Accession #: D196022485

Document #: SD-SNF-SDD-004

Title/Desc:

SYSTEM DESIGN DESCRIPTION FOR SAMPLING SLUDGE IN K BASINS FUEL STORAGE CANISTERS

Pages: 50

FEB 06 1996 Sta. 21

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 610194

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Spent Nuclear Fuel Evaluations 8M710	4. Related EDT No.:
5. Proj./Prog./Dept./Div.: SNFP	6. Cog. Engr.: R.B. Baker	7. Purchase Order No.: N/A
8. Originator Remarks: For Release -- SYSTEM DESIGN DESCRIPTION FOR SAMPLING SLUDGE IN K BASINS FUEL STORAGE CANISTERS		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: 105-K Basins/100K
11. Receiver Remarks:		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date:

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-SNF-SDD-004		0	SYSTEM DESIGN DESCRIPTION FOR SAMPLING SLUDGE IN K BASINS FUEL STORAGE CANISTERS	N/A	1,2	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. R.B. Baker	R.B. Baker	1/12/96	H0-40	K.L. Pearce	K.L. Pearce	1-18-96	R3-48	1	1
1	1	Cog. Mgr. R.P. Omberg	R.P. Omberg	1/15/96	R3-85	M.J. Langevin	M.J. Langevin	2/5/96	X3-74	1	1
1	1	QA G.M. Davis	G.M. Davis	2/6	X3-80	D.W. Bergmann	D.W. Bergmann	2-5-96	R3-86		
1	1	Safety D.O. Hess	David O. Hess	2/5/96							
		Env.									
1	1	C. Defigh-Price	C. Defigh-Price	1/17/96	X3-79						
1	1	C.T. Miller	C.T. Miller	2/5/96	X3-72						

18. R.B. Baker [signature] 1/12/96 Signature of EDT Originator Date	19. Authorized Representative for Receiving Organization Date	20. R.P. Omberg [signature] 1/15/96 Cognizant Manager Date	21. DOE APPROVAL (if required) Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

BD-7400-172-1

SYSTEM DESIGN DESCRIPTION FOR SAMPLING SLUDGE IN K BASINS FUEL STORAGE CANISTERS

R. B. Baker
Westinghouse Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 610194 UC: 2070
Org Code: 8M710 Charge Code: LB031
B&R Code: EW 3135040 Total Pages: 46

Key Words: K Basins, Sampling Equipment, Sludge Characterizaton, System Design Description, Spent Nuclear Fuel Project, and Fuel Storage Canisters

Abstract: This System Design Description provides: (1) statements of the Spent Nuclear Fuel Projects (SNFP) needs requiring sampling of canister sludge in the K East and K West Basins, (2) the sampling equipment system functions and requirements, (3) a general work plan and the design logic being followed to develop the equipment, and (4) a summary description of the design for the sampling equipment.

James J. Bishop 2-6-96
Release Approval Date

Release Stamp

Approved for Public Release

SYSTEM DESIGN DESCRIPTION FOR SAMPLING SLUDGE IN K BASINS FUEL STORAGE CANISTERS

R. B. Baker
Westinghouse Hanford Company

January 1996

CONTENTS

LIST OF FIGURES

LIST OF TABLES

SYSTEM DESIGN DESCRIPTION FOR SAMPLING SLUDGE IN K BASINS FUEL STORAGE CANISTERS

1.0 INTRODUCTION

A number of key activities underway as part of the Spent Nuclear Fuels (SNF) Project are related to the handling, processing, and disposing of sludge from the 105-K Basins (K Basins). The proposed "Path Forward," Reference 1, disposition of sludge materials is summarized in Figure 1 along with estimates of the quantities involved. Development of sludge recovery equipment, processing equipment, transport methods, and disposal options all require specific characterization data for the sludge materials. In addition, the sludge must be characterized for properties that affect (1) its removal from the fuel storage canisters and (2) the behavior (e.g., drying performance) of the multi-canister overpacks (MCO) loaded with the spent fuel and residual sludge (i.e., that sludge which remains on the spent fuel elements after the general removal and cleaning process).

While some data on floor sludges have been and are being obtained, References 2 and 3, recent studies, Reference 1, conclude there is little or no direct data on sludge in the existing fuel storage canisters on which to make project decisions and design bases. The quantity of sludge in the canisters, much less its composition, remains uncharacterized in either basin. Additional quality data are required and will be defined in detail through the process of developing Data Quality Objectives (DQO) and Sample Analyses Plans (SAP). Because of the requirements for characterizing the sludges from the fuel storage canisters in both K East and K West Basins, the canister sludge sampling system is being developed to be used as a routine process applied by Basin Operations. Application of the system will be under the cognizance of the Spent Nuclear Fuel Evaluations (SNFE) group who is tasked to provide characterization data for both the fuel and sludges for the SNF Project.

The SNF Project has (see Section 1.2) established sludge (located in the fuel storage canisters in the K East and K West Basins) as one of the immediate needs for additional characterization data. The first characterization data sampling run with the subject canister sludge sampling system will be in K East, followed later by sampling in K West. The DQO and SAP for gathering data to characterize the sludges in the canisters will be the ultimate basis of requirements for this sampling system, References 3 and 4. These documents are being developed. All primary requirements, for the sampling system are addressed in this System Design Description (SDD). An initial assumption is that the first sampling run will likely involve approximately nine samples from canisters in K East and, the second sampling run will then follow in K West (the DQO will establish the actual number). The first two sampling runs will be linked to the removal of fuel elements for characterization, Reference 14, to use resources as efficiently as possible. The final level of sampling needed for the canisters will be determined once the data from these two sample runs are available. Additional sampling during final processing (e.g., movement out of K Basins) of the bulk K Basins sludge (and fuel elements) may or may not be needed.

Taking canister sludge samples is a comparatively simple task by Basin Operations standards and is basically considered an "activity" rather than a "project." Based on discussions with Operations staff, a graded approach is being used for the requirements for K Basin reviews as defined in the draft "K Basin Project Review Process," Reference 5. Responding to this, the current SDD document addresses several documentation needs including: (1) statements of the SNF Project needs requiring this sampling, (2) the sampling system functions and requirements, (3) a general work plan and design logic being followed, and (4) a summary design description of the primary system including process flow. This SDD provides an integrated package for use by K Basin staff and for interfacing with the design and support team staff.

It is planned that the initial applications of this sampling equipment will be linked to the next fuel sampling efforts at K East and K West Basins. The interface of the equipment is described in a companion SDD, Reference 14. This includes information on when the canister sludge sampler would be used in the overall sampling campaign and how it would be integrated into the overall process flow. The system, if needed for other sampling efforts, can be applied directly in K East (where canisters have no lids) with minimal additional equipment--the primary need is the transportation cask. In K West to sample sludge in the canisters, the canister lids would need to be removed; thus, all the equipment required for canister lid removal/replacement would be needed, in addition to the sludge sampling equipment and cask.

1.1 DEFINITIONS

Sludge (General): K Basin "sludge" or sediment is particulate matter that has settled to the bottom of the basin, remote pits, and spent fuel storage canisters. It is generally found to consist of particulate matter composed of solid atmospheric pollutants (e.g., sand, dust, insects, etc.), storage canister corrosion products (particularly from those in K East constructed of aluminum), sloughed-off Basin structural material (e.g., concrete grit from Basin walls, rust from storage racks, paint, etc.), fuel element reaction products (e.g., cladding corrosion products, fuel, fission products, etc.), miscellaneous materials accumulated during the operations of the Basin (e.g., hardware, ion exchange module beads, etc.) and organic matter (e.g., rodents, spiders, etc.). The majority of these sludges are apparently in the K East Basin, see Figure 1 and Reference 2. Based on past practices and project definitions, the "sludge particles" are assumed to be less than or equal to 0.25 inch. Material larger than this is considered "debris." (The 0.25 inch limit is linked to the past practice to avoid criticality concerns in the Basins. However, it continues to be used for process equipment design, as it provides a reasonable functional definition.) Particles have been found to range down in size to smaller than 0.5 micron.

Fuel Storage Canister Sludge: Sludges found in the fuel storage canisters containing fuel elements. Composition of this sludge is expected to contain anywhere from little or no fuel and fission products to the potential for major quantities in the cases where fuel has totally reacted out of cladding. The canister sludge in the open K East canisters is expected to contain essentially the same compliment of materials as the floor sludge plus the high concentration of degraded fuel element and canister barrel materials. Sludge in the canisters at K West Basin should contain primarily degraded fuel element and canister related materials. Because the canisters in K West were closed and a corrosion inhibitor was included (to some degree) while the K East canisters are all open and have been subjected to a variety of water conditions, the behavior of sludge buildup and composition may vary significantly between the two basins. Design of equipment for sampling this "hot" sludge is covered by this SDD.

Floor Sludge: Sludges found on the floor of the main basins, remote pits and empty storage canisters. This sludge is normally expected to be fairly low in fuel constituents compared to the sludge in fuel storage canisters with breached fuel. However, because of circumstances in K East this may not always be the case. There are three reasons for this: (1) significant numbers of failed fuel elements are contained in storage canisters composed of barrels with open bottoms and in some instances slotted sides--these allow canister sludge, likely rich in fuel products, to mix directly with the Basin floor sludges, (2) the storage barrels containing the breached fuel have no lids allowing movement of fuel particles from breached fuel elements to surrounding water and floor (this is true even if the storage barrels have no holes at the bottom), and (3) sludge has been pumped from the Discharge Chute-Segregation area into the Weasel Pit--this sludge potentially contains canister sludge with fuel products because of past activities carried out in this area. There is no indication to-date of hard "caked" or packed sludge on the floors, etc. However, it is a potential condition.

Reference 2 provides additional information on the conditions of the K East Basin sludges. It should be noted that most historic data used sampling procedures that limited the radioactivity of sludge samples to 500 mR/hr or less. Thus, these samples contained minimal amounts of fuel components and fission products, as a consequence of the collection method. Recent sampling of floor sludge in K East, Reference 11, used specially developed equipment able to handle samples up to 10 R/hr. However, data from this work is still being analyzed.

1.2 PROJECT BASIS OF NEED FOR SAMPLING SYSTEM

The sludge sampling equipment that is the subject of this SDD has the primary objective of providing key data on sludges from the fuel storage canisters in K East and K West Basins. This activity is an integral part of the current SNF Project characterization program, Reference 6, which responded to the accelerated Path Forward Memorandum of Agreement, Reference 7. The Path Forward classification for K Basin sludges as "wastes," is provided in References 8 and 9.

Specifically, sampling of sludges from the fuel storage canisters with this system will provide key data for programmatic and technical decisions related to:

- Handling the fuel and fuel storage canisters in the Basins.
- Separating as much as practical the sludge from the fuel elements.
- Transporting (i.e., pumping, storage trucking, etc.) and dispositioning of the bulk sludge removed from the canisters (e.g., to the Tank Waste Remediation System--TWRS).
- Handling of the fuel elements and residual sludge that remains on the elements in the MCOs as they are conditioned and stored in the Canister Storage Building (CSB).

Related to all these activities are decisions on methods of sludge handling and equipment design. These decisions will ultimately be receiving design reviews for purchases of equipment and facilities, and design applications. The responsibility for design of the methods and equipment for the bulk sludge belongs to the Engineering Support group. The recovery of the fuel elements at the Basins is the responsibility of the Fuel Retrieval Projects group. The design of the MCO and its interface with the CSB is the responsibility of the Process Engineering group. The objectives and requirements for this sampling of fuel storage canisters will be developed through the DQO process, Reference 3, under the guidance of the SNFE group, who is responsible for SNF Project characterization activities.

The need for additional sampling after the initial sampling of canister sludge in the K East and K West (in addition to the data in-hand from current and historic analyses of floor sludges) will be evaluated as soon as the canister sludge characterization data are available. Supporting additional DQO and Sampling Analyses Plans (SAP) will be developed as required.

2.0 FUNCTIONS AND REQUIREMENTS

2.1 FUNCTIONS

The system will provide samples of sludges from the fuel storage canisters at the K East and K West Basins with compositions representative of the local sludge material. At K West it is assumed lids will be removed prior to sampling. The sample taken should not selectively exclude any type of sludge material (e.g., heavy fines resting on the bottom of the canister, "hot" fuel particles, etc.) under 0.25 inch in diameter. Material or particles greater than 0.25 inch in diameter should be excluded and remain in the canister or Basin. The system shall recover representative samples of the "free" sludge (when no particles over 0.25 inch are present) in a selected canister barrel. This will be verified through acceptance tests with up to approximately 2,000 ml of selected sludge simulants in a simulated fuel storage canister with elements under cold (i.e., non-radioactive) test conditions run in the 305 Building cold test (pool) facility. The system shall be capable of sampling sludge co-mingled with particles greater that 0.25 inch but no efficiency shall be imposed because of the resulting interfering rubble bed. Sludge trapped in the annuluses of the fuel elements and below debris (e.g., cladding shards) that block penetration of a extraction nozzle will not be addressed by this system.

Because of the complexity and variables involved in pulling sludge from K Basin fuel storage canisters containing fuel elements (e.g., small crevices, unknown depth of sludge, ability of sludge to move between the fuel elements in canister barrel while sampling is on-going, etc.) a two stage acceptance test will be run on its functionality: (1) confirming the general efficiency of the system to pull free sludge--using an open container about 4 inches in diameter containing about 1,500 ml of sludge simulant, and (2) confirming its ability to sample to the bottom of a Mark II type K Basin fuel storage canister barrel containing seven simulated fuel elements and 1,000 to 2,000 ml of sludge simulant. The tests will be in the 305 Building pool facility at depths of water similar to K Basins. Recovery of at least 85% of the simulant in the first case and at least 60% of the simulant in the second will be considered acceptable.

The expected state of the floor sludge based on past work is summarized in Table 1, canister sludge will likely be similar only with more fuel element related components. Hard "caked" or packed sludge has not been encountered in any historic sampling, Reference 2. The sampler system is not required to remove such material. In the Mark 0 canisters openings in the bottom and sides provide direct communication of material outside and adjacent to the canister, with the sludge and water inside. Thus, any sampling of sludge in this type canister is acknowledged to include surrounding floor sludge.

The system will reliably provide samples consistent with the corresponding DQO and SAP, maintaining traceability and minimizing potential contamination. The sampling system is not required to meet RCRA sampling protocol but must be consistent with good laboratory practices, References 3 and 4.

The system will provide the samples to an appropriate transport cask (e.g., Chem-Nuclear* cask) for ultimate delivery to the 222-S Analytical Laboratory or 325 Building Laboratory for required analyses. Cask and sample handling may require an intermediate processing facility (e.g., 327 Building) to receive these high activity samples.

The system will incorporate as many proven design features as possible from past successful sampler concepts (References 9 through 12) to achieve the highest potential of success. Because of the near-term need for data, the system should use currently available casks, and available facilities at the Basins and Hanford.

2.2 REQUIREMENTS

The following summarize the system requirements:

A. The system shall provide a sludge sample of sufficient quantity to allow analyses required by the DQO, Reference 3, and the final SAP, Reference 4, for sampling of the sludge in the fuel storage canisters in K East and K West Basins. The target range of sludge sample volume contained in a single sample container from the system should nominally be 500 ml to 1,500 ml, assuming sludge in an as-settled state similar to that in the canister residing in the Basin.

B. The system shall be able to provide adequate samples from sludge varying in depth from less than 0.5 to 12 inches in a canister barrel, without foreknowledge of the sludge depth in the canister (actual application may use an ultrasonic device to establish sludge depth in canister). The sampler shall be able to function in canisters with moderately breached or damaged fuel elements. The sample taken shall include all components that compose the sludge being sampled and not discriminate between materials (e.g., because of density, particle size, etc.), with the exception that particles greater than 0.25 inch will be excluded from the sample.

C. The system will allow for multiple insertions of the extraction nozzle into a canister barrel (e.g., moving between open cusps between fuel elements and the barrel) or between canister barrels while filling a single sample container.

D. The system shall be able to reliably recover samples with radiation dose rates consistent with major portions of the recovered sludge being fuel and fission product materials. The system shall operate and maintain the primary sample 10 feet under the surface of Basin water (for shielding). A design basis of 300 R/hr at 2 inches on the outside of the sample container shall be assumed for 3,000 ml of sludge in the as-settled state (operationally it is expected the dose rate will increase as the sludge settles to the bottom of the sample container after actual sampling is completed). The intent of this sample equipment design is not to be limited by the dose rate of any sample taken from a canister or the Basins.

*Chem-Nuclear is a trademark of Chem-Nuclear Sys., Inc., Columbia, SC

E. The system shall make use of methods to minimize exposure of the operators and staff to all hazards, striving for exposures being As Low As Reasonably Achievable (ALARA).

F. The system shall minimize any potential mechanical changes to the sludge materials as they could relate to fluid and pumping (i.e., rheology) parameters. Therefore the use of filters, pumps, and similar features that would further change the physical state of the materials should be avoided.

G. The sample container should provide the capability to be monitored for hydrogen production once the sludge sample is taken, in order to support cask shipments.

H. The system shall operate with present utilities available in the K East and K West Basin areas (or use outside power sources if more practical to application and compatible with K Basins facilities), and be able to operate with the existing physical environment (e.g., from existing grating, within overhead obstructions, weight restrictions, air quality, etc.) and the K Basin Safety Analysis Report (SAR). The system should function either within the remote pit areas where fuel sampling is performed or directly to canisters under the grating slots; canisters located under unslotted grating will have to be moved under a slot or have grating removed (not intended for initial sampling) to be sampled. The underwater equipment, particularly the sample container, will be designed with negative buoyancy.

I. The overall system shall deliver the required sludge samples to the 222-S Analytical Laboratory or 325 Building Laboratory within the requirements of the DQO and SAP, References 3 and 4. In order to accommodate the limits on dose rate at these facilities and the cask system being proposed, intermediate handling at the Hanford 327 and 325 Buildings may be required to breakdown large high dose rate samples into ones acceptable to the analytical laboratories. Cross-contamination shall be minimized consistent with good laboratory practices, but RCRA protocol is not required (e.g., common tubing used to sample should be replaced or flushed for each sample). Traceability of samples to the sampling locations must be clearly maintained. Materials in contact with the sludge sample shall not compromise planned analytical analyses (see Appendix A) as called for in the DQO and SAP (e.g., contacting surfaces should be clean so as not to introduce artifacting).

J. Interfaces of transportation (e.g., Chem-Nuclear cask), and laboratory handling (e.g., 222-S, 325 Building, and 327 Building) shall be fully defined and integrated in the system planning. Interface limits (e.g., dose rate, size, weight, etc.) in each case shall be fully integrated. [This SDD does not cover the cask system. The cask system will be designed to interface with the acceptance criteria of the laboratory facilities chosen. These acceptance criteria will be noted in the cask supporting documents (e.g., loading procedures, design requirements, etc.), also see Reference 14.]

K. The system shall be designed for routine use by K Basin Operations staff. System controls and handling will account for the incumberances on the operators wearing the levels of protective clothing needed in K East and K West Basins.

L. The system and its operation will minimize waste and consider ease of disposal of waste throughout its life cycle (i.e., fabrication, operation, storage, and final disposal of equipment).

M. The system design should build on available successful design, experience, and equipment wherever possible.

3.0 GENERAL WORKPLAN AND K BASIN PLANT INTERFACES

Figure 2 describes the general design sequence for the canister sampling system equipment. Basically equipment development will follow from the functions and requirements described in the previous sections. A key to this is the cold test pool facility in the Hanford 305 Building. This will be used for prototype development and training, assuring performance of the equipment and minimizing dose to operators and developers. The cold test facility will be used for feature testing (e.g., independent testing of individual design features), design refinement, acceptance testing (i.e., final cold testing of the integrated prototype system with sludge simulant), and cold training for the K Basin operators. Further validation of the operators will follow in the K West Basin, again to minimize dose (versus a dry run in K East), while allowing final validation of the design in the actual environment of the Basin facilities.

Parallel to the development of the equipment will be development of the readiness process, using a graded approach for readiness as per RL directive 5480.31. Readiness documents (i.e., readiness checklist, workplan, procedures, etc.) and safety reviews (i.e., hazards category, unreviewed safety questions, etc.) for the sampling run will be developed.

The interface and reviews between the design process of the equipment and the K Basin Operations Plant staff are summarized in Figure 3. This is based directly on Reference 5 recommendations, assuming a graded approach--combining related steps where feasible to simplify this effort, which is for a comparatively simple system. An example of this is the use of this SDD to provide four of the primary initial documents (e.g., documenting the SNF Project need, the functions and requirements, the general workplan, and the preliminary design summary), also see Section 1.0. This interface approach was reviewed with key K Basin staff and should provide sufficient depth for the task involved. Among other features, it includes the four reviews, Reference 5, of the system with the K Basins Management Review Board: (1) concept presentation (KR-0), (2) two preliminary design reviews (KR-1 and KR-2), and (3) a final design review (KR-3). In addition, the Point of Contact (POC) will be continually advised on the design development steps as they occur. At all stages input from K Basin operations staff will be considered for potential use in the sampling system design.

Figure 4 shows the present work breakdown for the canister sampler. Table 2 provides the primary documents, authors, and approving organizations. Table 3 provides a summary of primary design areas and responsibilities. Because the first sampling is viewed as a high priority for input to process equipment and other SNF project designs, Section 1.2, the schedule for this sampling equipment makes use of as many parallel development activities and past design work as reasonable. Sound engineering, safety, ALARA, data quality, and K Basin Operation requirements however require a set of steps that cannot be short cut if the sampling is to be successful.

Since the canister sampling system is to be run by K Basin Operations staff, training of the operators is a very important ingredient to success. This will be accomplished through (1) initial interface meetings on the equipment as it is designed and developed, (2) cold training in the Hanford 305 Building with the operators using the final equipment, and (3) a "dry run" (using Basin water not sludge) made in the K West Basin. In all these steps input from the operators will be solicited to assist the equipment designers and procedure writers in developing the most viable system. Significant periods of time are allotted to these tasks to help assure the final application of the system is successful with minimum dose to the staff. Recent experience with the K Basin floor sludge sampler, Reference 11, confirmed this to be a sequence that leads to successful application.

4.0 SYSTEM DESIGN DESCRIPTION

The design of the sludge sampling system for fuel storage canisters is based in part on concepts from floor sludge sampling equipment successfully used for systematically sampling the floor sludges in the K East main basin and Weasel Pit, Reference 11.

Figures 5 through 9 depict the overall system design features. Figure 10 shows the sequence or process flow of the system in normal application. Figure 11 provides a schematic of the general process flow in the sampling equipment. The system itself is composed of:

<u>Sample Extraction Tool Tube Assembly</u>
This is composed of a lower stainless steel 1/2 inch outer diameter tube with the nozzle, Figures 6 and 7, which uses opening diameters of no more than 1/4 inch (to restrict the maximum diameter of particle to this or less). The metal tube is connected to a spring loaded ball valve (valve "V1" on Figure 11) that shuts off flow from the nozzle unless activated by the operator. The outlet of the valve is connected to reinforced flexible vinyl tubing, which in-turn is connected to the backflush "Y" and valves on the sample container control rod assembly. Metal hose clamps are provided to assure secure attachment of the tubing.

The nozzle tube is connected to a pole assembly ending in a handle above the Basins grating level. The handle has incorporated into it a "squeeze lever" that through a connecting steel cable activates and releases the ball valve controlling the flow through the nozzle. This extraction tool and handle are designed to work through the 2 inch slots in the Basins grating, as well as in open remote pit areas.

<u>Sample Container Control Rod Assembly</u>
This is composed of a set (two) of quick disconnects that interface with couplings on the lid of the sample container. The couplings are controlled by a control rod assembly ending in a "T" handle above the grating level. This handle mechanically opens the couplings when squeezed to allow them to engage the corresponding couplings on the sample container lid, when released the spring loaded control rod returns to the locked position--engaging and sealing with lid couplings. These couplings connect the inlet and outlet tubes to the sample container preparing it for receiving the sample.

The sample container control rod assembly also includes the valving on the container inlet side for backflushing the extraction tube and nozzle, see Figure 11. The backflush water supply is attached to this pole assembly; connecting a basin hose bib or independent pressurized water supply to one side (V3) of the valve assembly. The valve assembly allows the inlet tube to the sample container to be closed and the backflush water supply to flow back through the extraction tube and nozzle.

The outlet tube side of the sample container control assembly is connected by tubing to the safety delay container located along the pole assembly. The outlet of this delay container is routed along the pole and to the peristaltic pump located on a cart on the grating.

The safety delay container is transparent and has a capacity requiring approximately 30 seconds to fill [should the check valve (CV1) not close] providing time for an operator observing this container during sampling to react and shut off the pump. As a further precaution the safety delay container includes a second check valve (CV2) that closes if water fills the container-stopping sampling. Thus, there are three redundant independent mechanisms that guard against basin water and sludge reaching the pump at grating level (1) the float check valve in the sample container that closes when full of water, (2) the operator monitored safety delay container that if water is observed the action will be to immediately stop sampling, and (3) a second float check valve in the safety delay container that closes when the water level reaches it.

Sample Container Support Pole Assembly
This assembly consists of a pole reaching from a "T" handle above the grating level and resting on the floor of the Basin. The diameter of the pole is sized to reach the Basin floor by passing through the space between the upper and lower trunnions that connect the barrels of a canister. Along the pole, just above the height of lidded canisters, are holding brackets to support the sample container during the sampling process. The height of these is such that the container maintains a 10 foot layer of water between its top and the water surface of the Basin pool. The design is such the sample container must be lifted to be removed, thus precluding it being dislodged accidently while in use.

Sample Container and Lid Assembly
This is composed of a 5.75 inch inner diameter container, made of stainless steel, Figure 8, with a welded bottom. The bottom has additional plate added to assure the assembly always has negative buoyancy even when empty. The volume of this container is approximately 10 liters. The lid is bolted to the container with interfacing gasket material to provide a demonstrated seal.

The lid itself has ports that mate to the quick-disconnect couplings on the sample container control rod assembly. The inlet has a coupling on it that provides a straight through path into the container and includes a manual shut-off valve (V4) below the coupling. The outlet has a coupling with a valve seal that opens when the quick-disconnect coupling is engaged, it also includes a float check valve (CV1) assembly on the inside. A third smaller valve (V5) assembly on the lid allows for venting of the interior of the container once the sample is taken to verify the potential of hydrogen production. The container includes a flexible bail for handling.

The size of the sample container with lid is such that it will fit in the Chem-Nuclear cask system, Reference 14. It will also interface with the proposed intermediate transport and handling path (i.e., 327 Building pool, 327 "A" cell, PNL waste cask, and 325 Building cells).

As initially loaded into the basin the sample containers will be cleaned, uniquely numbered, contain 1 atmosphere of air, and be totally sealed ready to be snapped onto the quick-disconnects of the control rod assembly.

Peristaltic Pump
The outlet of the safety delay container is connected to a peristaltic pump, Figure 11. It provides a vacuum in the sample container and the extraction tube system which in-turn pulls the sludge and water into the sample container. Capacity of the pump system to handle the sludge involved is verified by cold tests. In the normal collection mode, the pump only moves air, evacuating the sampling system. Neither sludge nor water is moved through the pump. The air being pumped may contact the sludge sample and therefore a high-efficiency particulate air (HEPA) filter is used on the outlet exhaust to assure no particulate matter is emitted into air being pumped into the Basin building. The pump has a rheostat to control speed. Flow of water or sludge to the pump from the sample container is blocked by the primary (in the sample container) and backup (in the backup reservoir) float valves, plus the backup safety delay container provides a visual sign water is being drawn too high in the system, giving sufficient time for the operators to react and shut off the pump (see paragraph on "Sample Container Control Rod Assembly").

Vacuum Breakers
A solenoid activated vacuum breaker valve is provided in the line between the pump and safety delay container to cause automatic, positive stoppage of sludge and water sampling when the pump is stopped. This can be used when required as a backup to the ball valve control on the extraction nozzle tube. A backup manually operated vacuum breaker is also provided at the same location.

Backflush System
Between the sample container inlet and the extraction tube assembly a set of valves are arranged to shut-off flow to the sample container and open a path to a pressurized water system (e.g., Basin demineralized water supply through hose and hose bib, or independent pressurized water tank) to be used for backflushing, Figure 11. The water supply is protected by an in-line back-flow preventor. The tubing system is designed for >125% nominal expected pressure. This backflush is provided to rinse the extraction tube prior to reuse, and to help clear blockages from the extraction tube and nozzle if they occur.

Pump Cart
A 4 foot long, 2 foot wide, four wheeled industrial cart carries the pump, and supporting hardware, Figure 5. This is the same basic cart and pump design used for floor sludge sampling in 1995 in the K East Basin, except the un-needed sample bottle pigs have been removed to keep the weight down, Reference 11. A control box will be provided with a 10 foot cable to remotely start the pump (and sampling), and stop the pump (and sampling). Weight of the cart as applied will be within the limits for loading of the Basin grating.

Radiation Detectors
Radiation detectors will monitor the dose levels at the grating level, so the operators can take manual action to stop pumping if any limits are exceeded.

Video Cameras
Two underwater cameras will be used with the sampling system; one to assist in sludge sampling at the top of the canister barrel and to make general observations. The second camera will be used to maintain a status of water level in the sample delay container to initiate stoppage of sampling as required if water is detected.

Hydrogen Monitoring Equipment
A clear plastic cover will be placed on top of the sludge sampling container after it is filled to verify if hydrogen is being produced from the sludge. This cover will capture any released gases allowing measurement. The sample container lid (Figure 8) provides a small valve that is opened prior to putting the monitoring cover into position over the sample container.

Transport Cask
The Chem-Nuclear CNS-1-13G or equivalent transfer cask will be used for sample transport. It will allow shipment of the sludge samples between K East and the Hanford 327 Building or other selected facility, while meeting all Hanford shipping requirements. It is proposed that from the 327 Building the sample containers will be transferred to the 325 Building hot cells for initial, sub-sampling and then transferred to the 222-S and 325 Building laboratories.

Drawings for the canister sludge sampler equipment are currently being completed and include: the general arrangement of the equipment (H-1-81520), the extraction nozzle assembly (H-1-81522), the sludge sample container (H-1-81459), the support pole assembly (H-1-81523), and the control rod assembly (H-1-81521).

The designed system meets all functions and requirements prescribed in Section 2.0, see summary in Table 4. The use of a hydraulic sampler, as compared to a mechanical core sampler, not only follows successful historic methods in the Basins but it also is the only envisioned method that has the potential to sample all the materials in the canister sludge--including heavy fines that may be laying against the bottom of the canisters. (Fines like this were observed in the recent pumping of sludge from the Discharge Chute-Segregation area into the Weasel Pit as part of the barrier door installation activities in K East in 1994.)

Sampling will be composed of a series of columns (or "cores") of sludge that are trapped in cusps between fuel elements and between fuel elements and the canister barrel wall. Each "column" will be taken to the bottom of the fuel canister barrel, thus sampling all horizontal layers present. By moving radially across the canister barrel sampling cusps, a representative overall sample will be acquired for a canister barrel. A design trade-off was not to use any auxiliary tube to isolate cores of sludge (e.g., like the recent floor sludge sampler) because of the variable physical conditions expected sampling canisters with deformed/failed fuel elements and debris. Such a "coring" tube (which would then need to have an extraction tube to vacuum out the core) would be extremely difficult to use (e.g., insert, recover, seat, insert multiple times, etc.) in the canisters, and would greatly restrict the location of samples that could be taken. The selected design maximizes the sampling capabilities across Basins. A trade-off of the selected design was the sample taken, while containing some of all materials present, may not contain them in exact proportion to a specific condition in the canister. This is due to material potentially moving between cusps. This trade-off is viewed as a minor disadvantage since the normal sludge composition could vary significantly radially in a canister due to local failed fuel elements, and effects of openings in the bottom of some canisters allowing floor sludge to mix freely with the canister sludge.

The use of a vacuum to pull the sludge and water into the sample container, rather than direct pumping, provides the advantages of (1) minimal disruption of the sludge physical state and (2) provides an added safety advantage since any leaks in the system will cause leakage into the system, as opposed to a system under positive pressure where potentially contaminated air/water and sludge could leak-out of a hole posing a problem to the operations staff. A drawback to the hydraulic sampling system is the amount of water accumulated with the sludge sample requiring extra volumes to be handled.

This sampling system compliments the successful floor sludge sampler developed in 1995, Reference 11, which is limited to sample dose rates of less than 10 R/hr. It uses the same pump and cart components as the floor sampler, already familiar to operators. This canister sampler could be used in any area in the Basins where high dose rate sludge (>10 R/hr) samples need to be obtained as long as the depth of sludge is kept to about 20 inches or less. A specific procedure can be developed to allow research samples to be obtained using the extraction tube alone sampling directly from the sludge in any location (e.g., pits). This would allow special purpose high dose rate sampling under controlled collection methods.

Feature tests with the primary components of this system in the non-radioactive pool facility at the Hanford 305 Building (i.e., prototypic of K Basin pool) have shown the system functions as designed. Sludge simulants were:

- <u>Used in Acceptance Test of Equipment</u>

  Fly ash (1 to 120 microns)

  Sand (50 to 300 microns)

  Tungsten powder (1 and 10 microns)

- <u>Additional Components Used for Feature Tests</u>

  Pea gravel (up to >0.25 inch)

  Tungsten powder (26 micron)

  Tungsten and molybdenum pieces (up to >0.3 inch).

All these have been handled with the system and recovered if particles were less than 0.25 inch. Tungsten with a theoretical particle density of 19 g/cc compares well with the heaviest material expected to be recovered (i.e., UO_2 at about 10 g/cc and U metal alloys at about 18 g/cc). An acceptance test was run on the sludge sampling equipment (per WHC-SD-SNF-TP-013 , Meling 1996) in the 305 Building facility. The system successfully recovered the required percentages of indicated sludge simulant as prescribed in the second paragraph of Section 2.1 of this SDD. Here for Case 1 90% of the material was recovered compared to a required minimum of 85%, and for Case 2 67% was recovered compared to a required minimum of 60%. The tests are currently being documented and will be issued in WHC-SD-SNF-TRP-013.

ALARA concerns have been addressed continually during the development of the system. Table 4 summarizes some of the primary features designed into the system related to minimizing dose. The use of the 305 Building and K West for training and dry runs are examples of efforts made to minimize dose for this overall activity by using non-radioactive facilities and lower exposure areas as much as possible. Viable training will also be provided to minimize dose during the actual sampling by shortening the time spent in the Basins by staff. This philosophy has been shown to work during other recent sludge sampling efforts.

Waste handling has been kept minimized and optimized where possible. Poles and extraction tubes will be built to lengths less than 66 inches to allow easier disposal as solid waste. The cart used for the system has been designed to minimize weight and for decontamination where possible, this should minimize disposal problems for the equipment at end-of-life. For example, portions of the cart, including the wheels, are removable allowing separation of potentially radionuclide contaminated parts from those that are not contaminated (or easily decontaminated), minimizing the volume of radioactive waste. The reuse of the pump and cart used previously for floor sludge sampling will also lead to a minimum of materials from the overall characterization program going through waste handling.

5.0 OPERATION

The sequence of normal operation of the system is summarized in Figure 10.

The basin location and canister to be sampled will be selected by the SAP. The ability to perform sampling at the selected location will be verified by observation of the physical state of basin obstructions in the pool, at the grating, and overhead above the sample site. The condition of the fuel elements and ability to reach to the bottom of the canister with the extraction nozzle will also be reviewed. Depth of the sludge at the location will be obtained if possible from observation, ultrasound, or boroscope. The sampling pump cart and supporting equipment will be moved to the location and connected to required electrical power and water sources.

Following the preparation and securing of the sample equipment at the location of the storage canister to be sampled the extraction tube and nozzle will be backflushed, if this has not been previously done, to clean out any residue materials (sludge) from prior sludge sampling. A uniquely numbered sample container will be loaded into the sample container support pole assembly. This container will have been sealed prior to entering the basin water and contain only air at one atmosphere pressure. The sample container control rod assembly will be moved into position over the sample container and the quick-disconnects engaged/connected to the inlet and outlet ports on the lid of the sample container.

The fuel storage canister barrel to be sampled along with the canister location in the basin will be recorded in a log book along with the sample container number. The position of the backflush valves will be verified as returned to the "sampling position" (i.e., backflush valve (V3) closed and isolation valve (V2) open). The inlet port isolation valve (V4) on the sample container lid will be opened.

Video cameras will be used and positioned to monitor the extraction nozzle location at the canister barrel and to provide a view of the clear vinyl tubing connected to the extraction tube (to confirm that the sludge sample material is being recovered correctly). Another camera will monitor the safety delay container to confirm its status (i.e., confirm no water present at start and the need to stop pumping if water/sludge appears).

The peristaltic pump will be started and the sampling system evacuated to the point the pump indicator shows no more flow of air being drawn from the sample container. In preparation for sampling the canister barrel the extraction nozzle will be lowered to just above the surface of the sludge as indicated by ultrasound measurements made previously (marks on related tubing will be used for reference). An alternative is to gently probe for sludge with the extraction nozzle to establish by "feel" the approximate depth of sludge present (e.g., where resistance is felt).

Sampling of the canister barrel will follow. The sample system fills the sample container (about 10 liters) with the water and sludge picked-up at the nozzle. Once this capacity is reached the check valve stops the flow and sampling is complete. There are approximately 60 seconds of actual sample extraction time which is controlled by the ball valve. The sampling will begin with the extraction nozzle being lowered down the cusps between the fuel elements and the canister barrel; the ball valve actuation handle will be squeezed to initiate sludge extraction when sludge is encountered. The sludge to the bottom of the barrel in each cusp location will be recovered so a representative sample is obtained. The status of the sludge will be monitored through the resistance of the nozzle as it is worked through the sludge to the bottom of the canister barrel and the presence of sludge materials visible in the transparent reinforced vinyl tube leading to the sample container from the extraction nozzle. Marks may be used on the extraction tube to indicate the depth of the tube and nozzle compared to the depth of the barrel. The nozzle should be moved from cusp to cusp; closing the ball valve as the nozzle is moved, as needed to obtain a complete sample. If little sludge is encountered it may be an option from the SAP to sample more than one canister barrel into a single sample container.

Once the sample container is full, sampling will stop because of the check valve in the sample containers. The operator will close the extraction tube valve (V1) and then stop the pump and release the vacuum in the system. The lid inlet port isolation valve (V4) will be closed. The quick-disconnects will be disengaged and removed from the sample container inlet and outlet ports on the sample container lid. The vent valve (V5) will be opened to fill the sample container completely with water. Chain-of-custody (COC) forms will be filled-out following sampling, documenting the required information to maintain required sample tracking.

A "stiff back" will be used to grapple the sample container bail and move the container out of the sample container support pole assembly and move it to the location in the Basin where the containers will be stored and checked for hydrogen. At all times during the movement of the container the sample container will remain at least 10 feet under the surface of the Basin water.

Once in the storage location the hydrogen monitoring cover will be installed after opening (with a special tool) the small valve (V5) on the container lid provided for this purpose. After monitoring the sample container will be ready and can be transferred to the Chem-Nuclear or equivalent cask, along with other fuel and sludge samples. The cask will be secured, cleaned, and transported to the 327 Building (or other selected facility) to initiate sample handling for the analyses required.

The backflush system will be used, as noted in Section 4.0, to (1) rinse the extraction nozzle and tubes for reuse and (2) help clear the extraction tube/nozzle of blockages. For rinsing (see Figure 11); the backflush water supply will be activated, the valve (V2) on the backflush "Y" connecting the extraction tube to sample container will be closed, the extraction tube will be raised to clear the canister sludge, the valve (V3) between the backflush and extraction tube will be opened and the extraction tube backflushed with clean demineralized water for at least 30 seconds. Once rinsing is complete the valve (V3) between the extraction tube and backflush water supply will be closed, the backflush equipment secured, extraction tube valve (V1) will be closed, and the next step in sampling begun.

After the sample container is removed from the sample container support pole assembly, the sampling equipment will be relocated to where the next sample will be taken and the sampling process repeated until all the required samples are taken.

With respect to waste generated during sampling: It is expected that only one set of tubing and valves will be used in a sampling campaign. A new sample container will be used for each sample and shipped to the laboratories who will dispose of it.

The application of this sludge sampler as part of the near-term fuel and sludge sampling campaigns in the K East and K West Basins is discussed in Reference 14.

6.0 SYSTEM LIMITATIONS, CASUALTY EVENTS AND RESPONSE TO EVENTS

6.1 MINOR OFF-NORMAL EVENTS

The following events are considered likely to happen in the course of sampling. The general response to the event is discussed:

Plugging of the Sludge Sample Extraction Tube
Response: Dislodge the plug of sludge by either (1) stopping and restarting the pump and pickup action while opening and closing the control valve (V1), or (2) using the backflush capability of the system (see Section 5.0). If the latter option is used the extraction tube should be raised to avoid washing sludge out of canister barrel. If this action does not clear the extraction tube and nozzle the components will be replaced with new pieces and the old components discarded or recovered at a later time.

Lack of Pickup of Sludge Material
If probing with the extraction nozzle and the attempted recovery of a sludge sample yields no sludge material during initial retrieval and it is confirmed the behavior is not due to plugging (see prior paragraph); the Test Engineer will decide either to (1) move the sampling to an adjacent pre-selected canister barrel, (2) unload the sample container and move to a different location and barrel for sampling, or (3) abort the sampling with this partially filled sample container.

6.2 SIGNIFICANT OFF-NORMAL EVENT

The following events are considered very unlikely to occur in the course of sampling, however, the potential impact (e.g., ALARA exposure, spills, etc.) of such events are significant enough that the course of action for the staff has been reviewed:

Pump Stoppage
Response: Assess time needed to repair or replace. If short, repair or replace immediately. The PIC and Test Engineer will determine if the sample attempted should be aborted with residual vacuum, or held. If the problem will take significant time to resolve; evaluate from ALARA standpoint and stop sampling activity until repaired. The PIC and Test Engineer will determine the condition sampling area will be left in. A spare pump will be available as a spare part for the sampling system.

Electrical Power Loss
Response: Switch off pump. Put equipment in "standby" mode (i.e., power switch off, power disconnected, etc.) and under direction of PIC and Test Engineer leave area until power is restored.

<u>Radiation Monitoring Instrumentation Failure</u>
Response: Sampling should be stopped and not resumed until PIC and Test Engineer are satisfied monitoring of critical areas in sampler sequence can be performed.

<u>Evacuation of Facility</u>
Response: Sampling or preparations for sampling must be stopped as soon as the evacuation alarm sounds (e.g., "ah-ooh-gah") and the area evacuated. The equipment should be left with power disconnected. Any off-normal condition of the equipment must be communicated by the PIC to the shift or facility managers or other responsible staff, so the condition is clear to staff restarting the activity after the evacuation.

<u>Spills and Leakage of Sample or Water</u>
Response: Any spills or leaks will be evaluated by PIC and handled consistent with normal Basin practices (as appropriate the shift and facility managers will be involved in the evaluation). Since the collection system is under vacuum in all but the backflush mode no significant leaks are expected during collection of samples.

<u>Failure or Partial Failure of Sample Container Check Valve</u>
Response: A float check valve (VC1), Section 4.0, is designed to normally, shut-off flow of any water out of the sample container toward the pump. Should this fail to seat for some reason basin water, and perhaps sludge, will be drawn into the safety delay container. A video camera will be providing a dedicated operator the status of fluid in the safety delay container. This operator will use the pump control box to stop the pump and sampling as soon as water or sludge is noted in the container. The safety delay container also has a backup check valve.) The PIC and test engineer will evaluate the situation for either leaving the area or following the procedure to clear the safety delay container and secure the sample container. Dose rate should be monitored during this event to confirm acceptable levels. No further attempts to sample should be made until the safety delay container is emptied.

<u>Failure of Video Camera Monitoring Safety Delay Container</u>
If the video camera used to monitor the status of the Safety Delay Container fails to operate correctly sampling should not proceed. The PIC and Test Engineer will evaluate the situation providing actions to be taken until camera is functional.

7.0 MAINTENANCE

As required a general maintenance document will be prepared for the system indicating any periodic maintenance needs (e.g., pump tube replacement, etc.), spare parts list (e.g., drawings, specifications, etc.), and any unique procedures required in the course of storing or preparing equipment for use after storage.

8.0 REFERENCES

1. Letter G. E. Culley (WHC) to C. A. Hansen (RL), "K Basin Sludge Disposition Strategy," WHC-9552284, April 24, 1995, Westinghouse Hanford Company, Richland, Washington.

2. R. B. Baker, "Summary Status of K Basins Sludge Characterization," WHC-SD-SNF-TI-006, dated January 1995, Westinghouse Hanford Company, Richland, Washington.

3. B. J. Makenas, et al., "Data Quality Objectives for K East Basins Sludge Sampling," WHC-SD-SNF-DQ-008, DRAFT, Westinghouse Hanford Company, Richland, Washington.

4. T. L. Welsh, et al., "Sampling Analysis Plan for K East Basins Canister Sludge," WHC-SD-SNF-PLN-XXX, DRAFT, Westinghouse Hanford Company, Richland, Washington.

5. "K Basins Project Review Process," K Basin Procedure 7-003-00, Draft January 9, 1996, Westinghouse Hanford Company, Richland, Washington.

6. Letter, D. W. Siddoway (WHC) to C. A. Hansen (RL), "K Basin Path Forward Action Items," WHC 9551459, March 15, 1995, Westinghouse Hanford Company, Richland, Washington.

7. Memorandum of Agreement on Path Forward for K Basin SNF, dated February 14, 1995, Westinghouse Hanford Company, Richland, Washington.

8. Letter, J. C. Fulton (WHC) to R. A. Holten (RL), "K Basin Sludge Classification Recommendation," WHC 9550053, January 6, 1995, Westinghouse Hanford Company, Richland, Washington.

9. Letter, C. A. Hansen (RL) to A. L. Trego (WHC), "Concurrence on K Basin Sludge Classification," dated March 15, 1995, Westinghouse Hanford Company, Richland, Washington.

10. SNF Project Integrated Schedule, Westinghouse Hanford Company, Richland, Washington.

11. R. B. Baker, "System Design Description for Sampling Fuel in K Basins," WHC-SD-SNF-SDD-003, June 1995, Westinghouse Hanford Company, Richland, Washington.

12. UNC Internal Memo, T. D. Blankenship to A. E. DeMers, "Radionuclides Concentration in the K East Basin Seg. Pit Sludge," dated July 1986.

13. L. A. Lawrence and S. C. Marschman, "Plan for Characterization of K Basin Spent Nuclear Fuel and Sludge," WHC-SD-PLN-007, June 1995, Westinghouse Hanford Company, Richland, Washington.

14. F. J. Mollerus, "System Design Description for Sampling Equipment for K Basin Spent Nuclear Fuel," WHC-SD-SNF-SDD-005, January 1996, Westinghouse Hanford Company, Richland, Washington.

Table 1. Summary of K Basin Floor Sludge Characteristics.

Typical Characteristics of Dissolved K East Sludge from Historic Samples

	Range or Type
• Particle size distribution - Median of volume distribution (μ) - 90% of volume (μ)	 32 to 44 4 to 120
• Settling times (second)	Not determined
• Particle shape	Not determined
• Density - Settled-with water (g/mℓ) - Particle density-dried (g/mℓ)	 1.13 to 1.54 3.0 to 3.3
• Percent solids	17.5 to 52.6
• Percent nondissolvable solids*	25 to 94
• Chemical composition of dissolvable portions	Fe>U>Al>Ca>Si>Cr>Zn>Mg
• Fissile content - U (%) - Pu	 3.5 to 10.9 (~1/400 of U) (?)
• Radiation level (mR/hr/g of ß/γ)	3.3 to 11.4

*Methods used did not dissolve silica (e.g., sand), this material likely composed bulk of undissolved material.

Table 2. Documents Supporting Design and Application of K Basin Canister Sludge Sampler.

Name of Document	Author	Accepting Organizations
1. Cold Feature Test Plan	SNFE	
2. Cold Acceptance Test Plan	SNFE	
3. Drawings	SNFE	
4. Preliminary Design Review Report	SNFE	KR-0, KR-1, KR-2
5. Final Design Review Report	SNFE	KR-3
6. Final Design Package for Equipment	SNFE	
7. Training Plan	K Basin/SNFE	
8. K Basin Operating Procedures	K Basin/SNFE	
9. Master Work Plan	K Basin/SNFE	
10. Data Quality Objectives	SNFE	
11. Sample Analysis Plan	SNFE	
12. LOI Hot Laboratory	SNFE	
13. LOI Mobile Laboratory	SNFE	
14. System Design Description SNFP Need Function and Requirements General Work Plan Design Description	SNFE	KR-0, KR-2
15. QA Plan	QA/SNFE	
16. Waste Management Plan	K Basin	
17. ALARA Assessment	K Basin	
18. USQ/Hazard Categorization	K Basin	
19. Readiness Assessment Checklist	K Basin/SNFE	
20. Job Safety Analysis	K Basin/SNFE	
21. Transportation Plan	SNFE/Pak	
22. Cask SARP Mod (as Needed)	Pak/SNFE	
23. Report Results	SNFE	

SNFE: Characterization group Spent Nuclear Fuel Evaluations
KR-0, KR-1, KR-3: K Basin Review Bodies
POC: K Basin Point of Contact
RL: Richland Operations DOE
ES: Engineering Support group
K Basin: K Basin Operations staff
Pak: Packaging and transport group
QA: Quality Assurance group
TBD: To Be Determined

Table 3. List of Primary Responsibilities.

	Organization	Staff-Lead/Support
Cognizant Manager for Characterization	SNFE*	R.P. Omberg
SNFP Data Needs	ES*	K.L. Pearce (C. Alderman)
Characterization Program Interface, Integration, and Data Requirements	SNFE/ES	R.B. Baker/K.L. Pearce
Data Quality Objectives	SNFE	B.J. Makenas
Sampling Analysis Plan	SNFE	T.L. Welsh/R.B. Baker, B.J. Makenas, K.L. Pearce
Design Engineering of Equipment	SNFE	A.E. Bridges/P.J. MacFarlan
Design and Application Interface Between K Basin and Characterization Group	SNFE (Characterization) K Basin (POC)	D.W. Bergmann C.D. Kirk
Work Plan and Procedures	K Basin SNFE	J.A. Serles
K Basin Standards and Requirements	K Basin	R.G. Gant
K Basin Safety	SNFP	D.O. Hess
Transportation of Samples	SNFE/Pak*	S.A. Chastain/S. Crow

*SNFE--Spent Nuclear Fuel Evaluations group.
ES--Engineering Support group.
Pak--Packaging and Transport group.
SNFP--Spent Nuclear Fuel Project.

Table 4. Primary Design Features of Canister Sampler to Meet Functions and Requirements.

1. Sampling system extracts representative sample of sludge from canister placing it in container for shipment to Laboratory. Thus, the sampling system, when applied as described provides the capability to sample the greatest number of locations with representative sampling of materials present.

2. The nozzle used has a demonstrated ability to pick-up sludge materials including heavy fines comparable to fuel material. Its design precludes recovery of particles with diameters over 0.25 inch.

3. Peristaltic pump is used to vacuum sample into sample container. This minimizes particles interfacing with mechanical action (e.g., filters, pump impellers, etc).

4. Backflush capability allows reuse of extraction tubing and nozzle allowing reuse of components without sample cross-contamination, which supporting ALARA (operator activities minimized versus replacement of parts) and waste minimization.

5. ALARA-Shielding, Time and Distance

   Sample is maintained under 10 feet of water similar to fuel.

   HEPA filters are used on pump.

   The vacuum system used for motivation of the sample minimizes the risk of leaks to operators versus a pressurized system.

   The safety delay container and check valves provide a triple guard against material coming to grating level.

   All sample handling at basins is minimized, with hot cells at laboratories doing all decanting, etc.

   Emphasis is placed on cold training and low exposure dry runs in K West to assure efficiency minimizing time spent in K East radiation field, etc.

Figure 1. Overview of K Basin Sludge and Path Forward.

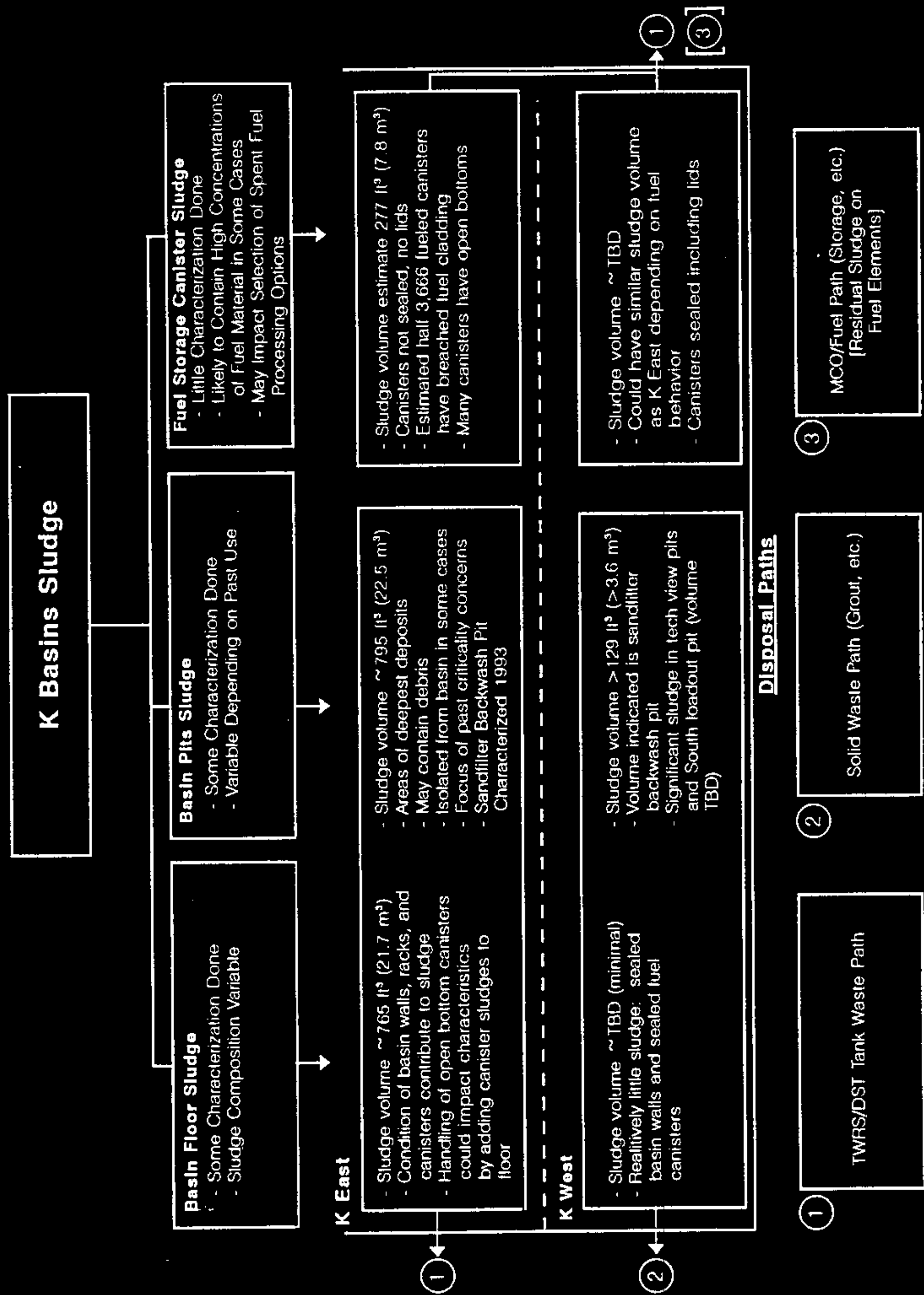


Figure 2. General Design Process to be Used to Develop K Basin Canister Sludge Sampler.

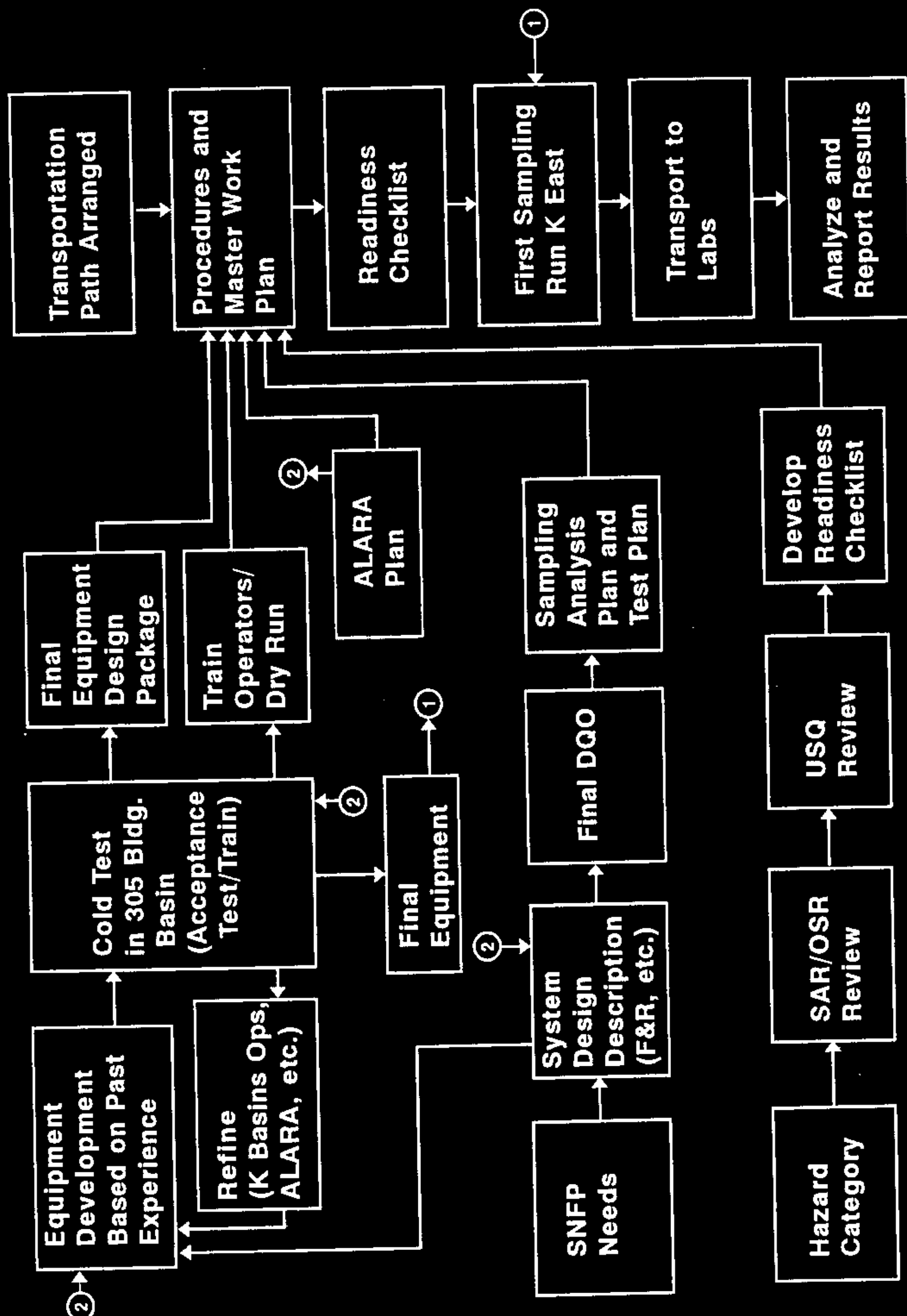


Figure 3. Proposed K Basin Plant Reviews of Canister Sludge Sampler Development and Application.

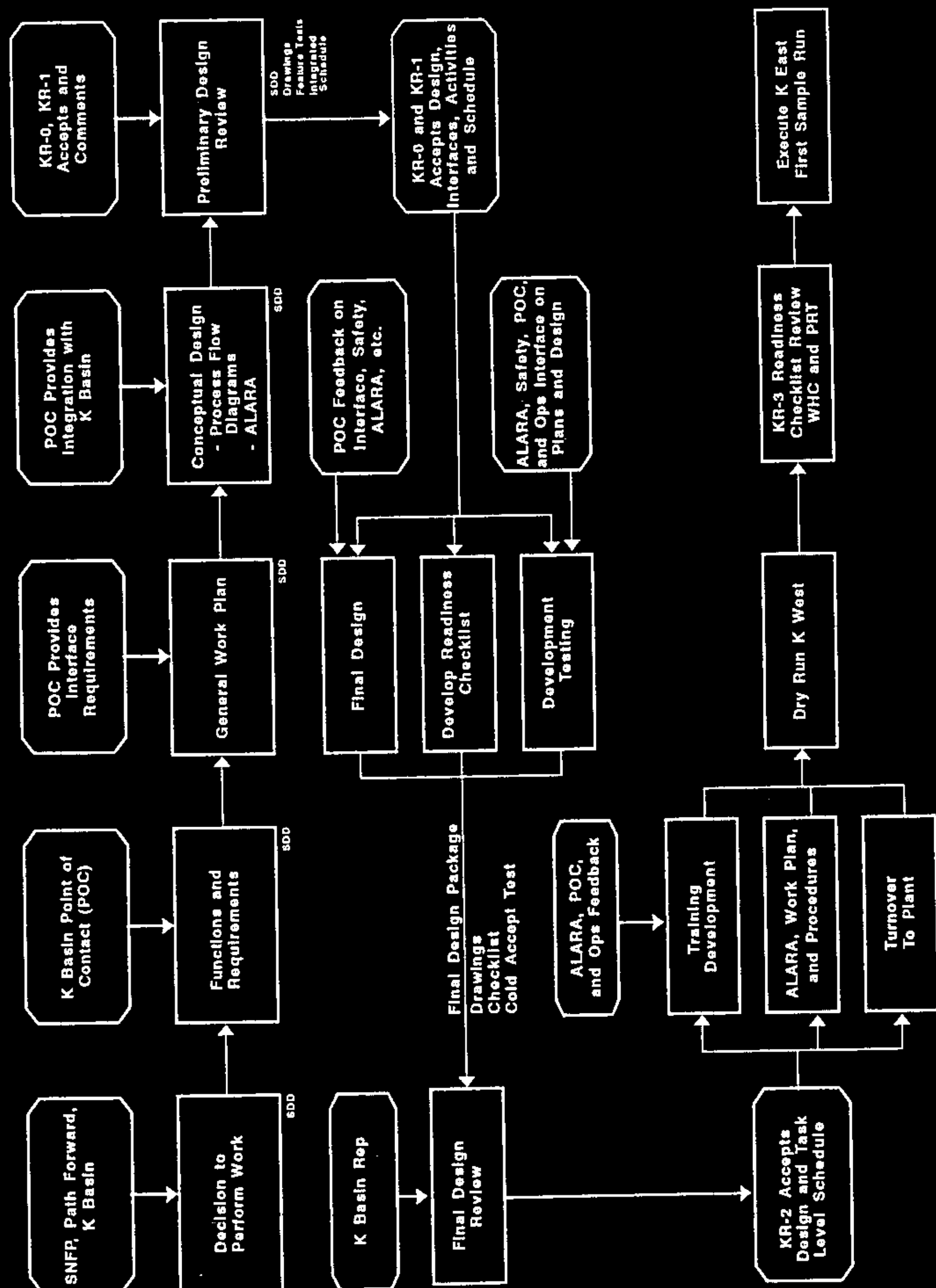


Figure 4. Work Breakdown for Development and Initial Application of K Basin Canister Sludge Sampler.

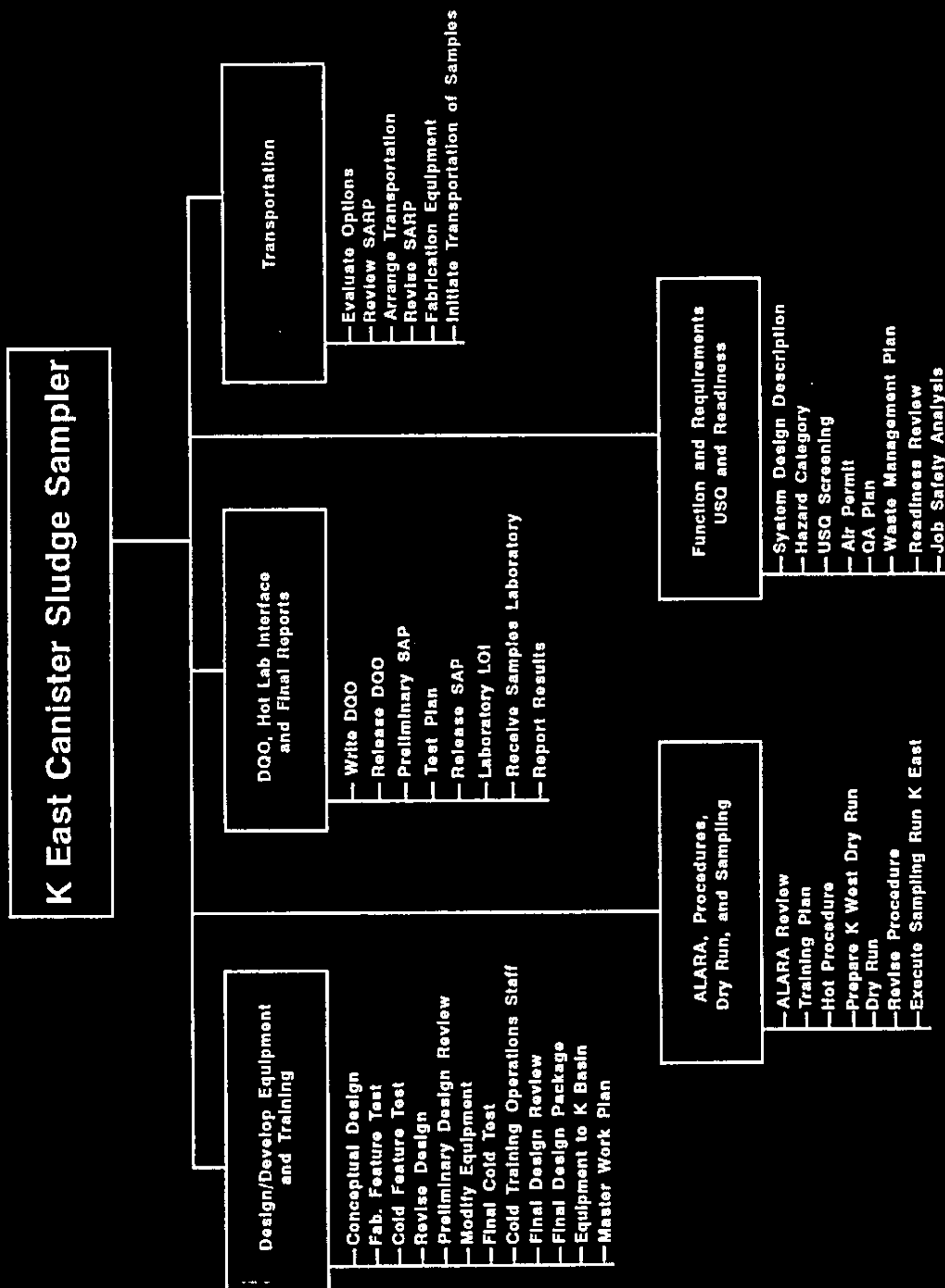


Figure 5. Schematic of Canister Sludge Sampler.

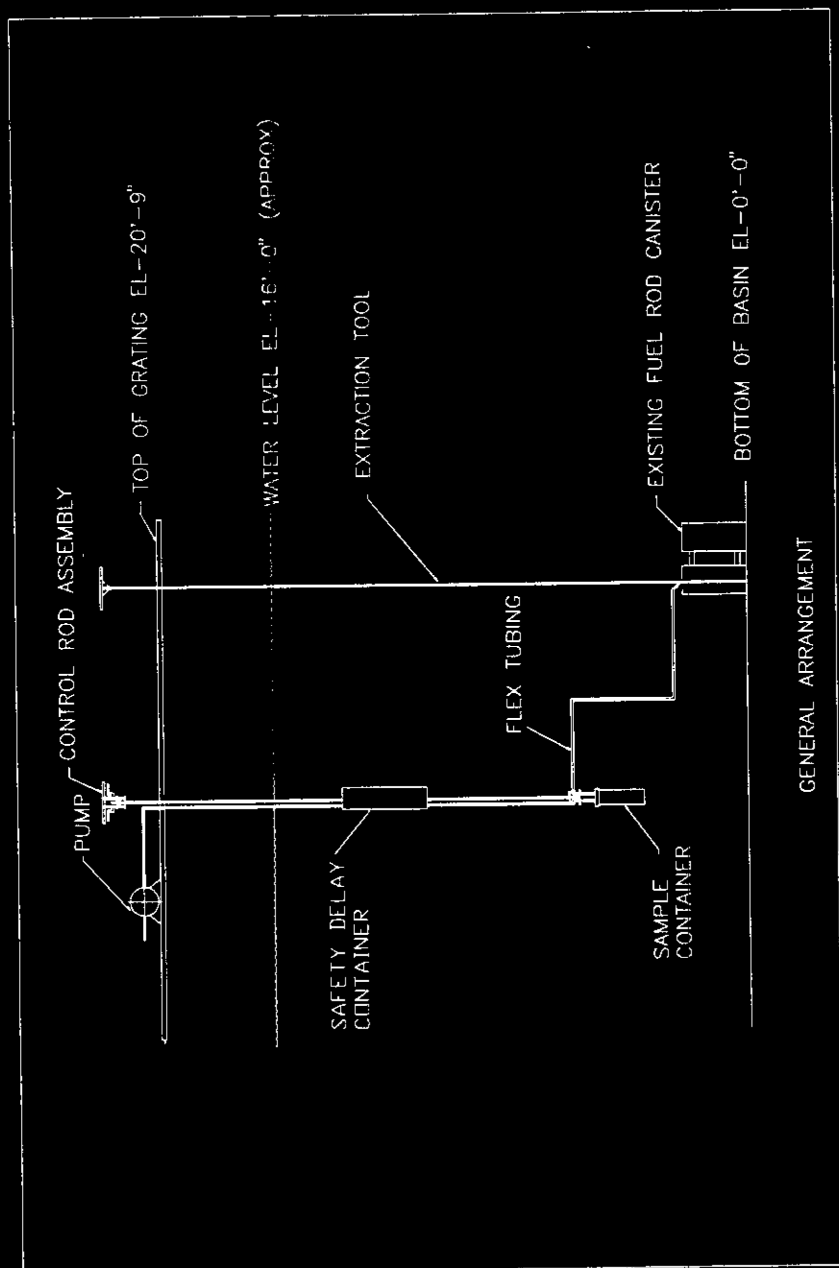


Figure 6. Overview of Features of Canister Sludge Sampler.

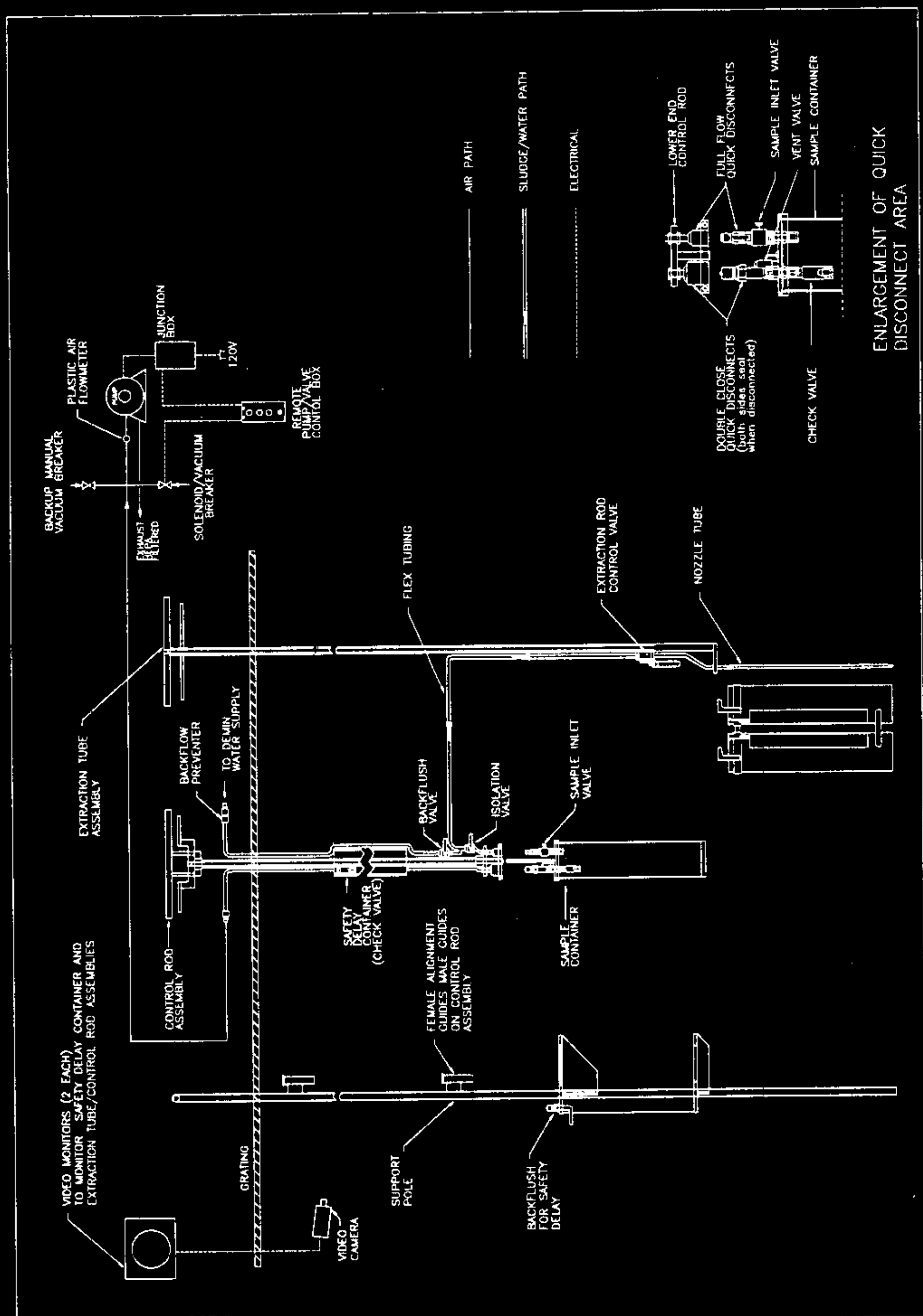


Figure 7. Extraction Tube Nozzle Detail.

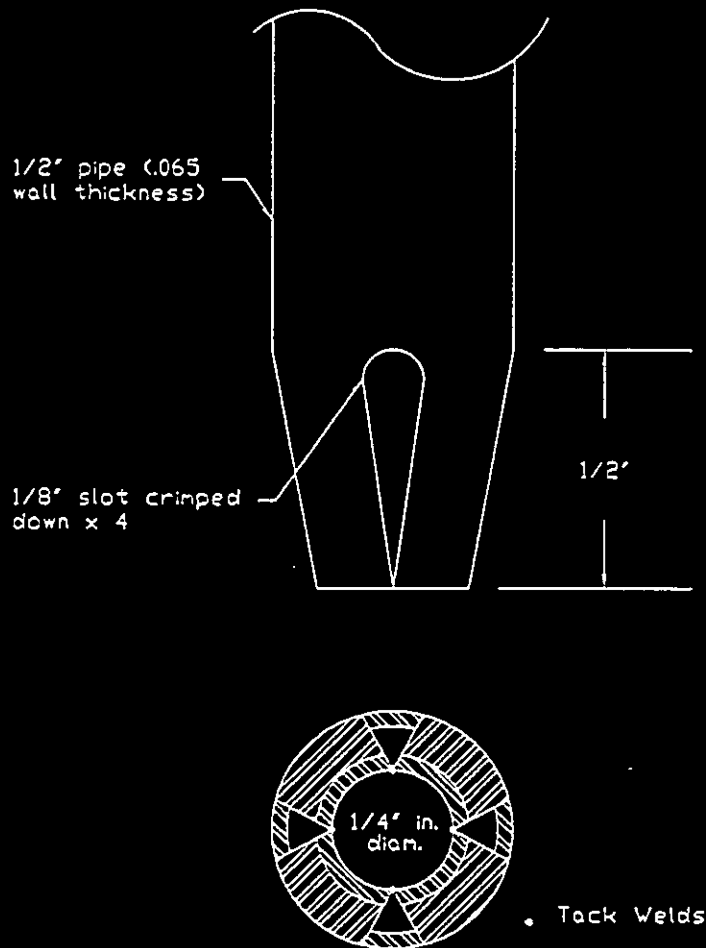


Figure 8. Sample Container.

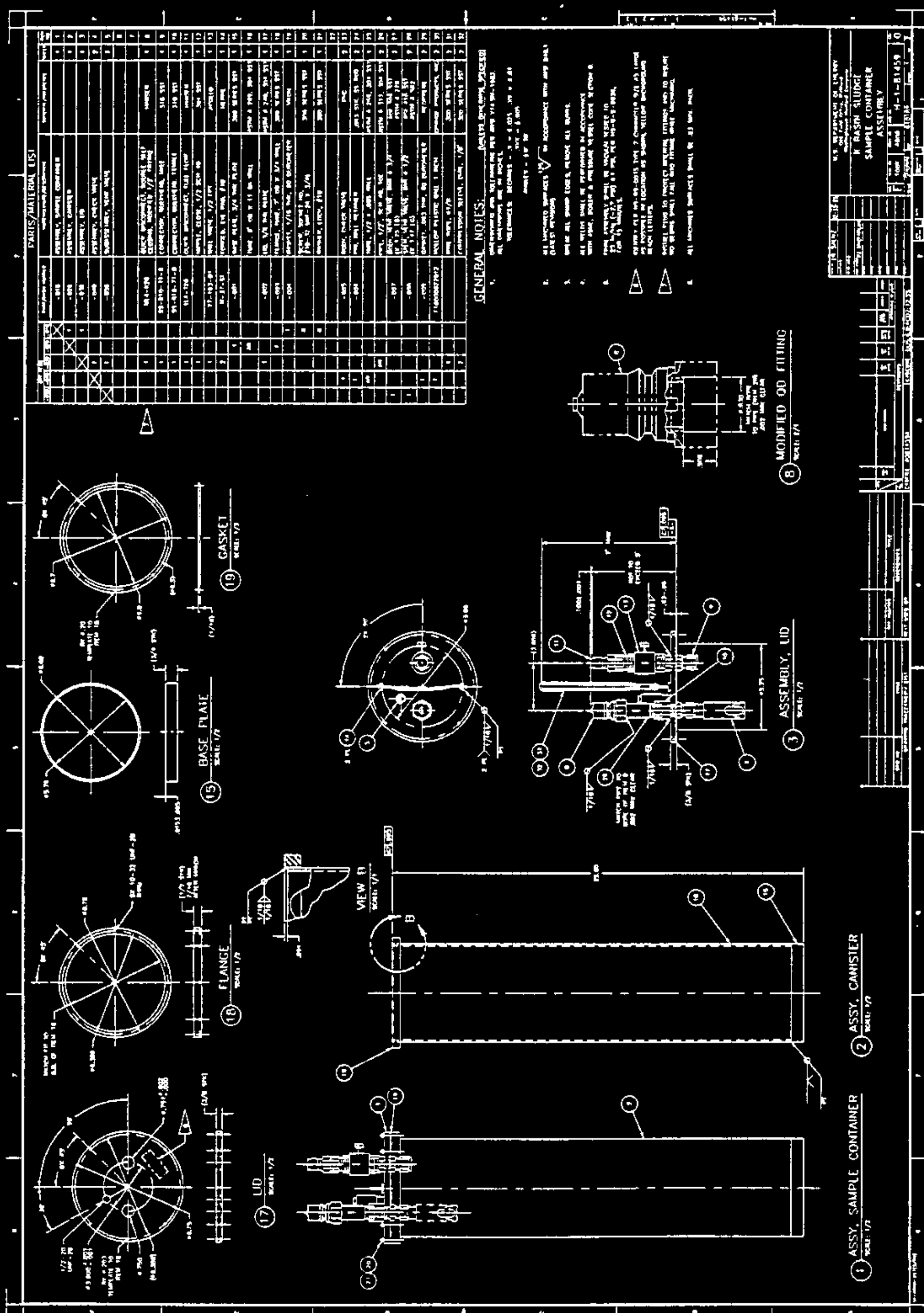


Figure 9. Sample Container Support Pole, Control Rod Assemblies, and Sample Container.

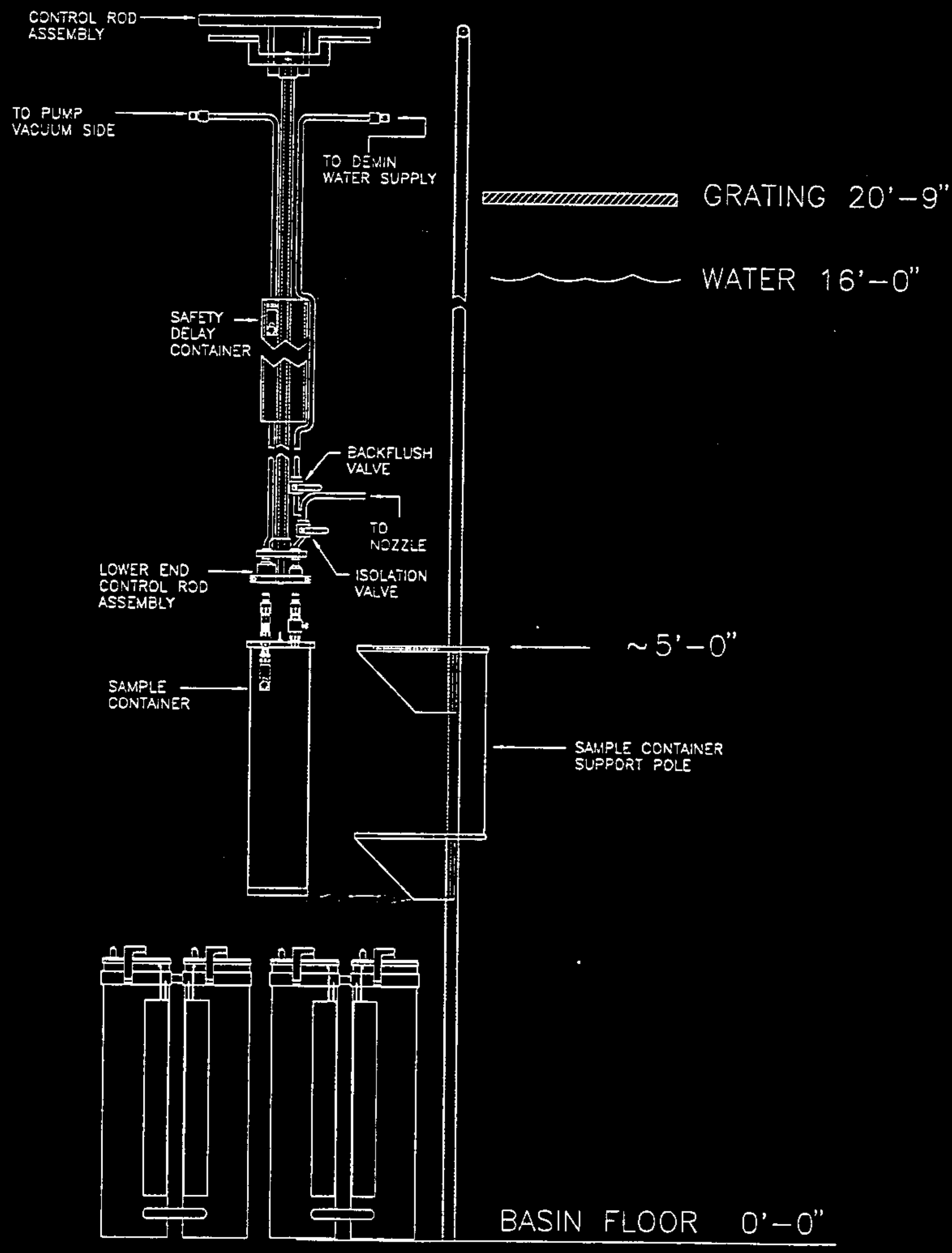


Figure 10. Process Flow for Application of Canister Sludge Sampler.

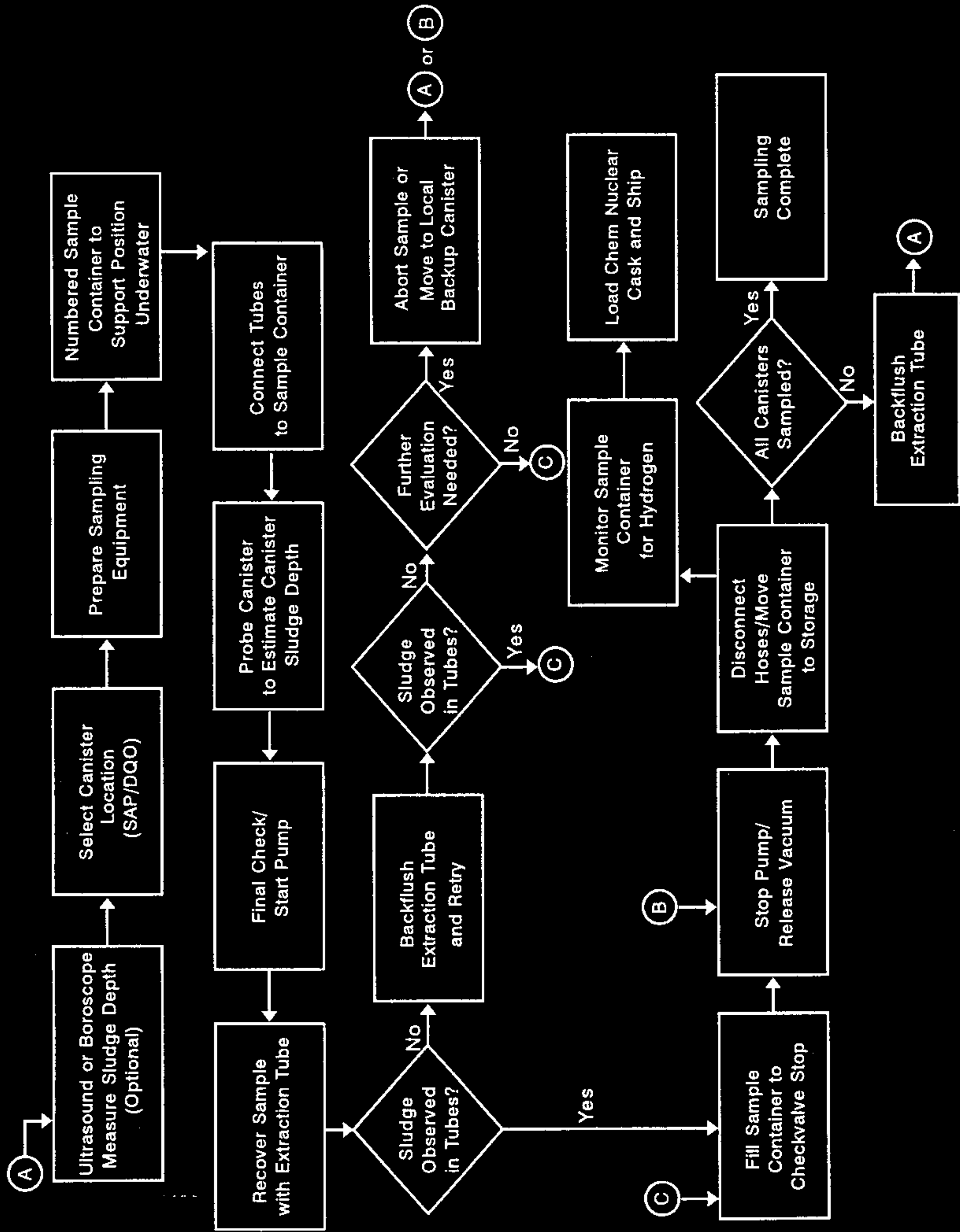
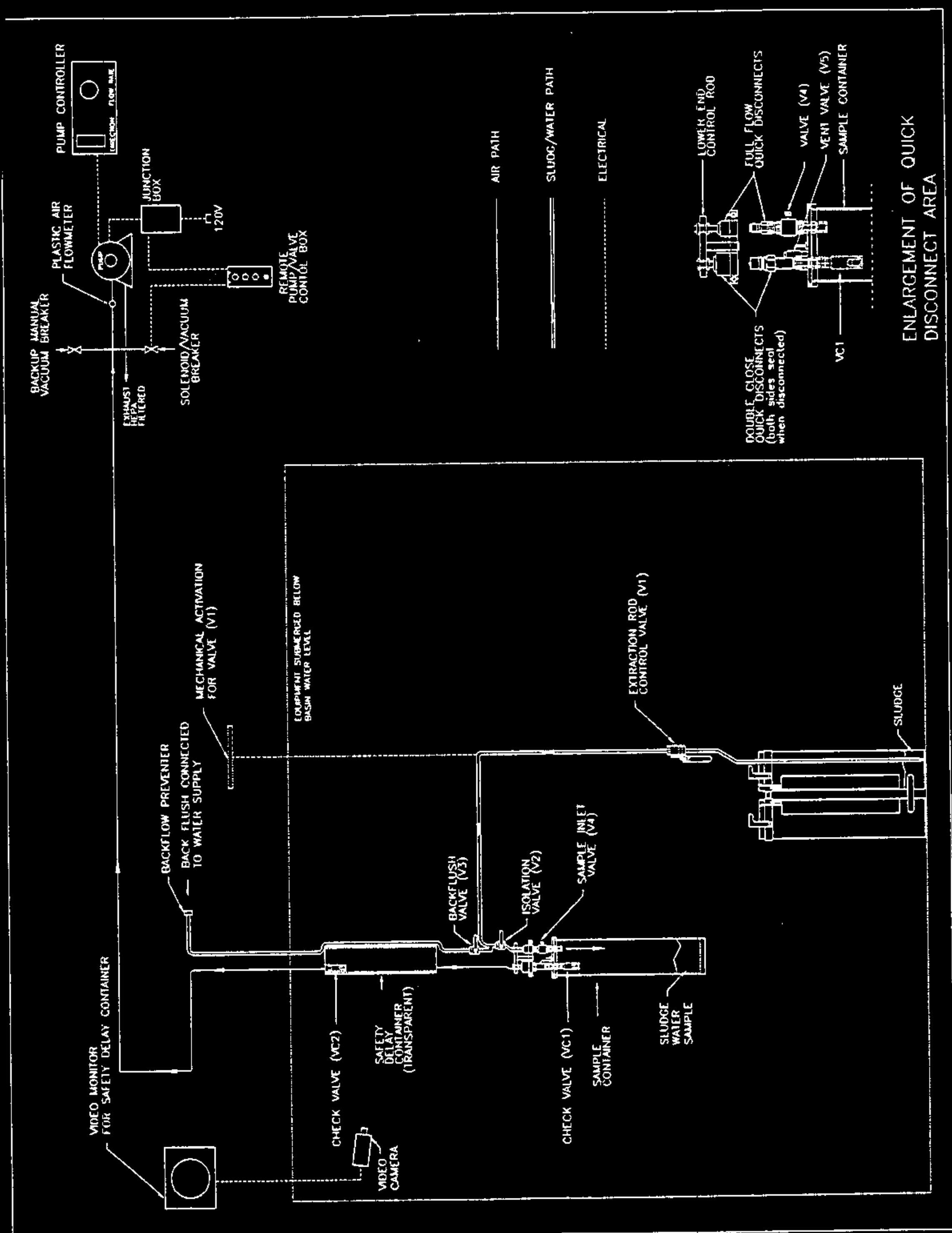


Figure 11. Schematic Process Flow Diagram for Canister Sludge Sampler.



APPENDIX A

SUMMARY REQUIREMENTS FOR K BASIN CANISTER SLUDGE CHARACTERIZATION

APPENDIX A

SUMMARY REQUIREMENTS FOR K BASIN CANISTER SLUDGE CHARACTERIZATION

The Data Quality Objectives (DQO) document, being developed, will provide the data and basis to be addressed in the K East and K West Basins canister sludge sampling. It will also provide the confidence level and analyses requirements to address the objectives. The Sampling Analysis Plan (SAP), being developed, will then address the number and locations of samples to meet the confidence levels required of the sampling. It will also address the specific analyses required from the laboratories for the first sampling run, and the logic to follow related to the need for future sampling--once analyses of the scoping samples are available. The SAP will also address potential limitations of the first sampling run (i.e., obstructions, etc.) and their impact.

Table A1 provides a summary overview of the parameters being sought from the first scoping samples.

Table A1. Summary Data Needs Related to Sampling of K Basin Canister Sludge.

K East Basin Canister Sludge SNFP Data Needs	Reference
General data needs	*
Accountability and criticality	
Data needs for process equipment design/simulants	
Particle size distribution	A2, A3
Rheology (over range of solids loading)	A3
Solid density (wet and dry)	A3
Carrier density	A3
Particle settling rates (over range of loading)	A3
Chemical analysis	A3
Shielding (dose)	
Hydrogen generation potential (?)	
Pyrophoricity/reactivity	
Data needs for transport from Basin area to TWRS	
Dose rate	A1
Source term	
Data needs for TWRS tank acceptance criteria	A1
TWRS waste stream profile sheet	
Pumping criteria, etc.	
Pyrophoricity/reactivity	
Data needs for rack paint chips	A4
Mass/volume in Basin and in Weasel Pit	
% spalled off	
Thickness	
Size distribution of flakes	
Chemical constituents (as applicable)	
Radionuclide content	
Data needs for fuel element processing	A5
Drying behavior of sludge	
Properties related to sludge removal	

*General requirement from K Basin and receiving facility.

References

A1. Memo, K. D. Fowler to C. J. Alderman, "K Basin Sludge to TWRS: Transfer Feasibility," January 25, 1995. Attachment: TWRS Waste Stream Profile Sheet dated January 12, 1995, Westinghouse Hanford Company, Richland, Washington.

A2. DSI, Craig Gates (PNL) to Leon Feigenbutz (WHC), "Key Physical Properties with Respect to the Removal of 105-K East Basin Sediment Sludge," October 22, 1994, Westinghouse Hanford Company, Richland, Washington.

A3. Report, "K East Basin Sludge Retrieval and Packaging Characterization Requirements," BNFL Inc., Document No. 2061.015.003, dated December 16, 1994.

A4. Personal Communication, L. M. McWethy, March 1995, Westinghouse Hanford Company, Richland, Washington.

A5. B. J. Makenas, "Data Quality Objectives for K East and K West Basins Canister Sludge," WHC-SD-SNF-PLN-008, Draft, Westinghouse Hanford Company, Richland, Washington.

DISTRIBUTION SHEET

To	From	Page 1 of 2
Distribution	Spent Nuclear Fuel Evaluations 8M710	Date 01/29/96
Project Title/Work Order		EDT No. 610194
Spent Nuclear Fuel Project		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
<u>U.S. Department of Energy, Richland Field Office</u>					
O. M. Holgado	S7-41	X			
J. Shuen	S7-41	X			
G. D. Trenchard	S7-41	X			
<u>Pacific Northwest Laboratory</u>					
G. R. Golcar	P7-20	X			
K. L. Silvers	P7-27	X			
J. M. Seay	P8-24	X			
<u>Mac Technical Services Company</u>					
G. Baston	R3-82	X			
<u>Mollerus Engineering Corporation</u>					
F. Mollerus	H0-40	X			
<u>Westinghouse Hanford Company</u>					
C. J. Alderman	R3-48	X			
R. A. Anderson	X3-86	X			
R. B. Baker (5)	H0-40	X			
D. W. Bergmann (5)	R3-86	X			
A. E. Bridges	H0-40	X			
S. A. Brisbin	R3-48	X			
B. S. Carlisle	R3-85	X			
S. A. Chastain	H0-40	X			
W. H. Cloos	X3-72	X			
S. R. Crow	G1-11	X			
G. M. Davis	X3-80	X			
B. L. Debban	R3-85	X			
C. Defigh-Price	X3-79	X			
L. E. Ebbeson	X3-78	X			
K. D. Fowler	R2-11	X			
J. C. Fulton	R3-11				
J. R. Frederickson	R3-86	X			
R. G. Gant	X3-79	X			
E. W. Gerber	R3-86	X			
M. A. Green	X3-67	X			
R. A. Harris	H0-40	X			
D. O. Hess	X3-80	X			
D. W. Humphrys	X3-67	X			
J. J. Jernberg	X3-85	X			
C. D. Kirk	X3-86	X			
R. E. Lacey	X3-85	X			

DISTRIBUTION SHEET

To	From	Page 2 of 2
Distribution	Spent Nuclear Fuel Evaluations 8M710	Date 01/29/96
Project Title/Work Order		EDT No. 610194
Spent Nuclear Fuel Project		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
Westinghouse Hanford Company (continued)					
M. J. Langevin	X3-74	X			
L. A. Lawrence	H0-40	X			
S. S. Lewis	X3-60	X			
C. D. Lucas	X3-67	X			
P. J. MacFarlan	H0-40	X			
B. J. Makenas	H0-40	X			
J. D. Mathews	X3-61	X			
C. T. Miller	X3-72	X			
G. L. Miller	T6-06	X			
W. C. Mills	X3-79	X			
C. R. Miska	R3-86	X			
R. P. Omberg	R3-86	X			
T. R. Pauley	X3-85	X			
K. L. Pearce	R3-48	X			
A. L. Pitner	H0-40	X			
R. D. Prescott	H0-40	X			
T. J. Ruane	X3-65	X			
J. P. Schmidt	X3-78	X			
J. A. Serles	X3-86	X			
D. W. Siddoway	X3-71	X			
S. A. Slinn	X3-74	X			
C. A. Thompson	R3-85	X			
D. J. Trimble	H0-40	X			
G. S. Voyles	X3-85	X			
T. L. Welsh	T6-07	X			
J. D. Williams	X3-72	X			
Central Files (2)	A3-88	X			
K.A. Robert, SNF	R3-11	X			