


RPP-6890-FP
Revision 0

Drilling and Sampling in Hanford's Highly Radioactive Environment

H.A. Sydnor
CH2MHILL Hanford Group, Inc.

Date Published
December 2000

To be Presented at
2000 Fall Meeting of the American Geophysical Union
San Francisco, CA
December 15, 2000

 12-18-00
Release Approval Date

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

Copyright License

By acceptance of this article, the publisher and/or recipient acknowledges the U.S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering this paper

CH2MHILL
Hanford Group, Inc.

Richland, Washington

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC06-99RL14047

Approved for Public Release; Further Dissemination Unlimited

LEGAL DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. 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. *The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.*

This report has been reproduced from the best available copy.

INFORMATION CLEARANCE FORM

A. Information Category <input type="checkbox"/> Abstract <input type="checkbox"/> Journal Article <input type="checkbox"/> Summary <input type="checkbox"/> Internet <input checked="" type="checkbox"/> Visual Aid <input type="checkbox"/> Software <input type="checkbox"/> Full Paper <input type="checkbox"/> Report <input type="checkbox"/> Other _____		B. Document Number RPP-6890 -FP C. Title Drilling and Sampling in Hanford's Highly Radioactive Environment D. Internet Address	
---	--	--	--


E. Required Information <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>1. Is document potentially Classified? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes (MANDATORY) <u>A. J. Knepp</u> Manager's Signature Required If Yes _____ <input type="checkbox"/> No <input type="checkbox"/> Yes Classified ADC Signature Required</p> <p>2. Internal Review Required? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If Yes, Document Signatures Below Counsel _____ Program _____</p> <p>3. References in the Information are Applied Technology <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes Export Controlled Information <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes</p> </div> <div style="width: 48%;"> <p>4. Does Information Contain the Following: (MANDATORY) a. New or Novel (Patentable) Subject Matter? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If "Yes", Disclosure No.: _____ b. Information Received in Confidence, Such as Proprietary and/or Inventions? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If "Yes", Affix Appropriate Legends/Notices. c. Copyrights? <input type="checkbox"/> No <input type="checkbox"/> Yes If "Yes", Attach Permission. d. Trademarks? <input type="checkbox"/> No <input type="checkbox"/> Yes If "Yes", Identify in Document.</p> <p>5. Is Information requiring submission to OSTI? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If Yes UC-_____ and B&R-_____</p> <p>6. Release Level? <input checked="" type="checkbox"/> Public <input type="checkbox"/> Limited</p> <p>7. Charge Code <u>106497</u></p> </div> </div>			
--	--	--	--

F. Complete for a Journal Article 1. Title of Journal _____	
---	--

G. Complete for a Presentation 1. Title for Conference or Meeting <u>2000 Fall Meeting of the American Geophysical Union</u> 2. Group Sponsoring <u>American Geophysical Union</u> 3. Date of Conference <u>12/15/00</u> 4. City/State <u>San Francisco, CA</u> 5. Will Information be Published in Proceedings? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes 6. Will Material be Handed Out? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes	
---	--

H. Author/Requestor <u>HA Sydner</u> (Print and Sign)	Responsible Manager <u>AJ Knepp</u> (Print and Sign)
--	---

I. Reviewers	Yes	Print	Signature	Public Y/N (If N, complete J)
General Counsel	<input checked="" type="checkbox"/>	<u>S. Bensussen</u>	<u>[Signature]</u>	<u>Y</u> / N
Office of External Affairs	<input checked="" type="checkbox"/>	<u>C. Kuhlman</u>	<u>[Signature]</u>	Y / N
DOE-RL	<input checked="" type="checkbox"/>	<u>R. Yasek</u>	<u>[Signature]</u>	<u>Y</u> / N
Other	<input type="checkbox"/>	_____	_____	Y / N
Other	<input type="checkbox"/>	_____	_____	Y / N

J. If Information Includes Sensitive Information and is not to be released to the Public indicate category below. <input type="checkbox"/> Applied Technology <input type="checkbox"/> Protected CRADA <input type="checkbox"/> Personal/Private <input type="checkbox"/> Export Controlled <input type="checkbox"/> Proprietary <input type="checkbox"/> Procurement-Sensitive <input type="checkbox"/> Business-Sensitive <input type="checkbox"/> Patentable <input type="checkbox"/> Predecisional <input type="checkbox"/> Other (Specify) _____ <input type="checkbox"/> UCNi		Information Clearance Approval <div style="text-align: center;">  <u>page 1 of 2</u> </div>
--	--	---

K. If Additional Comments, Please Attach Separate Sheet

INFORMATION CLEARANCE FORM

A. Information Category <input type="checkbox"/> Abstract <input type="checkbox"/> Journal Article <input type="checkbox"/> Summary <input type="checkbox"/> Internet <input checked="" type="checkbox"/> Visual Aid <input type="checkbox"/> Software <input type="checkbox"/> Full Paper <input type="checkbox"/> Report <input type="checkbox"/> Other _____		B. Document Number RPP-6890 C. Title Drilling and Sampling in Hanford's Highly Radioactive Environment D. Internet Address																															
E. Required Information																																	
1. Is document potentially Classified? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes (MANDATORY) <u>A. J. Knepp</u> Manager's Signature Required If Yes _____ <input type="checkbox"/> No <input type="checkbox"/> Yes Classified ADC Signature Required 2. Internal Review Required? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If Yes, Document Signatures Below Counsel _____ Program _____ 3. References in the Information are Applied Technology <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes Export Controlled Information <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes		4. Does Information Contain the Following: (MANDATORY) a. New or Novel (Patentable) Subject Matter? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If "Yes", Disclosure No.: _____ b. Information Received in Confidence, Such as Proprietary and/or Inventions? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If "Yes", Affix Appropriate Legends/Notices. c. Copyrights? <input type="checkbox"/> No <input type="checkbox"/> Yes If "Yes", Attach Permission. d. Trademarks? <input type="checkbox"/> No <input type="checkbox"/> Yes If "Yes", Identify in Document. 5. Is Information requiring submission to OSTI? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If Yes UC- _____ and B&R- _____ 6. Release Level? <input checked="" type="checkbox"/> Public <input type="checkbox"/> Limited 7. Charge Code <u>106497</u>																															
F. Complete for a Journal Article																																	
1. Title of Journal _____																																	
G. Complete for a Presentation																																	
1. Title for Conference or Meeting <u>2000 Fall Meeting of the American Geophysical Union</u> 2. Group Sponsoring <u>American Geophysical Union</u> 3. Date of Conference <u>12/15/00</u> 4. City/State <u>San Francisco, CA</u> 5. Will Information be Published in Proceedings? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes 6. Will Material be Handed Out? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes																																	
H. Author/Requestor <u>HA Sydner</u> (Print and Sign)		Responsible Manager <u>AJ Knepp</u> (Print and Sign)																															
<table border="0" style="width: 100%;"> <tr> <th style="text-align: left;">I. Reviewers</th> <th style="text-align: left;">Yes</th> <th style="text-align: left;">Print</th> <th style="text-align: left;">Signature</th> <th style="text-align: left;">Public Y/N (If N, complete J)</th> </tr> <tr> <td>General Counsel</td> <td><input checked="" type="checkbox"/></td> <td><u>S. Vensussen</u></td> <td><u>[Signature]</u></td> <td><u>Y</u> / N</td> </tr> <tr> <td>Office of External Affairs</td> <td><input checked="" type="checkbox"/></td> <td><u>C. Kuhlman</u> <u>A. Etheridge</u></td> <td><u>[Signature]</u></td> <td><u>Y</u> / N</td> </tr> <tr> <td>DOE-RL</td> <td><input checked="" type="checkbox"/></td> <td><u>R. Yasek</u></td> <td><u>[Signature]</u></td> <td><u>Y</u> / N</td> </tr> <tr> <td>Other</td> <td><input type="checkbox"/></td> <td>_____</td> <td>_____</td> <td>Y / N</td> </tr> <tr> <td>Other</td> <td><input type="checkbox"/></td> <td>_____</td> <td>_____</td> <td>Y / N</td> </tr> </table>				I. Reviewers	Yes	Print	Signature	Public Y/N (If N, complete J)	General Counsel	<input checked="" type="checkbox"/>	<u>S. Vensussen</u>	<u>[Signature]</u>	<u>Y</u> / N	Office of External Affairs	<input checked="" type="checkbox"/>	<u>C. Kuhlman</u> <u>A. Etheridge</u>	<u>[Signature]</u>	<u>Y</u> / N	DOE-RL	<input checked="" type="checkbox"/>	<u>R. Yasek</u>	<u>[Signature]</u>	<u>Y</u> / N	Other	<input type="checkbox"/>	_____	_____	Y / N	Other	<input type="checkbox"/>	_____	_____	Y / N
I. Reviewers	Yes	Print	Signature	Public Y/N (If N, complete J)																													
General Counsel	<input checked="" type="checkbox"/>	<u>S. Vensussen</u>	<u>[Signature]</u>	<u>Y</u> / N																													
Office of External Affairs	<input checked="" type="checkbox"/>	<u>C. Kuhlman</u> <u>A. Etheridge</u>	<u>[Signature]</u>	<u>Y</u> / N																													
DOE-RL	<input checked="" type="checkbox"/>	<u>R. Yasek</u>	<u>[Signature]</u>	<u>Y</u> / N																													
Other	<input type="checkbox"/>	_____	_____	Y / N																													
Other	<input type="checkbox"/>	_____	_____	Y / N																													
J. If Information Includes Sensitive Information and is not to be released to the Public indicate category below.																																	
<input type="checkbox"/> Applied Technology <input type="checkbox"/> Personal/Private <input type="checkbox"/> Proprietary <input type="checkbox"/> Business-Sensitive <input type="checkbox"/> Predecisional <input type="checkbox"/> UCN		<input type="checkbox"/> Protected CRADA <input type="checkbox"/> Export Controlled <input type="checkbox"/> Procurement-Sensitive <input type="checkbox"/> Patentable <input type="checkbox"/> Other (Specify) _____																															
K. If Additional Comments, Please Attach Separate Sheet																																	

Page 2 of 2

Drilling and Sampling in Hanford's Highly Radioactive Environment

Groundwater/Vadose Zone Integration Project

Abstract

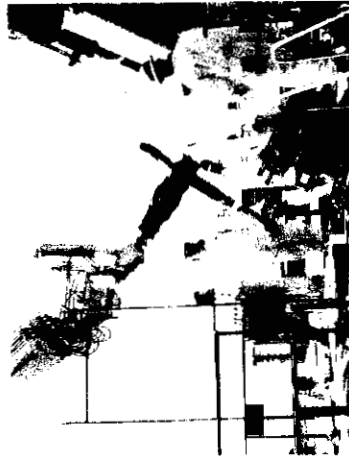
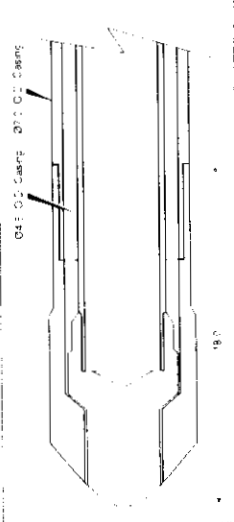
In the summer of 2000, a drilling and sampling program was performed to assess the highly radioactive contaminated vadose zone adjacent to and beneath the 241-SX-108 Single-Shell Tank (SX-108 SST) located at the Hanford Site in Washington State. The drilling and sampling effort was designed to retrieve contaminated samples where cesium-137 concentrations could be at the theoretical maximum concentration of 108 pCi/g. Handling of drill cuttings at this concentration was not an option, because dose rates to workers would have been several R/hr. A special drill rig and drilling and sampling system were designed, constructed, and fully tested to advance a casing string at an angle to collect periodic samples without damaging the SX-108 SST, generating any unnecessary wastes, or exposing workers to excessive radiation.

The drilling method used was a driven closed-end casing with a removable tip. An industry standard diesel pile driver was selected to provide optimum means for advancing the casing. A removable internal drill string was designed to provide access for sampling tools and to provide additional energy to the tip of the driver casing during its advancement. The drill rig used a remote-controlled articulating mechanical arm to maneuver casing and split-spoon samplers, avoiding direct worker contact with contaminated components or samplers. A lead shielded split-spoon sampler was designed to reduce personnel exposure from samples as the sampler was extracted from the borehole and placed in shipping containers. To further reduce dose rates, the sample size was limited to the minimum volume required for laboratory analysis.

Sample intervals were selected based on existing samples and geophysical logs from adjacent wells. Samples were physically constrained to one sample per 5 ft of advancement. Seventeen intervals were selected for sampling and 16 samples were successfully retrieved. Overall, sample recovery was 80%. The borehole was advanced at a 30 degree angle with a total distance of 172 ft (149 vertical ft).

These techniques provided exceptional contamination control and reduced worker exposure as well as providing representative soil samples. The maximum dose rate measured was 2 R/hr at 4 in. from the sampler on location and 14 R/hr in the laboratory on contact. Doses received by workers were kept well within administrative guidelines. The techniques deployed were extremely successful and provided results otherwise unachievable through standard practices. These techniques have far reaching applications and can provide viable alternatives for collecting characterization data during site investigations where high levels of radiological contamination are present.

Removable Drive Tip and Shoe Assembly



Remote Handling of Drill Tools



Rig Setup in Tank Farm

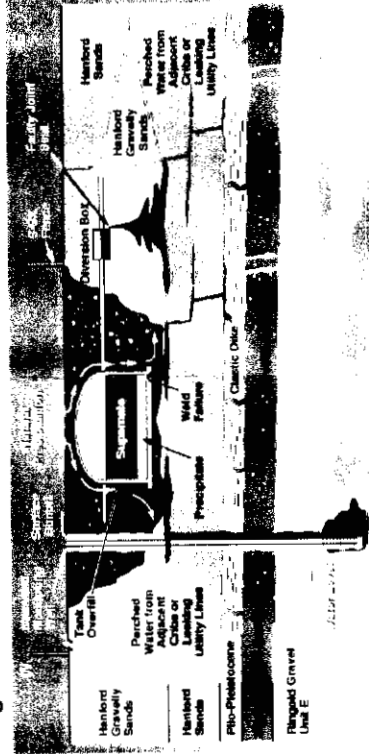


Tip and Shoe

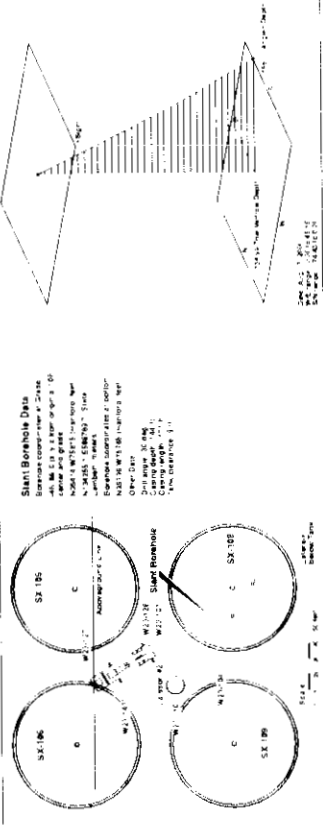
Packaging Sample

Pile Driver

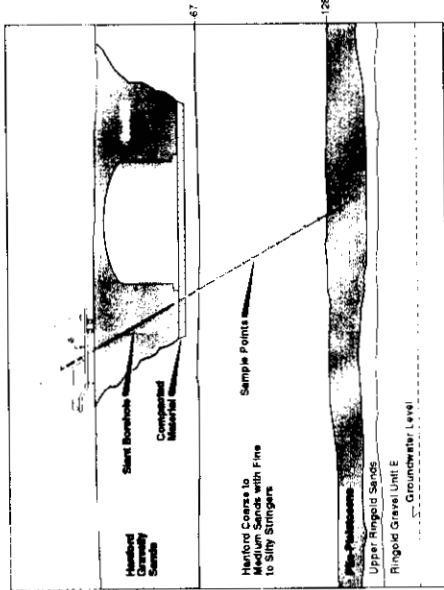
Preliminary Conceptual Model of Fluid Flow Beneath Single Shell Tanks



Slant Borehole Location near Tank 241-SX-108



Conceptual Drawing of Borehole Path and Sample Points



Sample Breakout Table



Soil Samples

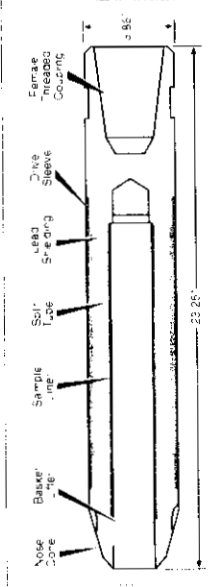
SX-108 137Cs Distribution



Borehole Geophysics



Internally Shielded Split Spoon Sampler



Project Team
CH2M Hill Hanford Group
Duralek Federal Services
Resonant Sonic, International
Pacific Northwest National Laboratory

**U.S. Department of Energy
Office of River Protection**
Harold Siddors
509.272.5474
Harold.Siddors@epo.doe.gov
Martin Gardner
509.372.8326
Martin.Gardner@epo.doe.gov