RELEASE AUTHORIZATION

Document Number:	WHC-SD-SNF-AP-001
Document Title:	SEALED CANISTER LIQUID SAMPLING FOR FUEL CHARACTERIZATION SHIPMENTS
Release Date:	1/12/95

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

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SUPPORTING DOCUMENT

1. Total Pages 8 11

2. Title	3. Number	4. Rev No.
Sealed Canister Liquid Sampling for Fuel Characterization Shipments	WHC-SD-SNF-AP-001	0

5. Key Words	6. Author
K-West Basin, Fuel Storage Canister, N-Reactor Fuel, Liquid Sampling, Fuel Characterization	Name: D. J. Trimble Signature Organization/Charge Code 8D510/L2104

7. Abstract

The conceptual process for sampling the liquid in the sealed fuel storage canisters in the 105 KW Basin is described. The process includes taking the sample, sample analysis, sample disposition, and canister disposition for potential opening to remove a fuel sample.

8. RELEASE STAMP

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SEALED CANISTER LIQUID SAMPLING FOR FUEL CHARACTERIZATION SHIPMENTS

1.0 INTRODUCTION

N-Reactor spent fuel elements will be removed from the sealed fuel storage canisters in the KW Basin and shipped to the 300 Area hot cells for characterization studies. Some of the canisters contain broken fuel elements exposing metallic uranium to the canister water. The exposed uranium surfaces have reacted with the water releasing fission product nuclides to the canister water. The extent of this release is unknown, but large radionuclide inventories could cause significant releases to the basin water. To avoid this, a method is needed to evaluate the magnitude of the canister water radioactivity to help make decisions about which canisters should not be opened for fuel sampling.

2.0 OBJECTIVE AND SCOPE

The objective of this document is to provide a conceptual description of the process for obtaining and evaluating gas and liquid samples from KW fuel canisters in support of fuel characterization shipments. Also described are the decisions regarding the acceptability of a sample, the actions to be taken to obtain an acceptable sample, and the logic leading to decisions about opening canisters for fuel characterization sampling.

This document will help guide a safety analysis of the liquid sampling process and the development of detailed procedures for the process. Outside the scope of this document are the processes for opening canisters, selecting fuel samples from opened canisters, shipping fuel samples, and closing canisters.

3.0 SAMPLING EQUIPMENT

A sealed canister gas and liquid sampler will be capable of drawing a 10 to 15 ml sample through one of two needle valves on the canister lid. If the outside valve (off-center valve) is chosen, a gas sample will be taken assuming there is some gas space in the canister. If the center valve is used, a liquid sample will be acquired assuming the canister liquid extends above the end of the gas-space tube. The gas-space tube extends from the center valve opening 2.5 inches into the canister. If the water is below the gas-space tube level, only gas samples will result from the sampling process.

The sample vial is a 15 ml evacuated glass tube with a rubber stopper and is secured inside a steel sleeve to protect against breakage. At the time of drawing the sample, the vial will be located near the canister being sampled and at the bottom of the 22-foot long sampler. (Alternatively an 18-foot sampler will be used in conjunction with a table to elevate the canister.) The sampler interfaces with a canister valve by sealing on the valve outer surface with an O-ring. The valve is opened and a needle is injected through

the vial stopper connecting the vial to the open valve. A liquid or gas sample is drawn into the vial by virtue of pressure differences. After about 30 seconds, the valve is closed and the needle withdrawn. The sample vial is then returned to the top of the sampler and above the surface of the basin water via a screw device.

The sampling equipment will be operated from the basin grating about three feet above the grating. A gas actuated valve operates the needle, a hand operated device opens and closes the canister valve, and an air operated screw operates the sample transport system moving the vial from one end of the sampler to the other. The sample path between the canister valve and the sample vial can be flushed with clean water to mitigate cross contamination of samples.

4.0 PROCESS FLOW DESCRIPTION

A process flow diagram (PFD) for liquid sampling and analysis is provided in Attachment 1. Summary and detailed descriptions of the process follow. Description headings relate to activity titles in the PFD.

4.1 SUMMARY DESCRIPTION

A canister is selected, moved to the sampling station, and a sample drawn from the center valve of a barrel. If the sample is liquid it is analyzed for activity, the data is compared to a set of criteria and a decision is made about acceptability for opening the barrel for fuel sampling. If the sample is gas, the barrel is flooded, re-sampled, the sample analyzed, and the results evaluated. The second barrel is also sampled and evaluated as for the first.

The sampled canister is then moved to the transfer channel, returned to main basin storage, or staged in the weasel pit. Canister barrels with acceptable liquid activity may be processed in the transfer channel in accordance with fuel shipping procedures and prepared for return to storage in the main basin. Canister barrels with leaking valves or that have been flooded may require reestablishing encapsulation before being returned to main storage as specified by the K Basins Operations Safety Requirements (OSR), WHC-SD-WM-OSR-006.

4.2 SELECT CANISTER/MOVE TO WEASEL PIT

A canister selection plan will provide the list of canisters that are expected to contain fuel elements that can be selected for characterization. A canister selected from this list will be transported from its main storage basin location to the weasel pit using the current monorail system, canister hoists and canister-handling tools. The canister will be placed in the weasel pit sampling station for sampling (see Section 4.3). Up to three additional selected canisters can be staged in weasel pit racks.

4.3 TAKE SAMPLE FROM BARREL

A sample will be drawn from the center valve of the selected barrel. As the sample is transported to the basin water surface, dose rates will be monitored by an HPT. If sample dose rate exceeds handling criteria (>100 mR/hr at 30

cm), sample will be placed in an underwater storage container (see Section 4.11). If the sample dose rate is acceptable for handling, the sample vial will be removed from the sample holder using tongs. The sample vial surfaces will be rinsed in clean water to minimize basin water contamination on the sample vial, and the vial will be placed in a clean plastic bag in preparation for further handling (see Section 4.4). The second barrel of the canister will also be sampled as described in this section.

4.4 SAMPLE SCREENING

A low gamma dose rate sample (<100 mR/hr at contact) will be visually inspected to determine if it is liquid or gas. A slot in the sample vial sleeve will provide visual access to the glass vial contents. If the sample contains less than **tbd** cc liquid, it will be declared a non-liquid sample and the canister barrel will be flooded (see Section 4.8). If the sample is less than **tbd** cc liquid and <1 mR/hr at contact, it will be declared gas. If the sample contains >**tbd** cc liquid or has a high gamma dose rate (>100 mR/hr at contact cm), it will be declared a liquid sample. Liquid samples will be analyzed for activity (see Section 4.5). Gas and non-liquid samples will not be taken to the mobil lab for analysis but will be prepared for shipment (see Section 4.7). The liquid quantity indicated by **tbd** will be specified before initiating gas or liquid sampling.

Sample dose rate criteria are set based on acceptable radiological practice and the expectation that the sample will not exceed the activity and dose rate requirements for the shipping system planned for transporting the samples to 222S and 325 facility laboratories.

4.5 MOVE SAMPLE TO ANALYZER AND ANALYZE

Sample activity analysis will be performed using gamma spectrometry in a truck mounted mobil laboratory stationed in or near the 105KW building. The sample will be moved to the laboratory in accordance with an approved Radiation Work Procedure. The counting will determine Cs-137 activity in the sample (the primary gamma emitting nuclide expected) and will be done in accordance with an approved procedure. After analysis, samples will be prepared for shipment (see Section 4.7) and data will be evaluated (see Section 4.6).

4.6 EVALUATE ANALYSIS

The counting data will be evaluated against calibration information and analysis data to give an estimated total activation load for the liquid contents of the canister barrel. The activity will be compared to acceptance criteria established by analysis* and approved by K-Basin operation management to determine if the barrel should be opened for fuel sampling (see Section 4.10).

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*An analysis will provide the basis for the consequences of large activity releases to the KW Basin water from canisters opened in the transfer channel. This analysis will provide the basis for the sample acceptance criteria for opening a canisters in the transfer channel.

4.7 DISPOSITION SAMPLE

4.7.1 Move Sample to Transportation Package / Secure in Package

After a liquid sample analysis is completed or when a sample is identified as gas, the sample will be placed in an approved shipping package. In general, gas samples will be packaged separately from liquid samples. The shipping system for the liquid samples may differ from the one used for gas samples due to the lower expected activity of the gas samples. Liquid samples will require a Type A or Type B shipping package and gas samples will require a Limited Quantity or Type A shipping package. Criteria will be established to provide guidance for selecting the proper shipping package(s).

4.7.2 Package Contains Four Samples?

No more than four samples, gas and/or liquid, will be placed into a single shipping package. In addition, dose rate at 30 cm from the surface of the package will not be allowed to exceed 20 Mr/hr. Those packages containing four samples or which have reached the dose rate limit will be prepared for shipment (see Section **4.7.3**) or temporary storage (see Section **4.7.5**). Not more than one shipping package will be handled at any one time until they are secured in an approved shipping container (see Section **4.7.3**).

4.7.3 Place Shipping Package into Shipping Container

When the shipping package loading limit has been reached, the package will be moved to and placed in the appropriate shipping container (when available). Up to four packages may be loaded into a single shipping container if approved by the container documentation. Only one package will be handled at a time until secured in an approved shipping container.

4.7.4 Secure Shipping Container and Ship to Laboratory

When the allowed number of packages have been loaded into the shipping container, the container will be secured and prepared for shipment in accordance with K-Basin, Hanford, and the container SARP procedures and requirements. When all requirements have been meet, the loaded transportation system will be shipped. Liquid samples will be shipped to the 222S Laboratory at 200W Area. Gas samples will be shipped either to the 222S Laboratory at the 200W Area or to the 325 Building laboratory at the 300 Area.

4.7.5 Store Package in Designated Storage Location

When four samples have been secured in a package and the appropriate shipping container is not available, the package will be moved to a designated storage location. Shipping packages will be held at this location in accordance with approved radiological work procedures until a shipping container becomes available (see Section **4.7.3**). Shipping package types will be selected to assure that a high radiation area will not be created at the storage location.

4.8 FLOOD BARREL

If the canister barrel water level is below the lid stem (2.5" below the lid), it will not be possible to draw a liquid sample from the barrel lid center valve. In this case the barrel must be flooded to raise the liquid level and subsequently given sufficient time to allow the new barrel mixture to equilibrate before re-sampling. The barrel will be flooded by opening both lid valves 1/2 turn using the sampling equipment. With the valves open, the sampler will be removed from the barrel lid. When gas bubbles are no longer being emitted from the lid, the valves will be closed.

After flooding the canister barrel with basin water, sufficient time must be allowed to assure adequate mixing of the canister water and the basin water before a new sample is taken. It is expected that sufficient mixing will occur within 24 to 48 hours, but an engineering analysis will be completed to provide the basis for the length of time needed. The flooded canister will be set aside to allow time for mixing to occur.

4.9 RE-SAMPLE BARREL

A second sample will be drawn (see Section 4.3) from the center valve of a flooded and equilibrated barrel. If this sample is gas (see Section 4.4), the barrel will be judged to be unsatisfactory for fuel sampling (see Section 4.10). If the sample is liquid (see Section 4.4), it will be processed as previously described (see Sections 4.5 and 4.6) to determine canister barrel activity and acceptability for fuel sampling (see Section 4.10). All samples will be prepared for shipment (see Section 4.7).

4.10 DISPOSITION CANISTER

4.10.1 Move Canister to Transfer Channel

After liquid samples have been secured from both canister barrels (or flooding fails to produce liquid samples), the canister will be moved to the South Loadout Pit Transfer Channel for sampling and/or to reestablish encapsulation.

4.10.2 Open Canister for Fuel Element Sampling

Canister barrels with liquid samples indicating acceptable barrel liquid activity will be opened for fuel sampling. This activity will be governed by the appropriate procedure (not covered in this document). Barrels which have been opened will be closed and purged (see Section 4.10.3) before returning to storage (see Section 4.10.4).

4.10.3 Gas Purge Canister Barrel

Canister barrels which have been gas/liquid sampled may require encapsulation to be reestablished before returning the canister to main basin storage as specified by the OSR (see Section 4.10.4). If the gas purge indicates a lid seal/valve leak and the barrel liquid activity is acceptable, the lid may require replacement. If the liquid activity is too high, the lid will not be removed for replacement without further evaluation.

4.10.4 Return Canister to Storage

Canisters having both barrels with acceptable lid seals and gas purges will be returned to storage in the main basin.

Unopened canisters with unacceptable liquid activity levels which will not maintain a satisfactory gas purge may be returned to storage if allowed by the OSR. This action will require an OSR revision.

4.11 Disposition Very High Dose Rate Sample

Samples with dose rates too high for processing into transportation packages will be placed in an underwater storage container in the weasel pit and held for dispositioning at a later time.

5.0 ATTACHMENTS

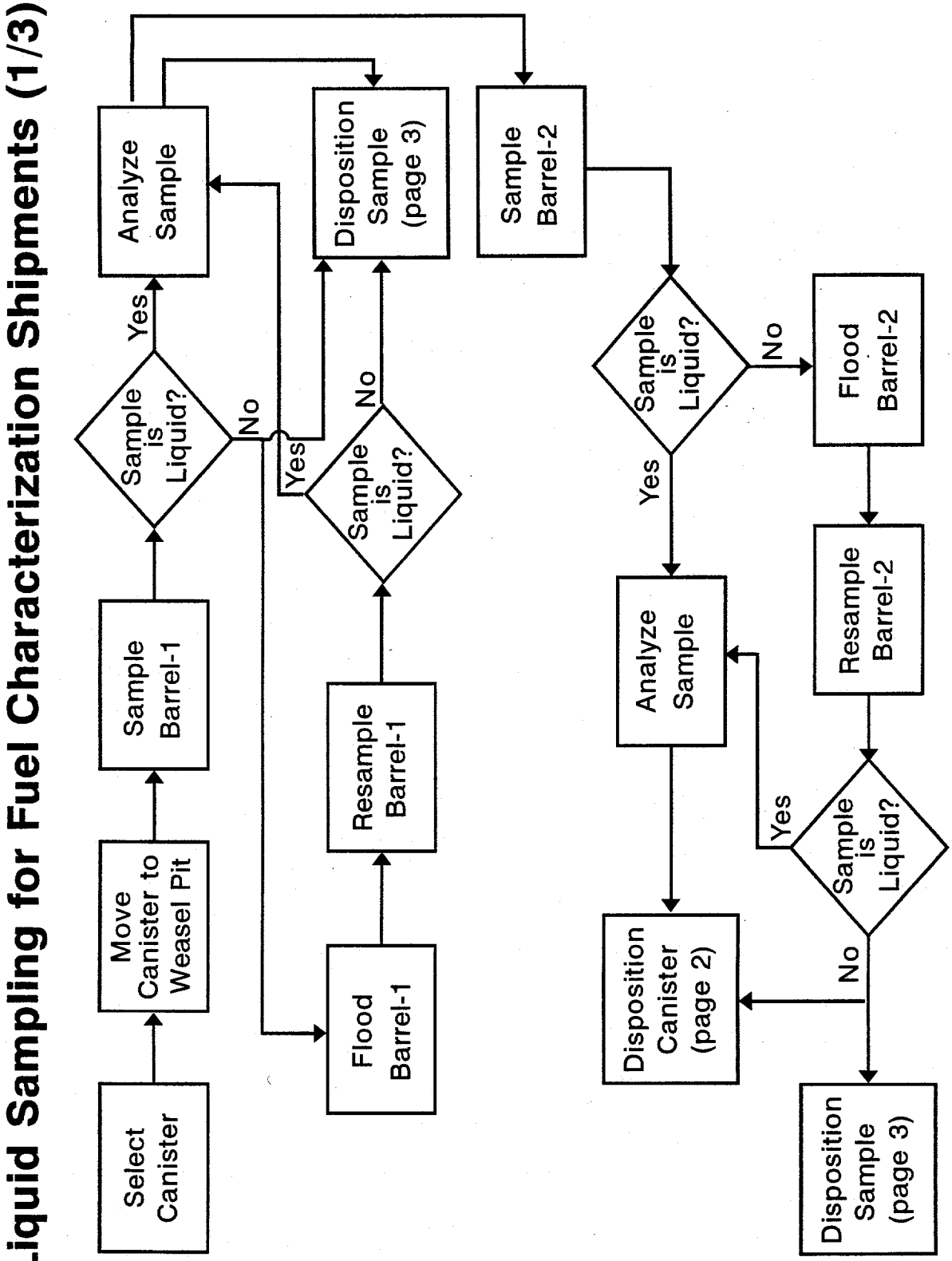
Attachment 1 Process Flow Diagram

ATTACHMENT 1

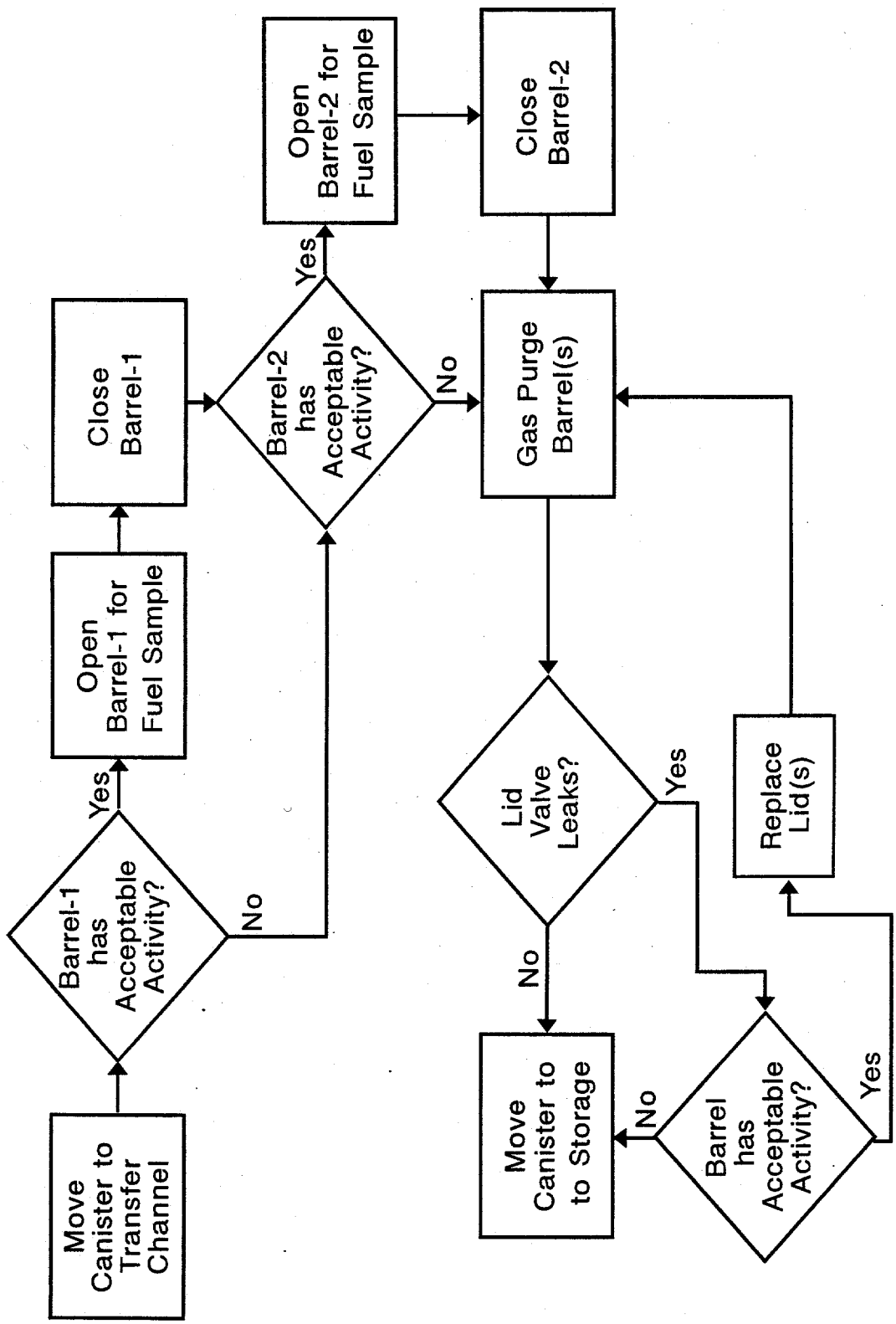
PROCESS FLOW DIAGRAM

LIQUID SAMPLING FOR
FUEL CHARACTERIZATION SHIPMENTS

Liquid Sampling for Fuel Characterization Shipments (1/3)



Liquid Sampling for Fuel Characterization Shipments (2/3)
Disposition Canisters



Liquid Sampling for Fuel Characterization Shipments (3/3)
Disposition Samples