1. **To:** (Receiving Organization)  
Distribution: Process Engineering  
5. Proj./Prop./Dept./Div.: Spent Nuclear Fuel Project  
8. Originator Remarks: For Release  

<table>
<thead>
<tr>
<th>Item No</th>
<th>(A) Item No</th>
<th>(B) Document/Drawing No</th>
<th>(C) Sheet No</th>
<th>(D) Rev No.</th>
<th>(E) Title or Description of Data Transmitted</th>
<th>(F) Approval Designator</th>
<th>(G) Reason for Transmission</th>
<th>(H) Originator Disposition</th>
<th>(I) Receiver Disposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SNF-6870</td>
<td>N/A</td>
<td>0</td>
<td>Effect of Canister Movement on Water Turbidity</td>
<td>Q</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**KEY**

- 1. Approval
- 2. Release
- 3. Information
- 4. Review
- 5. Post-Review

17 SIGNATURE/DISTRIBUTION

(See Approval Designator for required signature)

<table>
<thead>
<tr>
<th>(G) Reason</th>
<th>(H) Disp.</th>
<th>(J) Name</th>
<th>(K) Signature</th>
<th>(L) Date</th>
<th>(M) MSIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Authority</td>
<td>3</td>
<td>R.B. Baker</td>
<td></td>
<td>HO-40</td>
<td></td>
</tr>
<tr>
<td>Design Agent</td>
<td>3</td>
<td>A.L. Bridges</td>
<td></td>
<td>X3-85</td>
<td></td>
</tr>
<tr>
<td>Cog. Mgr. J.R. Frederick</td>
<td>3</td>
<td>K. Napora</td>
<td>R-3-86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QA D.W. Smith</td>
<td>3</td>
<td>A.L. Pajanan</td>
<td>R-3-86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>3</td>
<td>A.L. Piter</td>
<td></td>
<td>R3-86</td>
<td></td>
</tr>
<tr>
<td>Env</td>
<td>3</td>
<td>D.J. Trimble</td>
<td>R-2-86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNF Project Files</td>
<td>3</td>
<td></td>
<td></td>
<td>R3-11</td>
<td></td>
</tr>
</tbody>
</table>

BD-7400-172-2 (05/96) GEF097
Effect of Canister Movement on Water Turbidity

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Fluor Hanford
P.O. Box 1000
Richland, Washington

Approved for public release; further dissemination unlimited
Effect of Canister Movement on Water Turbidity

D. J. Trimble
Fluor Hanford

Date Published
August 2000

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13290

Fluor Hanford
P.O. Box 1000
Richland, Washington

Approved for public release; further dissemination unlimited
TRADEMARK DISCLAIMER
Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy. Available in paper copy and microfiche.

Available electronically at http://www.doe.gov/bridge. Available for a processing fee to the U.S. Department of Energy and its contractors, in paper, from:
U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
phone: 865-576-8401
fax: 865-576-5728
email: reports@adonis.osti.gov
Available for sale to the public, in paper, from:
U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
phone: 800-553-6847
fax: 703-605-6900
email: orders@ntis.fedworld.gov
online ordering: http://www.ntis.gov/ordering.htm

Printed in the United States of America

Total Pages: 19
SNF-6870, Rev. 0

Table of Contents

1.0 INTRODUCTION ............................................................................................................ 1
2.0 TEST OBJECTIVES AND SCOPE .................................................................................. 1
3.0 PROCEDURE .................................................................................................................. 1
4.0 RESULTS ....................................................................................................................... 2
4.1 CONCLUSIONS ............................................................................................................. 2
5.0 REFERENCES ................................................................................................................ 2
APPENDIX A .......................................................................................................................... A-1

List of Tables

Table 1. Results of Canister Movement Tests in K East Basin (Baker 1996, and Video Tapes #177 and #178) ............................................................................................................................. 3

List of Figures

Figure 1. Canister 3971 At End Of Initial Lift ........................................................................ 5
Figure 2. Initiating Traverse of Canister 3971 ........................................................................ 5
Figure 3. Canister 3971 At End Of Return From Traverse ..................................................... 6
Figure 4. Canister 5445 During Return Traverse .................................................................. 6
Figure 5. Canister 5446 After 30 Second Pause At End Of Traverse ..................................... 7
Figure 6. Canister 6069 At End Of 1st Lift ............................................................................ 7
Figure 7. Canister 6757 At End Of 1st Lift ........................................................................... 8
Figure 8. Traverse of Canister 6757 ..................................................................................... 8
Figure 9. Canister 6757 Lowered Into Slot After Traverse ................................................... 9
Figure 10. Canister 5618 At End Of Lift ............................................................................... 9
Figure 11. Canister 5618 Being Lowered Into Slot Following Traverse ............................... 10
Figure 12. Start Of Traverse of Canister 2211 ..................................................................... 10
Figure 13. Canister 2211 Returning Traverse ..................................................................... 11
Figure 14. Canister 0668 During Lift .................................................................................. 11
Figure 15. End Of Return Traverse Of Canister 0668 ......................................................... 12

List of Acronyms

Al  Aluminum
MCO  Multi-Cansiter Overpack
SNF  Spent Nuclear Fuel
SS  Stainless Steel
EFFECT OF CANISTER MOVEMENT ON WATER TURBIDITY

1.0 INTRODUCTION

Requirements for evaluating the adherence characteristics of sludge on the fuel stored in the K East Basin and the effect of canister movement on basin water turbidity are documented in Briggs (1996). The results of the sludge adherence testing have been documented (Bergmann 1996). This report documents the results of the canister movement tests.

2.0 TEST OBJECTIVES AND SCOPE

The purpose of the canister movement tests was to characterize water turbidity under controlled canister movements (Briggs 1996). The tests were designed to evaluate methods for minimizing the plumes and controlling water turbidity during fuel movements leading to multi-canister overpack (MCO) loading. It was expected that the test data would provide qualitative visual information for use in the design of the fuel retrieval and water treatment systems. Video recordings of the tests were to be the only information collected.

3.0 PROCEDURE

Canister movement test parameters, provided in the test plan (Briggs 1996), are as follows:

First canister

- Jog selected canister upward for 2 seconds and hold for 5 seconds to observe for canister bottom failure;
- If no failure, raise canister to just below upper limit using jog and pause intervals of 2 and 5 seconds, respectively;
- Hold canister for 30 seconds, allowing sludge plume to settle;
- Traverse canister at a slow, steady walking speed.

Subsequent canisters

- Vary the jog/pause intervals and traverse speeds to find optimal combination for minimizing formation of sludge plumes.

Eight canisters were selected for testing (Makenas 1996, Appendix A). Previous sludge depth measurements (in-canister and floor) as well as canister type and material provided the bases for the selections. These parameters are given in Appendix A for each canister tested.

Table 1 provides test parameters used in the tests. The canister vertical lift movements were usually a series of jog-pauses. The jogs were 1 to 2 seconds (s) long and the pauses were generally 10 to 20 seconds. A traverse (horizontal movement) of 6 to 12 feet followed a pause of 30 to 60 seconds. The canisters were tested with one or two traverse-return cycles.
4.0 RESULTS

The canister movement tests were performed on June 3, 1999, and the results were recorded on pages 3 to 5 of notebook WHC-N-1340-2 (Baker 1996) and on tapes from two video cameras. A videotape record of the tests is provided on Spent Nuclear Fuel (SNF) Characterization Video Tapes # 177 and 178, dated June 3, 1999. The time/date stamp on Tape #178 includes a 2H, distinguishing it from Tape #177. The date/time stamp for the cameras were out-of-sync by about one minute, with Tape #177 giving the earlier time. The videotapes were submitted to the SNF Project file for storage and retention.

Only qualitative data were available to describe the sludge plume and water turbidity resulting from the canister movements. Selected portions of the tests were documented by hard copy prints from the video. A summary of the results is provided in Table 1.

5.0 CONCLUSIONS

- Water turbidity usually occurred with the initial canister lifting movement.
- Fast traversing movements created more turbidity than slow movements for comparable canister conditions.
- Greater amounts of turbidity were observed for the slotted aluminum canisters, which contained large amounts of sludge.
- Turbidity cleared substantially within 1 or 2 minutes after movements were stopped.

6.0 REFERENCES


Table 1. Results of Canister Movement Tests in K East Basin (Baker 1996, and Video Tapes #177 and #178).

<table>
<thead>
<tr>
<th>Canister Location*</th>
<th>Vertical Traverse Rate</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3971</td>
<td>12 jogs none</td>
<td>Sludge issued from bottom at moderate rate (Figure 1). Rate did not appear to be related to jogs.</td>
</tr>
<tr>
<td></td>
<td>40 second pause then traverse slow walk, ~0.16 ft/s</td>
<td>Sludge issued from bottom at decreasing a rate; it moved mostly downward and visibility was reduced to the 2 to 3 canisters in direct line with the plume Figure 2)</td>
</tr>
<tr>
<td></td>
<td>none return, ~0.34 ft/s</td>
<td>Light plume from bottom. Turbidity cleared in about 2 ½ minutes (Figure 3).</td>
</tr>
<tr>
<td></td>
<td>lift not shown on video normal handling rate, ~1.0 ft/s</td>
<td>A heavy plume resulted causing much turbidity. Visibility was significantly obstructed over the row of canisters traversed (Figure 4).</td>
</tr>
<tr>
<td>5445</td>
<td>30 second pause after return none</td>
<td>Sludge continued to issue from bottom, and visibility of canisters traversed cleared considerably (Figure 5).</td>
</tr>
<tr>
<td></td>
<td>lowered into slot none</td>
<td>Turbidity cleared within 75 seconds of initial movement. Only minor effects on visibility remained.</td>
</tr>
<tr>
<td></td>
<td>1st lift, 9 jogs none</td>
<td>Minor plume resulted (Figure 6).</td>
</tr>
<tr>
<td></td>
<td>none 0.38 ft/s</td>
<td>Minor plume causing slight turbidity that reduced as the 12 feet traverse progressed. Returned to slot with no visible turbidity after 1 minute from initiating traverse.</td>
</tr>
<tr>
<td></td>
<td>2nd lift none</td>
<td>Minor plume</td>
</tr>
<tr>
<td></td>
<td>none 1.15 ft/s</td>
<td>2nd traverse--Very minor plume including return trip. Visibility good after 50 seconds of initiating traverse.</td>
</tr>
<tr>
<td></td>
<td>lowered into slot</td>
<td>Within 50 s visibility was good with minor turbidity remaining.</td>
</tr>
<tr>
<td>6069</td>
<td>9 jogs none</td>
<td>Small plume issued from bottom during pauses (Figure 7).</td>
</tr>
<tr>
<td></td>
<td>30 second pause 0.33 ft/s</td>
<td>Slight trail of sludge during traverse; small plume when traverse stopped and reversed (Figure 8).</td>
</tr>
<tr>
<td></td>
<td>lowered into slot return</td>
<td>No visible plume until return traverse stopped, plume had cleared within 90 seconds of initial movement.</td>
</tr>
<tr>
<td></td>
<td>2nd lift none</td>
<td>Moderate plume</td>
</tr>
<tr>
<td></td>
<td>none 0.95 ft/s</td>
<td>2nd traverse--Slight trail of sludge; moderate plume when traverse stopped and reversed.</td>
</tr>
<tr>
<td></td>
<td>return</td>
<td>Returned to initial point within 20 seconds, most of plume not visible, minor turbidity remained (Figure 9).</td>
</tr>
</tbody>
</table>
Table 2. Results of Canister Movement Tests in K East Basin (Baker 1996, and Video Tapes #177 and #178) (continued).

<table>
<thead>
<tr>
<th>Canister Location</th>
<th>Vertical Traverse Rate</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5618</td>
<td>8 jogs + 70 s pause none</td>
<td>Moderate plume (Figure 10).</td>
</tr>
<tr>
<td></td>
<td>none 0.32 ft/s</td>
<td>Small trailing plume.</td>
</tr>
<tr>
<td></td>
<td>none 0.69 ft/s</td>
<td>Return churned up a plume from canisters passed over.</td>
</tr>
<tr>
<td></td>
<td>lowered</td>
<td>Slight turbidity after 2 minutes (Figure 11).</td>
</tr>
<tr>
<td></td>
<td>8 jogs 100 s pause none</td>
<td>Moderate to heavy plume during lift and pause (Figure 12).</td>
</tr>
<tr>
<td></td>
<td>none 0.3 ft/s</td>
<td>Moderate, decreasing plume.</td>
</tr>
<tr>
<td></td>
<td>none 30 s pause</td>
<td>Small amounts of sludge continued to issue from bottom</td>
</tr>
<tr>
<td></td>
<td>none 0.3 ft/s</td>
<td>Return—Light plume trail. Minor turbidity remaining at origin (Figure 13).</td>
</tr>
<tr>
<td>1236</td>
<td>7 jogs none</td>
<td>Heavy plume with locally heavy turbidity.</td>
</tr>
<tr>
<td></td>
<td>60 second pause none none</td>
<td>Sludge continued to issue from canister bottom.</td>
</tr>
<tr>
<td></td>
<td>none 0.3 ft/s</td>
<td>Very little plume during traverse and return.</td>
</tr>
<tr>
<td></td>
<td>30 second pause none none</td>
<td>No issue of sludge. Some turbidity at origin.</td>
</tr>
<tr>
<td>0668</td>
<td>7 jogs + 70 second pause none</td>
<td>Moderate plume (Figure 14).</td>
</tr>
<tr>
<td></td>
<td>none 0.3 ft/s</td>
<td>No visible plume (Figure 15).</td>
</tr>
<tr>
<td></td>
<td>lowered none</td>
<td>Some sludge issued as canister jostled into place.</td>
</tr>
</tbody>
</table>

*Shown in the sequence in which the canisters were tested.*
Figure 1. Canister 3971 At End Of Initial Lift

Figure 2. Initiating Traverse of Canister 3971
Figure 3. Canister 3971 At End Of Return From Traverse

Figure 4. Canister 5445 During Return Traverse
Figure 5. Canister 5446 After 30 Second Pause At End Of Traverse

Figure 6. Canister 6069 At End Of 1st Lift
Figure 7. Canister 6757 At End Of 1st Lift

Figure 8. Traverse of Canister 6757
Figure 9. Canister 6757 Lowered Into Slot After Traverse

Figure 10. Canister 5618 At End Of Lift
Figure 11. Canister 5618 Being Lowered Into Slot Following Traverse

Figure 12. Start Of Traverse of Canister 2211
Figure 13. Canister 2211 Returning Traverse

Figure 14. Canister 0668 During Lift
Figure 15. End Of Return Traverse Of Canister 0668
APPENDIX A

Memo by B. J. Makenas
Ultrasonic canister sludge measurements and floor sludge depth measurements were reviewed to obtain candidate canisters for canister movement studies. Movement of canisters at different speeds will be accomplished with video taping of the resulting dispersal of canister and floor sludge in the pool water.

Parameters of interest are: (1) stainless steel canisters resting in deep and shallow floor sludge, (2) aluminum canisters containing deep and shallow canister sludge, and (3) at least one slotted canister. Note that it is not possible to determine with certainty from video records whether a non-slotted aluminum can has a screen or solid bottom. The attached table lists primary candidate canisters and a number of backups.

B. J. Makenas
Fellow Engineer

Jmn
Attachment

CONCURRENCE:

C. T. Miller
K Basin Operations

Date: 5/22/96
## CANDIDATE CANISTERS FOR MOVEMENT STUDIES

<table>
<thead>
<tr>
<th>Canister Location</th>
<th>Canister Sludge Depth (in.)</th>
<th>Floor Sludge Depth (in.)</th>
<th>Material</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2211</td>
<td>4.02</td>
<td>1.5</td>
<td>Al</td>
<td>Deep in-canister sludge</td>
</tr>
<tr>
<td>6069</td>
<td>0.07</td>
<td>6.1</td>
<td>Al</td>
<td>Shallow in-canister sludge--deep floor sludge</td>
</tr>
<tr>
<td>5445</td>
<td>7.52</td>
<td>1.3</td>
<td>Al (slotted)</td>
<td>Deep in-canister sludge</td>
</tr>
<tr>
<td>668</td>
<td>3.23</td>
<td>4.9</td>
<td>SS</td>
<td>Deep floor sludge</td>
</tr>
<tr>
<td>3971</td>
<td>1.24</td>
<td>1.4</td>
<td>SS</td>
<td>Shallow floor sludge</td>
</tr>
<tr>
<td>1236</td>
<td>4.61</td>
<td>1.3</td>
<td>Al (slotted)</td>
<td>Backup Al canister</td>
</tr>
<tr>
<td>6757</td>
<td>11.07</td>
<td>4.2</td>
<td>SS</td>
<td>Backup, deep floor sludge</td>
</tr>
<tr>
<td>5518</td>
<td>0.85 to 1.53</td>
<td>1.1</td>
<td>SS</td>
<td>Backup, shallow floor sludge</td>
</tr>
</tbody>
</table>