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7. Abstract

Data Quality Objectives (DQOs) for gas and liquid sampling from the sealed canisters in K West Basin have been developed and are presented in this document. The scope of this document is limited primarily to the initial sampling effort. This sampling campaign either supports the selection of canisters to provide fuel for hotcell examinations, supports the demonstration of sampling equipment capabilities or provides an initial assessment of gas/liquid chemistry for comparison to the results of fuel element hotcell examinations. It is anticipated that the need for future campaigns which further assess the state of the basin canister inventory will require a separate DQO process after the initial scoping gas/liquid sampling efforts are completed and after fuel examinations are completed as prescribed by a previous separate DQO document. Such a more comprehensive effort to characterize the canister contents would be designed to support the currently evolving path forward for removal of fuel from K Basins and for fuel storage on the Hanford site.

No sampling of canisters has occurred since 1983. It is proposed here that samples of gas and water be analyzed for constituents such as cesium, fission gases, and hydrogen which are markers for corrosion of uranium in a water environment. These data will allow an assessment of the risks involved when particular canisters are opened to retrieve fuel. This sampling campaign will also ensure that canisters with some failed fuel elements are included in the population that is opened for retrieval of fuel for hotcell examinations. Additionally, valuable correlations between the macroscopic visible condition of fuel, hotcell examinations, and the gases generated in canisters will be possible. The analysis of other chemical species in the gas and liquid will allow assessments of the performance of the previously added corrosion inhibitor and possibly assessments of radiolysis.

Sampling of canisters will be performed with equipment that opens the valves in the canister lid and draws a 15 ml sample of either gas or water. This work will most likely be performed in one of the pits associated with the K West Basin.

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B. J. Makenas
Westinghouse Hanford Company

February 1995

BS

Document Title: **DATA QUALITY OBJECTIVES FOR GAS AND LIQUID SAMPLES FROM SEALED K BASIN CANISTERS**

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EXECUTIVE SUMMARY

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CONTENTS

DATA QUALITY OBJECTIVES FOR GAS AND LIQUID SAMPLES FROM SEALED K BASIN CANISTERS

1.0 INTRODUCTION

This document describes the Data Quality Objectives (DQOs) for the effort to obtain samples of gas and water from the closed canisters in the Hanford K Basins. As such, it follows the general guidelines stated in DQO strategy document (Lawrence 1994). It is an attempt to unequivocally state the reasons this sampling effort is being undertaken, to delineate the boundaries of the effort, and to document the fact that considerable input has been gathered during the process of DQO formation. Listed below are each of the DQO steps and some detail on how each of the steps has been or will be addressed. The input given below was obtained though a series of meetings with small groups of participants. It was recognized at the outset that the set of stakeholders was large and encompasses viewpoints that are widely varied. The proposed experimental efforts discussed in this report hold promise to be of value to both current basin operations and to those concerned with longer term processing and storage of the N Reactor fuel, i.e., the Path Forward (see Fulton 1994). Appendix B to this report documents the meetings that were held and also lists stakeholders, responsible parties and their functions. Appendix A presents the written input that was received independent of meetings.

This document is limited in scope in that it does not define the minimum number of canisters that will be required to adequately characterize the K West Basin. This is because the sampling apparatus is of new design and because sampling of canisters has not been done in the last decade. Therefore the range of possible canister states is not known and will be known only after some limited sampling has first taken place.

2.0 STATE THE PROBLEM

Over three thousand canisters reside in the water-filled Hanford K West Basin. A canister may contain up to 14 N Reactor fuel assemblies (14 inner elements and 14 outer elements consisting primarily of metallic uranium with zirconium alloy cladding) distributed between two stainless steel or aluminum barrels. The canisters were initially filled in the 1980's with fuel, water, corrosion inhibitor and a nitrogen cover gas. The fuel elements are believed to be in assorted conditions which span the gamut from pristine to badly damaged. The canisters may be of Mark I or Mark II design and all are sealed with metal lids so that the condition of the contents is not readily observed. The contents of the canisters has not been inspected in more than a decade. Historical data (circa 1983), similar to that being proposed in this DQO, are summarized in references Emory 1994 and Mollarus 1995. Furthermore, as pointed out in a recent review article (Weber 1994), some corrosion of exposed uranium fuel is almost certainly occurring. The extent of this corrosion is not known but when it occurs, fission products and hydrogen are released into the canister. These species are available for release to the surrounding environment if the canisters are opened during a future processing/shipping scheme or if the canisters are disturbed in a way which affects the gas traps or lids associated with the canisters. Some radioactive species were indeed found in canister water during the 1983 campaign but it is not at all clear that these data can be extrapolated to the present or into the future.

In April of 1994 a Forum was held at Hanford on the characterization needs for fuel in K Basins. This Forum consisted of both Hanford and off-site experts in the arena of metal fuel. One of the Key actions identified by this panel was that, prior to Westinghouse Hanford Company (WHC) engaging in any processing scheme for the stored fuel, the wisdom of the current storage scheme should be ascertained through examination of the contents of sealed canisters. Subsequent to the Forum, K Basin operations requested that limited gas/liquid sampling be used as a tool to screen canisters which might be candidates to supply fuel elements for characterization hotcell examinations. Such screening is important from a safety and operational point of view since gas/liquid activity may result in operator exposure and since the contents of an opened canister will at least temporarily raise the concentration of radioactive species in the basin water. From a characterization point of view sampling could increase the certainty that canisters with the desired amount of corroded fuel were opened in the basin. The primary question to be answered by the first gas/liquid sampling campaign thus is: which canisters are most likely to yield the proper fuel for hotcell examinations and introduce only limited radionuclide contaminants to the K West Basin during the opening process?

The secondary question to be addressed is: What is the condition of the contents of the sealed canisters given that no data are currently available to feed future decisions on fuel disposition? Initial DQO meetings in this vein established guidelines which stated that any data obtained should aim to ascertain the present condition in a way that allows WHC to predict the future condition of the fuel under foreseen circumstances. The data should be taken in a way that enhances the Hanford site's ability to move, isolate, process and store the K Basin fuel. It is envisioned that the current effort to sample gas and water from canisters would contribute in such general areas as safety and fuel handling by quantifying the potential for contamination and for energetic reactions when canisters are opened at some future date.

Finally, the method of sampling of canisters must conform to certain constraints. These include the necessity for the sampling to be done safely (from a public and worker point of view), the necessity for ALARA considerations, the recognition that resources of operations personnel are limited, and the necessity for not appreciably worsening the basin contamination situation during sampling.

3.0 IDENTIFY THE DECISIONS OR DECISION PATHS

Sampling of gas and water from closed K West canisters will endeavor to answer the following questions or contribute to specific decision pathways related to specific characterization issues/decisions. Note that Section 3a culminates in a definite decision on which canisters will supply fuel for hotcell examinations. The remainder of the Sections 3b through 3e delineate data gathering activities in areas where no valid data currently exist on K West canisters. They are attempts to gain initial data that confirm previous design paths, correlate with other expected data or provide guidance for future data acquisition. The points where these data interact with or complement the fuel hotcell examination are summarized in Figure 1. It is anticipated that future needs for hotcell examinations or gas/liquid sampling will be influenced by this synergism.

a. **Shipping for Examination:** Several issues are connected with the near term shipping of fuel to the hotcells. Is the contamination level inside of closed canisters sufficient to cause unacceptable levels of radioactive species in the basin pool or adjacent air space when a limited number of specific canisters are opened for examination and shipping of fuel to Hanford hotcells? Will additional ion-exchange capacity be needed to mitigate the effects of the canister opening? Thus liquid and gas sampling are expected to take place in conjunction with efforts to ship fuel to hot cells for examination which is a subject covered under a separate DQO document (Lawrence 1995). Sampling to address these issues will be for quantification of radioactive contaminants in the liquid (primarily) and gas (secondarily) of particular canisters with a firm decision made on which canisters will be opened to yield the best fuel specimens for hotcell examination (Figure 2).

b. **Interim Storage and Associated Processing:** How much fission gas, hydrogen, dissolved nuclides and sludge must be dealt with in the eventual shipping and processing of all of the K West Basin fuel when it is removed from the basin. Another way to phrase this question is "how much corrosion of damaged fuel has taken place in the closed canisters"? since it is the corrosive process which gives rise to the release of fission products, the production of some hydrogen and the production of a nonadherent oxide/hydride (i.e., sludge). Both the gas and liquid samples will contribute understanding here.

c. **Inhibitors:** Is the corrosion inhibitor (potassium nitrite added when the canisters were filled) effective and to what extent has it been consumed or diluted? Analysis here will be for the presence of the inhibitor or its conversion products in the liquid. These data will feed the decision on whether to add inhibitor to any wet-storage overpack containers that might be built and will provide information on whether this inhibitor is the right inhibitor (given that there may be other candidate inhibitors). The extent of any wet storage phase (prior to conditioning and dry storage) contained in the Path Forward has yet to be determined.

Figure 1. Flowchart of Interaction Between Gas/Liquid Sampling Described in this DQO Document and the Hotcell/Shipping Tasks Described in the DQO Document (Lawrence 1995).

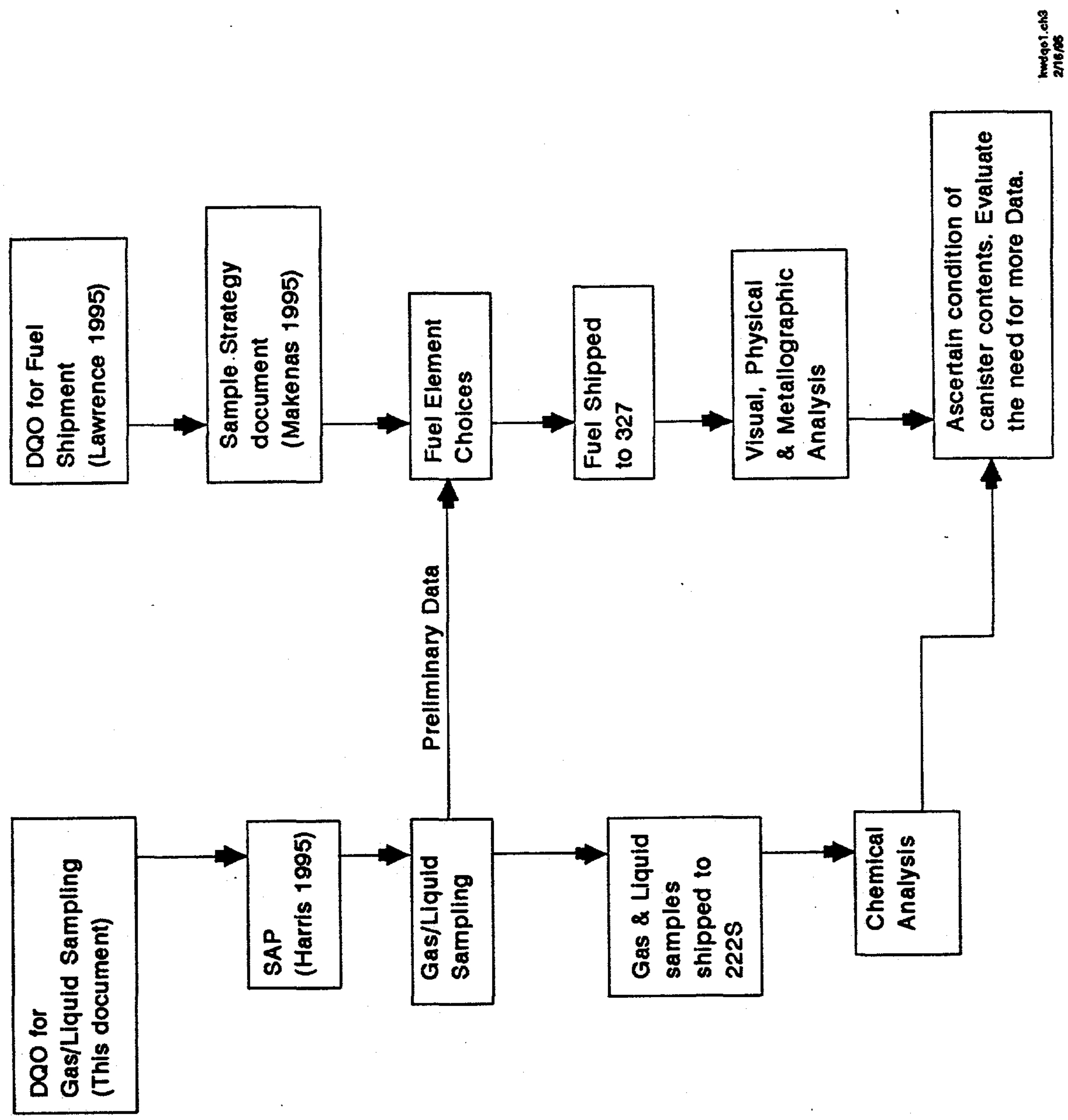
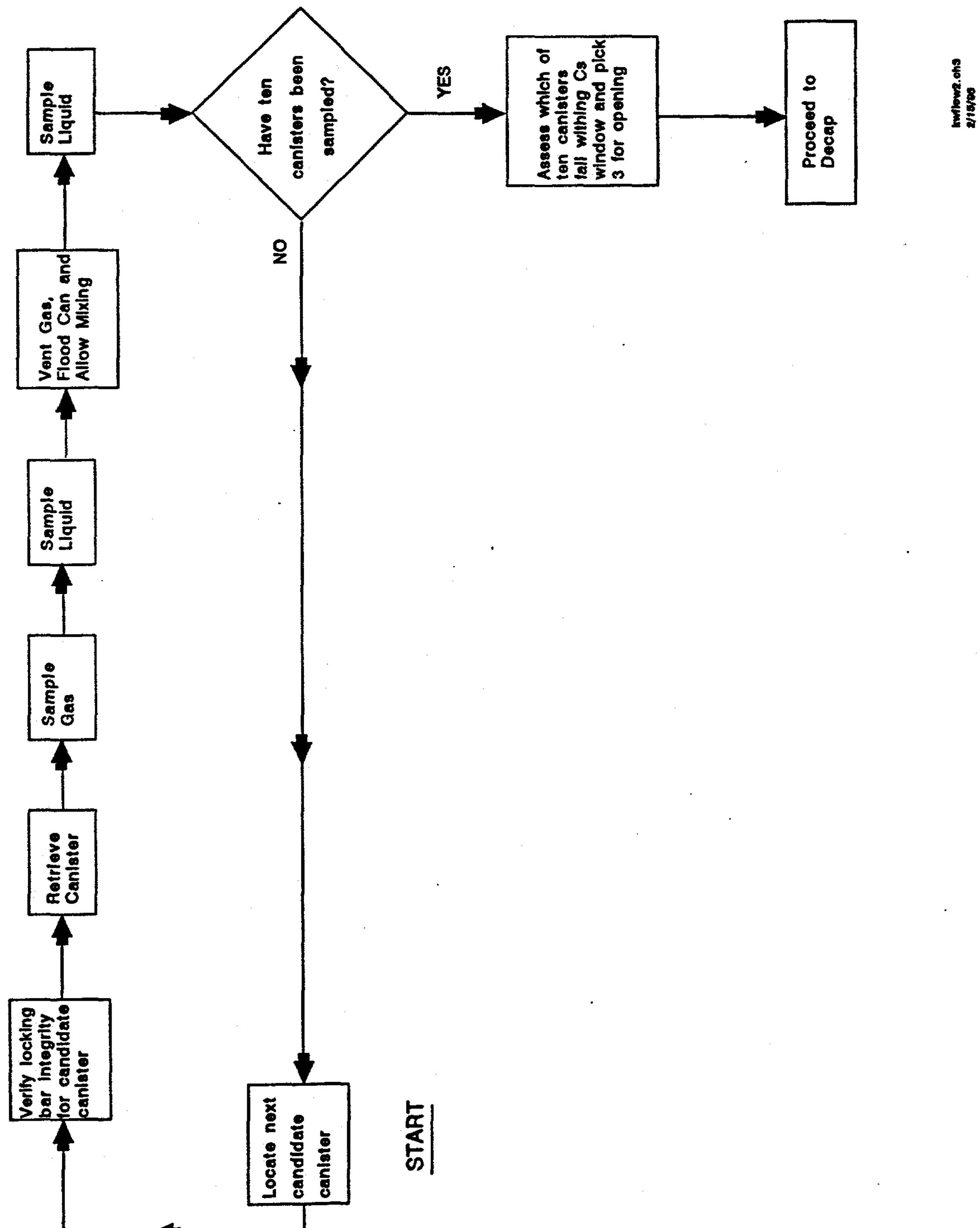


Figure 2. Flowchart Showing where the Decision is made on which K West Canisters to Open (figure is from Makenas 1995.)



d. **Radiolysis:** How much radiolysis can be expected to occur in conjunction with the storage of N Reactor fuel? This question will influence the choice of gas venting/purging systems connected to the interim storage of fuel during a wet storage phase. To date, opinions on the magnitude of this effect vary widely. Data on this issue is expected to come from the analysis of canister gases although interpretation of the data may be difficult due to other sources of the same gas species (e.g., hydrogen from corrosion and oxygen from air ingress). As with Section 3c, the importance of these data will depend on the extent of wet storage determined for the Path Forward.

e. **Relationship to Hotcell Examinations:** Can a minimally invasive screening technique be developed which can give information about the state of canister contents in a manner less costly (in time, dollars and dose) than hotcell examinations? If the results from gas/liquid sampling can be correlated with results from a limited number of hotcell examinations, then the gas/liquid sampling could become a routine tool to determine the degree of corrosion in a canister and thus infer the potential for the canister to contain pyrophoric hydrides, released fission products and hydrogen gas.

4.0 THE DATA TO BE ACQUIRED AND TECHNIQUES TO BE UTILIZED

It is envisioned that the above questions can at least be partially addressed by obtaining small (approximately 15 ml) samples of gas and water from the sealed K West canisters. One barrel of a Mark II canister is shown schematically in Figure 3. Samples can be taken through the two vent valves in the canister lid. The sampling apparatus will seal with the canister lid, open valves, extract a small sample of gas or water and reseal the vents. Such an apparatus has been designed and constructed. It is shown in Figure 4 and described in Pitkoff 1994a and Pitkoff 1994b. This device uses two evacuated vials to draw gas through the off-center vent valve and to draw liquid through the thin tube which is attached to the underside of the central valve. Nominally the water level in the canister barrel should be at the lower tip of this tube. The apparatus is designed to interface with either Mark I or Mark II canisters. Specific instructions for laboratory analysis of samples will be published in the upcoming Sample Analysis Plan (Harris 1995).

The types of data to be acquired as part of the initial campaign are summarized in Table 1. The desired data include the concentration of several specific analytes, such as cesium or hydrogen, and include qualitative determinations such as whether a water sample is obtained when a gas sample is expected (indicating a leaking, flooded canister). Also listed in Table 1 are the rationale connecting each desired datum to the questions asked in Section 3.0 of this report. Concentrations of Cesium, hydrogen, and fission gas will allude to corrosion rates since these are produced or released during the oxide forming process. Remaining nitrogen will indicate how much gas has been swept out through the gas trap. Hydrogen and oxygen will quantify

Figure 3. Schematic Drawing of K West Mark II Canister.

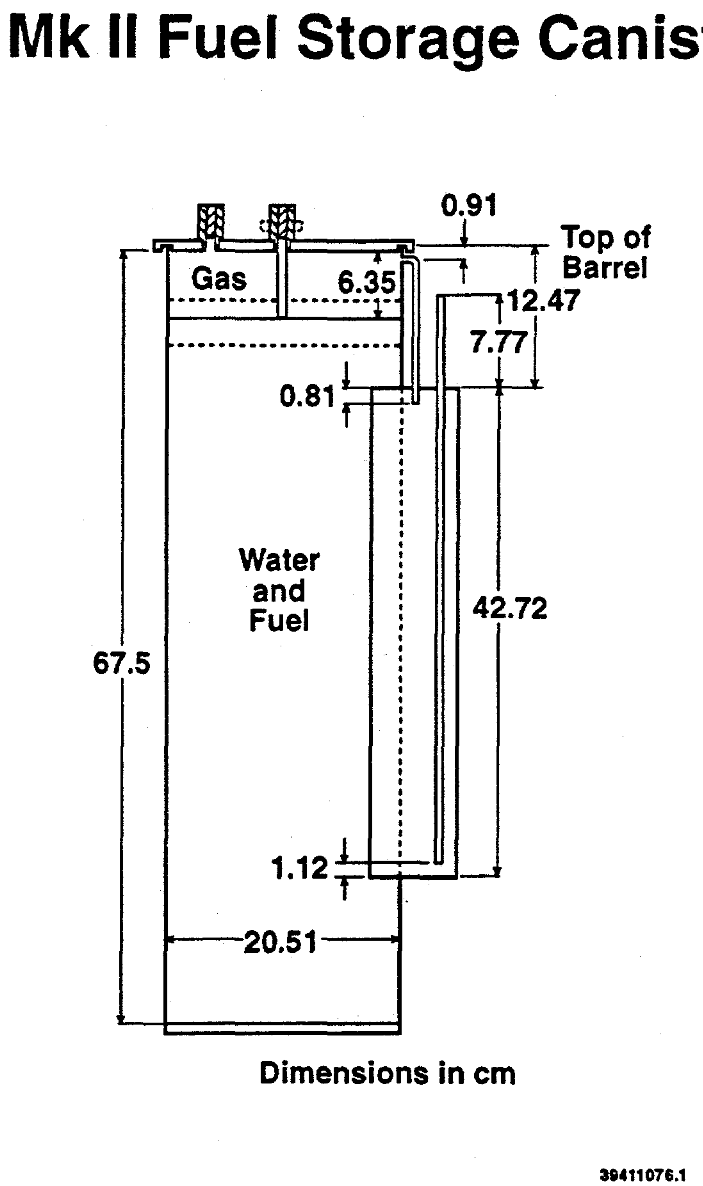


Figure 4. Apparatus for Sampling Gas and Liquid from Sealed Canisters.

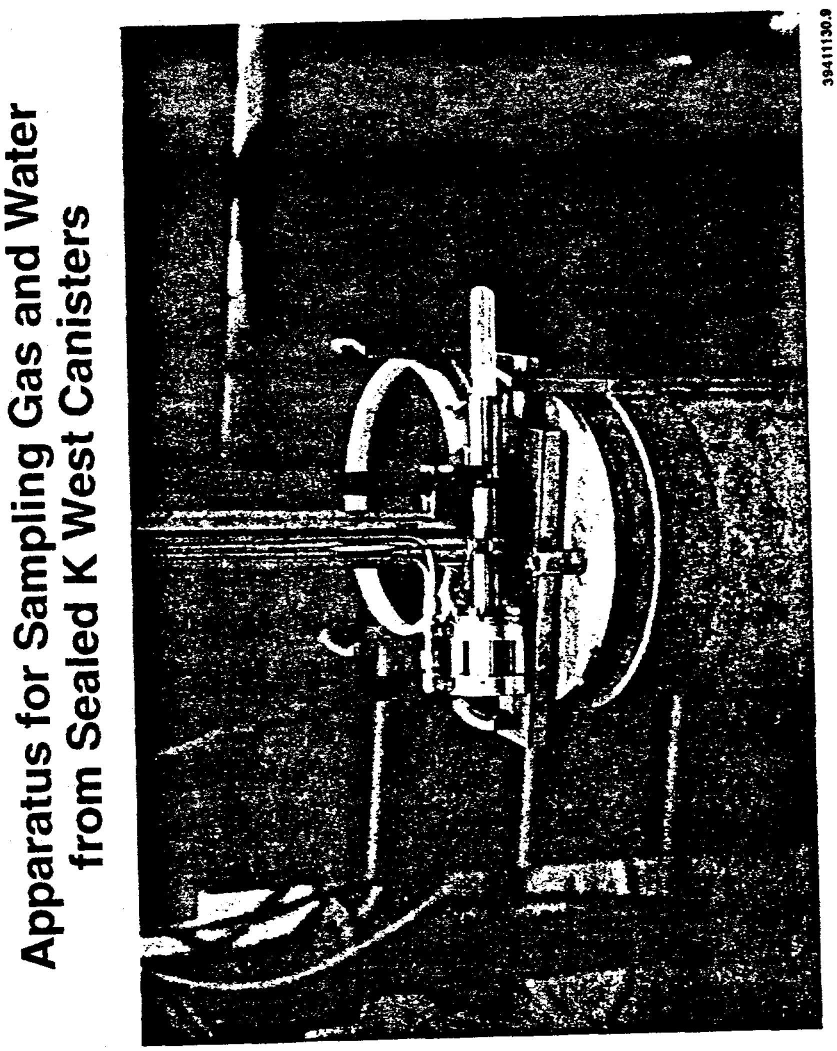


Table 1. List of Analytes for Canister Gas and Liquid Sampling.

Element/Phenomenon	Gas/Liquid	Rational (from Section 3.0)	Cautions	Responsible Facility
Cesium	liquid	total corrosion (3a,3b,3e)	Cs plating out or in sludge	222S Laboratory and ML*
Hydrogen	gas	corrosion (3b,3e)	escape from trap; radiolysis hydrogen	325 Building
Atmospheric gases (Ar:N:O)	gas	equipment leakage or sample contamination		325 Building
Nitrogen	gas	remaining covergas (3b, 3e)	diluted with H	325 Building
Inhibitor-nitrite	liquid	amount of inhibitor used up/decomposed (3b,3c)		222S Laboratory
Ammonia and nitrate	liquid	inhibitor Rxn product (3c)	corrosion and radiolysis products react with inhibitor	222S Laboratory
Fission gas (Kr/Xe)	gas	release from corroded fuel; compare to H results (3a,3b,3e)	uncertainty in gas release from oxide and sludge	325 Building and ML
Hydrogen/oxygen	gas	radiolysis (3d)	other H and O sources i.e., corrosion and air	325 Building
Liquid level	liquid	U corrosion consumes water (3b,3e)	2.5 inch (6.35 cm) diptube	K Basin
Liquid obtained when gas expected	liquid/gas	identify leaking canisters; compare to gas trap measurements		K Basin
Gas obtained when liquid expected	liquid/gas	corrosion indication (3b,3e)		K Basin
Sr, Pu, U, tritium	liquid	expected release when canisters are opened (3b,3e)		222S Laboratory
pH	liquid	inhibitor chemistry; compare to basin water (3c)		222S Laboratory
Total radioactivity	liquid	integrated hazard of canister opening (3a,3b)		222S Laboratory and ML

NOTE: Until further experience is gained with the current conditions of the SNF sealed canisters, accuracy and precision should be those consistent with current standard laboratory practice.

*ML = Mobile laboratory.

radiolysis while the amount of argon will be a marker for contamination of sample with air. A more detailed discussion of the rationale for and cautions associated with each type of data is given in Appendix A.

It is recognized that, due to the multitude of processes occurring in a canister, a true mass balance will probably not be obtainable and that different analytes (such as fission gas versus cesium) will more than likely give differing numbers for corrosion rates. This situation is further complicated by the fact that other relevant data, such as how much cesium is trapped in the sludge (if any), will not be known until subsequent characterization campaigns (such as sludge sampling) have been completed. Extrapolation of the concentration numbers (whether liquid or gas) to absolute quantities will require assumptions about the size of the gas space versus the liquid level since the canister gas/liquid interface will not be directly observable.

5.0 DEFINE STUDY BOUNDARIES

The gas and liquid sampling will take place in at least two phases with different operational scenarios:

a. **Demonstration Run:** Sampling will be done in conjunction with the first shipment of fuel from the basin to hotcells such that samples of liquid will be used to screen out canisters with too high a potential to contaminate the basin water (i.e., more than 3.7 Ci Cesium per canister barrel, see Mollarus 1995). Gas samples would indicate the potential for escape of radioactive gas during canister lid removal (decapping). It is expected that the initial analysis of these samples would be done with mobile gamma counting apparatus. Emphasis would be on analysis for cesium and krypton. Gas and liquid samples would be held for later analysis by other laboratories.

   At least ten canisters will be sampled for gas/liquid as part of a demonstration run. The subsequent decapping effort will be limited to a maximum of three canisters in process at any one time with an anticipated maximum of 10 canisters opened in the entire campaign. It would be prudent to identify at least 20 satisfactory candidate canisters to account for those canisters which might be rejected prior to sampling or prior to opening. These candidate canisters are named in reference Makenas 1995.

   Operations records and existing ultrasonic measurements of gas traps have been (Makenas 1995) used to pick target canisters. These targets include canisters with known broken fuel but not canisters with broken locking bars (which lead to water ingress), or canisters with ultrasonic indications of water-fill traps. Two liquid samples (before and after canister flooding) are planned for each canister barrel. Over-the-road shipping to laboratories would be accomplished and the full gamut of analyses described in Section 4.0 would be performed for the samples obtained in this manner. Expedient shipping and analysis of gas samples is required due to concerns over hydrogen loss from sample vials, and expedient analysis of the first few liquid samples is required to confirm or mitigate assumptions made as to the shipment classification (Harris 1995).

b. **Future Data Gathering Activities:** Without knowing the variation in attributes for the canisters in K West Basin, it is not possible *a priori* to provide a statistical basis for choosing the number of canisters required to characterize, with confidence, the state of K West fuel if such characterization becomes necessary. The data gathered in the demonstration run described in the preceding sections will provide an understanding of the variations or commonalities between canisters. This along with an increasingly mature Path Forward for K Basin fuel will lead to a revised set of DQOs. The revised version should be able to delineate the process by which an adequate picture (as defined by the Path Forward) of the state of the K West Basin fuel is formulated. It is also probable that upcoming hotcell examinations of K West fuel and associated shipping campaigns may provide understanding which allows a more intelligent choice of target canisters for a future campaign of gas/liquid sampling. In other words, if observations of fuel condition made in the hotcells (or observations made when canisters are opened in the search for elements to ship to hotcells) are correlatable with the analyses of gas and liquid samples collected prior to shipping, the credence and ultimate quantity of needed future gas/liquid samples may be definable.

6.0 DECISION LOGIC

This section relates the needed decisions identified in Section 3.0 with the results obtained through gas and water sampling. A specific decision rule can be defined in Case 6a, i.e., for the choice of shipping candidates. For Cases 6b through 6e the goal is data gathering where no data currently exist and to provide definition to future DQO efforts.

a. **Shipping:** Section 3a calls for a decision on which canisters to open based on the amount of contamination present in the canisters. If the cesium-137 content of a canister barrel is above 3.7 Ci then the subject canister will probably not be chosen for the initial shipping campaign due to limitations of the basin ion-exchange system (Mollarus 1995). Similarly, a lower limit of around 0.03 curies per barrel will be established to guarantee some non-negligible corrosion has occurred in the canister barrel. Reference Makenas 1995 gives the details of the decision logic associated with these choices. The master work plan (MWP 1995) for shipping will identify responsible individuals and the proper point of decision.

b. **Interim Storage:** Section 3b discusses the need for quantification of fuel corrosion as input to the Path Forward design efforts. It is very likely that by the time samples covered by this DQO document are acquired and analyzed that the Path Forward for basin fuel will have been essentially chosen using only currently available information. This chosen path will, of necessity, make certain assumptions about the amounts of existing corrosion product (including sludge), liquid contaminants and potential corrosion processes (such as hydrogen generation). If this is true then the role of the data gathering during gas/liquid sampling will be a confirmatory one as to whether those design assumptions were correct.

c. **Inhibitors:** If significant corrosion (macroscopic oxidation of bulk fuel metal) is not identified in existing canisters (through analysis for cesium, fission gas and hydrogen) then development of a new inhibitor for the Multi Canister Overpack (MCO), now under design, will, in all probability, not be necessary. This effort may also yield data on the mechanism of inhibitor action such that the need for an inhibitor per se (during an as yet undetermined wet storage period) may be reevaluated.

d. **Radiolysis:** Some assumptions on the amount of Radiolysis will be made in designing MCOs if the wet storage phase is assumed to be protracted. These assumptions will occur earlier than the date that data from this study will be available. Thus, data on the radiation produced decomposition of water into hydrogen and oxygen obtained from canisters during the current effort will be confirmatory and, if significantly different from the MCO design assumptions, may force a reevaluation of the design assumptions.

e. **Correlation with Hotcell Data:** The degree to which gas/liquid samples can be connected to data obtained in the hotcell will not be known until hotcell data can be gathered and the morphological and chemical species are identified. The reader is referred to the fuel examination DQO document (Lawrence 1995) for an indication of what types of data will be gathered. Essentially the hotcell examinations will produce a visual, physical or metallography based estimate of corrosion while the gas/liquid samples obtained here will give a similar estimate of corrosion through measurement of liberated fission products and generated hydrogen.

7.0 DECISION ERRORS

The risks of failure to obtain the data or of obtaining an incorrect result are qualitative at this time. They are:

a. The Path Forward MCO may be over or under designed for handling generated gas if the amount of corrosion and radiolysis are not correctly estimated. This could lead to unnecessary expenditure of resources or to redesign.

b. The radiation exposure of personnel while opening canisters (for hotcell shipping or for other processing associated with Path Forward) may be unexpectedly high during opening or handling processes if the mobile fission products are underestimated. Similarly, water cleanup systems could be unexpectedly overloaded.

c. More hotcell examinations would be performed than would otherwise be needed if gas/liquid sampling could provide needed data in a more cost effective manner. Hotcell examinations with their shipping tasks are more expensive than gas/liquid sampling.

8.0 DECISION OPTIMIZATION

The sequence of a demonstration run, followed by possible additional runs was deliberately chosen to allow for the optimization of the process. It is believed that constraints on shipping and laboratory throughput will be determined early and be well defined by the time further runs are initiated. Reference Makenas 1995 provides the rationale for choices of specific canisters for the demonstration run. The Sampling Analysis Plan (SAP) (Harris 1995) addresses the implementation of this DQO document. Specifically it calls out the particular analytes listed in Table 1 and discusses the numbers of samples that will be part of the initial campaign. Data from early runs will be used along with the needs of the SNF Path Forward to determine the number of canisters that need to ultimately be sampled to characterize the basin. For example if a very wide variation in canister properties is seen in the initial canisters, then statistical analysis will dictate a rather larger number of canisters will need to be sampled. The number of samples ultimately taken will also depend on the degree of correlation achieved between the initial gas/water samples and upcoming hotcell examinations.

The degree of success in taking samples may also dictate some changes in equipment design or sample-taking procedure. This is particularly true with respect to reliance on the 2.5 inch (6.35 cm) tube in the cover plate to access canister liquid. If an insufficient number of samples are taken by this method then either the equipment will be modified or canisters will need to be flooded with water through valves in the lid in order to collect a sample. The effect of this newly introduced water will need to be carefully evaluated.

9.0 REFERENCES

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A P P E N D I X   A

K WEST STORAGE BASIN MK II FUEL CANISTER IN PLACE SAMPLING AND EXAMINATION

by R. G. Cowan

KW Storage Basin MK II Fuel Canister In Place Sampling and Examination

Draft R. G. Cowan June 7, 1994

Gas Samples	Function of Sample Analysis	Limitations
Ratio $Kr:H_2$ and $Xe:H_2$	This information will be used to Determine if uranium hydride is being formed. Hydride formation will be indicated by a higher than calculated ratio of Kr to H_2. This calculation also requires knowledge of the burnup of the fuel. It may be possible to detect loss of as little as 10% of the hydrogen to hydride formation. Element to element variations in fuel exposure due to position in the reactor may give false indication of hydride formation.	The fission gasses may not be released when the uranium is oxidized. Incomplete release of fission gas during fuel corrosion could result in failure to detect hydride formation. Destructive examination of both the fuel and corrosion products to measure the fraction of fission gasses released during oxidation is also required.
Ratio $N_2:H_2$	Hydrogen formed by reaction of water with uranium will dilute the nitrogen cover gas added when the canister was closed. Knowing the total initial inventory of N_2, the volume of hydrogen formed can be calculated. This also allows calculation of the quantity of uranium which has reacted with water during storage.	The calculation of the amount of uranium oxidized requires more than the hydrogen to nitrogen ratio. The gas volume, argon, and oxygen in the canister must also be known.
Ratios $Ar:N_2:O_2$	Argon is used to measure the air contamination of the sample and allow subtraction of the nitrogen from this source. The argon to oxygen ratio will indicate if the air contamination occurred in the canister or in sample after removal. Oxygen may react with the solution in the canister but should not with the gasses.	Air is assumed to be the only source of nitrogen but, nitrite was added to the canister liquid and may react to provide nitrogen and consume hydrogen.
H_2 and O_2 Concentration	Hydrogen and oxygen from radiolysis of water could bias the estimate for amount of uranium-water reacted. The oxygen concentration can be used to correct for radiolysis. This data should also determine if there is adequate oxygen, corrected for air contamination, in the canister gas space to support combustion.	The ratio of hydrogen from radiolysis and reaction of the fuel with water is assumed to be constant with time. This is a very simplistic assuption but may be adiquate. If hydrogen from radiolysis is a small fraction of the total and the oxygen reacts with the corrosion products, radiolysis will not impact the hydrogen generation.

KW Storage Basin MK II Fuel Canister In Place Sampling and Examination

Draft R. G. Cowan June 7, 1994

Water sample	Function of Sample Analysis	Limitations
Cs-137 concentration	The concentration of Cs-137 is related to the quantity of uranium that has been oxidized by water. This data will verify the estimate uranium oxidation based on the gas sample	Cs, like the fission gasses, may be trapped in the sludge and not released when the uranium reacts with water. This could result in a low estimate for reacted fuel.
Sr-90, Pu, and U	This data will be used to estimate the release fraction when the canisters are opened. These elements may be in the sludge or in the water. A high concentration of these elements in the water could complicate disposal of the water.	The Pu behavior in the sample after removal from the canister could complicate the analysis. Oxidation of Pu^{+3} to Pu^{+4} by air could result in precipitation or deposition on the walls of the sample vial.
H-3	The fission product tritium may be in the water or gas. Water disposal and air permits will need the concentration and amount of tritium to be discharged when the canisters are opened.	The very low energy beta from tritium decay is difficult to measure accurately. This problem is compounded by the presence of other high energy beta emitters.
Liquid Level	Function of Data Taken	
At 2½ dip tube	If the fuel is covered by water, hydride formation is less likely. Reaction of a large fraction of the uranium metal will consume most of the water and may lower the liquid level (the reaction products are more dense then the reactants) and expose more fuel to hydrogen gas. Canisters with the water level below the dip tube are most likely to contain hydride and may have the greatest degree of oxidized fuel.	This data will be available as part of the canister sampling. If the end of the dip tube is still covered, a liquid sample can be taken directly from center port. If the water level is below the dip tube, liquid sampling will be much more difficult and an alternate sampling procedure will be required.
Liquid Level In The Trap	A high water level in the trap indicates low hydrogen generation or failure of the lid seal. Data from the gas and liquid samples will resolve this uncertainty.	A large number of gas traps have been tested and the data is available. But, without other data it is difficult to select canisters for fuel sampling.
Liquid Level In The Canister	A high liquid level in a canister would indicate a sealing failure in the lid. If the lid fails to seal, water from the inside will bypass the gas trap and exchange with the basin water. This would release fission products. Canisters with a high water level would be candidates for reencapsulating or over packing.	A high precision method of measuring the water level on the inside of the canisters is needed. The water level in the canisters could be the key data in selecting canister for fuel sampling. The level in the canister is also needed to calculate the amount of uranium oxidized from the H_2 to N_2 ratio.

APPENDIX B

MEETINGS AND STAKEHOLDERS

APPENDIX B

MEETINGS AND STAKEHOLDERS

List of DQO Meetings for Gas/Liquid Sampling from Sealed Canister

10-25-94
Attendees: B. J. Makenas, R. G. Cowan, A. E. Bridges, B. Emory, R. B. Baker.
Subject: Specific analyses to be performed for gas/liquid samples.

10-31-94
Attendees: PNL and WHC characterization groups plus Blair Emory.
Subject: High level objectives for gas and water sampling.

11-15-94
Attendees: G. Baston, R. P. Denise, D. W. Bergmann, R. P. Omberg, G. D. Trenchard, C. C. Pitkoff, J. R. Fredrickson, D. J. Trimble, J. Shuen
Subject: DOE and MACTEC input on gas/liquid sampling objectives.

11-17-94/12-7-94
Attendees: A. T. Kee, A. L. Pajunen, et al.
Subject: Obtain Path Forward input into gas/liquid sampling objectives.

11-21-94
Attendees: T. A. Thornton, D. J. Trimble, B. J. Makenas
Subject: Establish PNL position on gas/liquid analytes.

12-01-94
Attendees: M. W. Goheen, D. J. Trimble, B. J. Makenas, C. C, Pitkoff
Subject: Capability of 325 Building to support gas analyses. Initiate tests of sample vial integrity with hydrogen.

12-06-94
Attendees: J. G. Kristophsky, A. D. Rice, W. J. Winter, D. J. Trimble, R. B. Baker, B. J. Makenas
Subject: Capabilities of 222S Laboratory to perform suggested analyses for liquid and gas.

List of Stakeholders for Gas/Liquid Sampling

Path Forward	A. L. Pajunen, L. H. Goldman, A. T. Kee, R. G. Cowan
K Basin Operations	B. S. Carlisle
K Basin Engineering	J. P. Schmidt
K Basin Safety	C. L. Bennett
QA	D. W. Smith
Analytical Support	J. B. Cooper
222S Laboratory	A. D. Rice
325 Building Laboratory	M. W. Goheen
Equipment Design	C. C. Pitkoff
Equipment/Operations Interface	D. J. Trimble
DOE/RL	G. D. Trenchard
Characterization Management	R. P. Omberg*
Sample Analysis Plan	R. A. Harris

*Key decision maker.