top End Rupture on an Outer Element (6513 U).

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Figure 5. Detached End Cap on Center Element (6513 M).

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Figure 6. Split Cladding and Fuel Voiding (5744 U).

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Figure 7 Inner and Outer Elements with Split Cladding (1512 M).

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Figure 8. Minor Cracking Along the Side of an Element (6513 M).

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Figure 9 Major Cracking Along the Side of an Element (1164 M).

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Figure 10. Rust Blisters on an Outer Element (2660 U).

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Figure 11 Broken Outer Element Being Extracted from Canister (0161 U)

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Figure 12. Outer Element Broken During Examination (1860 U).

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Figure 13 Layered Sludge Band at the Bottom of an Outer Element (2660 M).

Figure 14 Bottom End Rupture (1226 U).

Figure 15 Bottom End with Loc and Cap and Split Cladding (7913 U).

Figure 16. Medium Coating on an Outer Element (0091 U).

Figure 17 Example of Heavy Element Coatings (0161 M).

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Figure 18 Translucent Coating Flakes (0091 M)

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Figure 19 Fuel Element with Orange Coating (2667 U)

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Figure 20. Dark Colored Sludge Trail (6513 M)

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Figure 21 Orange Colored Sludge Trail (1512 M).

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Figure 22. Flocculent Sludge Inside a Canister Barrel (6743 U).

Figure 23. Chip Can Containing Fuel Fragments (5903 U)

Figure 24. Fuel Elements Stuck Inside a Mark I Canister Lid (0943 U).

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Figure 25. Fuel Damage Versus Cesium Level.

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Figure 26. Sludge Level Versus Cesium Level.

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