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1	1	Safety J. W. Osborne X3-80 10/17/95			
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SUPPORTING DOCUMENT

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Water Upgrade, Filtration, Hazard Categorization, 105 KE/KW Basins	Name: K. R. Conn Signature Organization/Charge Code 2A100/LD043

7. Abstract

This Supporting Document provides the hazard categorization for the K Basin Water Filtration Upgrade Project at K East. All activities associated with the project are less than Hazard Category 3, except for the handling of the ECO-ROK liners containing spent filter cartridges. All activities involving the handling of liners, containing spent cartridges, by monorail, forklift or mobile crane are classified as Hazard Category 3.

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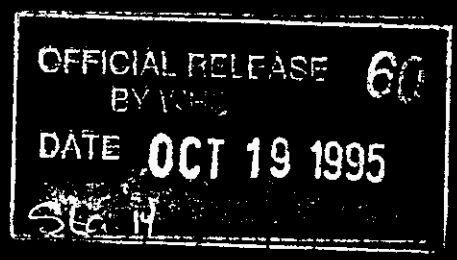

HAZARD CATEGORIZATION OF K BASIN WATER FILTRATION UPGRADE PROJECT

1.0 PURPOSE AND SCOPE

The purpose of this document is to provide a hazard categorization of the activities associated with the K Basin Water Filtration Upgrade Project. Only the implementation of the project at K East is addressed. With respect to the spent filter cartridges, the activities considered extend only to the movement of the ECO-ROK 25-11 cask, with the ECO-ROK liner and spent filter cartridges enclosed, to a local storage location. Any activities involved with future disposal of the cartridges are not considered in this hazard categorization.

2.0 SUMMARY

All activities associated with the Water Filtration Upgrade Project at K East are less than Hazard Category 3, except for the handling of ECO-ROK liners containing spent filter cartridges. All activities involving the handling of the liners, containing either existing or replacement spent cartridges, by monorail, forklift or mobile crane are classified as Hazard Category 3.

No significant nonradioactive hazards were identified.

3.0 DESCRIPTION OF SIGNIFICANT ACTIVITIES

The project consists of three parts:

3.1 reactivation of the cartridge filters with enhancements to the cartridge design, function and replacement/disposal technique.

3.2 piping modifications to supply discharge flow from the recirculation system to the IXMs

3.3 replacement of the recirculation pump motors with larger motors, with speed increaser or control device

Initially, the project will only be initiated at the K East basin. It may subsequently be implemented at K West.

3.1 Reactivation of upgraded cartridge filters

The cartridge filters will be reactivated to provide (with the piping modifications indicated above) filtration ahead of the IXMs to reduce the transuranic (TRU) isotope buildup in the IXMs. The present cartridge assembly will be replaced with an array of individual removable cartridges within a cage assembly in the filter housing. The flow direction through the cartridges will be reversed from out-to-in to in-to-out. This will result in the filtered material being collected on the inside of the cartridges, where it will remain trapped during cartridge replacement.

The method of cartridge changeout and packaging for disposal is changed to reduce radiation doses and provide packaging compatible with future disposal methods. For cartridge replacement, both the cartridge assemblies presently installed in the filter housings, and future spent cartridges, will be transferred underwater from the filter housing to an ECO-ROK liner. The lid will be placed on the liner and the liner raised above the water surface to allow draining. The liner will then be moved by monorail through room 3 to an outside loading area. It will then be moved by a forklift to a location where it will be placed into an ECO-ROK 25-11 cask by mobile crane. The cask will be moved to a local storage location until removal of the container and/or cartridges for final disposal.

3.2 Piping modifications

The piping modifications will consist of a) addition of connecting piping from the recirculation system discharge piping to the inlet piping to the IXMs, b) addition of isolation and check valves to provide isolation between the recirculation and sandfilter system discharges and c) removal of a section of the existing recirculation system piping to the ion exchange columns.

3.3 Replacement of recirculation pump motors

The recirculation pump motors will be replaced with larger motors operating at a higher speed to provide additional pump head necessary to allow the IXMs to be supplied with flow from the recirculation system.

4.0 HAZARD CATEGORIZATION

The methodology of DOE Standard DOE-STD-1027-92 (Reference 1) is used for this hazard categorization. This methodology establishes the hazard categorization based upon potential airborne release of hazardous radioactive materials.

The attached table (from Reference 2) provides the threshold data from Reference 1 for the significant radionuclides associated with irradiated N Reactor fuel. The table lists the Category 3 threshold for the various TRUs as 0.52 Ci (except 0.62 Ci for Pu-238). The threshold for Sr-90 is listed as 16 Ci and for Cs-137 as 60 Ci. The category 2 thresholds are listed as 55 to 62 Ci for the TRUs, 22000 Ci for Sr-90 and 89000 Ci for Cs-137. These values are the threshold quantities of the indicated radionuclides if they were the only one present. These individual threshold levels are reduced by the presence of other radionuclides.

The only activities of the Water Upgrade Project which would involve significant quantities of radionuclides are the removal of the spent filter cartridges and the handling of the ECO-ROK liners and the shield containers with spent cartridges enclosed.

The recirculation and skimmer pumps will be shutdown and the piping systems drained before the lines are opened for the piping system modifications;

therefore, any spillage of basin water from the opened piping will be minor. However, even if a major spillage of water occurred there would be no significant airborne release of radionuclides. The maximum reported total TRU concentration in the basin water is approximately 0.21 uCi/l. At this concentration, it would require the TRU content of about 650,000 gallons of basin water, which is over half of the total water in the basin, to equal the Hazard Category 3 threshold.

The replacement of the recirculation pump motors will not involve any inventory of radionuclides.

4.1 Radionuclide Inventory of Previous Spent Filter Cartridges

Table 1 of Reference 3 gives the results of sample analyses of filtered material samples from two previously removed spent cartridges from KE. The resulting ratios of TRU to Cs were 0.30 and 0.32. A ratio of 0.35 is assumed for the present cartridge configuration. The ratios of Cs-137 to Sr-90 were 6.0 and 10.6. In Table 2 of Reference 3 a maximum quantity of 4.25 Ci of Cs-137 was established for the previously removed spent KE cartridge filters, based on dose rate surveys. This quantity (and the corresponding quantity of Sr-90 of 0.4 to 0.7 Ci) is well below the Category 3 threshold. However, based on a TRU to Cs ratio of 0.35 the maximum quantity of TRU on these cartridges would be 1.5 Ci. This is approximately three times the Category 3 threshold level of the TRUs, but 30+ times less than the Category 2 threshold.

Based on the above data it is apparent that the quantity of TRU is the controlling factor for hazard categorization.

4.2 Radionuclide Inventory of Cartridges Presently in Filters

Radionuclide inventories of the cartridges presently in the filters at KE are reported in Reference 4. The Pu-239/240 inventory for cartridge 77-1B, which was based on a mass balance using composite sample data, is given as 0.82 Ci. This is above the Hazard Category 3 threshold of 0.52 Ci. Subsequent surveys (see attachment) on the outside of the filter housings resulted in an estimate of Cs-137 loading of about 7 Ci. Using the TRU to Cs ratio of 0.35 from above this Cs level would indicate a TRU quantity of about 2.5 Ci. Therefore, it must be concluded that the radionuclide inventory on the existing filter cartridges is above the Hazard Category 3 threshold.

4.3 Expected Radionuclide Inventory of Replacement Filter Cartridges

The replacement cartridge array is expected to have a greater filtering capacity than the previous cartridge assemblies. Reference 5 specifies 13 Ci of TRU to be considered as the maximum quantity of TRU for the replacement cartridges. This is only about 1/4 of the Category 2 threshold. Therefore, the quantity of material that may be collected on the replacement cartridge arrays is greater than the Category 3 threshold, but less than the Category 2 threshold.

The removal of the spent cartridges and their placement into the ECO-ROK liner will be performed under water. Any filtered material displaced from the filter media as a result of dropping the cartridges, or spillage of the cartridges from the liner, would be under several feet of water. In Reference 6 the basis is presented for applying a decontamination factor (DF) for the scrubbing action of the water on the release to the air of radioactive material released under water. This reference considered a reduction factor of 10^4 to be conservative for the K basins. A reduction factor of only 10 would increase the Category 3 threshold quantity well above the maximum quantity of TRUs considered for the spent cartridges. Therefore, all activities during which the cartridges or liner remain under water are classified as less than Hazard Category 3.

During the handling of the ECO-ROK liner with the spent cartridges by the monorail, forklift or the mobile crane, the potential exists for an accident resulting in the dropping of the liner. Since there has been no demonstration by analysis or drop tests that the lid would remain in place in the event of a drop of the liner, failure of the lid, allowing the filtered material on the spent cartridges to be spilled into the open environment, must be considered. Therefore, since the quantity of radionuclides on the cartridges may be above the category 3 threshold, all activities involving the handling of the liner, with either existing cartridge assemblies or replacement cartridge arrays enclosed, by monorail, forklift or mobile crane are classified as Hazard Category 3.

In the case of a drop of the ECO-ROK 25-11 cask and enclosed liner, it is considered incredible that both the shield container would breakup and the liner lid would fail. Therefore, once the liner has been placed into the cask and the lid secured to the cask, all further handling activities are classified as less than Hazard Category 3.

Since the piping modification and recirculation pump motor replacement activities will involve no significant, if any, potential for airborne release of radionuclides they are classified as below Hazard Category 3.

5.0 REFERENCES

1. DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance With DOE Order 5480.23, Nuclear Safety Analysis Reports", December 1992.

2. WHC-SD-SNF-HC-005, Rev. 2A, "Hazard Categorization of 100 K East and 100 K West Basin Sludge Characterization Program Sampling", August 11,1995.

3. WHC-SD-SNF-TA-005, "Safety Evaluation - Spent Water Treatment System Components Inventory Release", January 24, 1995.

4. Memo 95-SPB-035, Cognizant Engineering to K. R. Conn, "Radionuclide Inventory of Spent Cartridge Filters in KE Basin", September 19, 1995.

5. Memo FJM-95-007, from F. J. Muller to Distribution, Memorendum of Understanding Activity A-1 Cartridge Filter Replacement, Source Term, dated October 4 , 1995.

6. WHC-SD-SNF-SARR-002, Rev 3, "Safety Assessment of Discharge Chute Isolation Barrier Preparation and Installation", December 28, 1994.

ATTACHMENT

CATEGORY 2 and 3 THRESHOLD QUANTITIES

RADIONUCLIDE IN URANIUM	Ci/MTU URANIUM (1)	Ci/KG URANIUM	CAT 3 THRESHOLD Ci	CAT 2 THRESHOLD Ci	CAT 3 RATIO for 1 Kg Uranium	CAT 2 RATIO for 1 Kg Uranium
Y-90*	5.80E+03	5.80E+00	2.10E+02	4.30E+05	2.762E-02	1.349E-05
Sr-90	5.80E+03	5.80E+00	1.60E+01	2.20E+04	3.625E-01	2.636E-04
Ru-106	5.20E+01	5.20E-02	1.00E+02	6.50E+03	5.200E-04	8.000E-06
Sb-125*	1.20E+02	1.20E-01	2.10E+02	4.30E+05	5.714E-04	2.791E-07
Te-125M*	3.00E+01	3.00E-02	2.10E+02	4.30E+05	1.429E-04	6.977E-08
Pr-144M*	3.30E-01	3.30E-04	2.10E+02	4.30E+05	1.571E-06	7.674E-10
Pr-144*	2.80E+01	2.80E-02	2.10E+02	4.30E+05	1.333E-04	6.512E-08
Ce-144	2.80E+01	2.80E-02	1.00E+02	8.20E+04	2.800E-04	3.415E-07
Cs-134	1.30E+02	1.30E-01	4.20E+01	6.00E+04	3.095E-03	2.167E-06
Cs-137	7.30E+03	7.30E+00	6.00E+01	8.90E+04	1.217E-01	8.202E-05
Pm-147	2.00E+03	2.00E+00	1.00E+03	8.40E+05	2.000E-03	2.381E-06
Eu-154	8.80E+01	8.80E-02	2.00E+02	1.10E+05	4.400E-04	8.000E-07
U-235	2.680E-02	2.68E-05	4.20E+00	2.40E+02	6.381E-06	1.117E-07
U-238	3.290E-01	3.29E-04	4.20E+00	2.40E+02	7.833E-05	1.371E-06
Pu-236*	2.20E-04	2.20E-07	5.20E-01	5.50E+01	4.231E-07	4.000E-09
Pu-238	4.80E+01	4.80E-02	6.20E-01	6.20E+01	7.742E-02	7.742E-04
Pu-239	1.10E+02	1.10E-01	5.20E-01	5.60E+01	2.115E-01	1.964E-03
Pu-240*	5.80E+01	5.80E-02	5.20E-01	5.50E+01	1.115E-01	1.055E-03
Pu-241	4.40E+03	4.40E+00	3.20E+01	2.90E+03	1.375E-01	1.517E-03
Pu-242*	2.10E+02	2.10E-01	5.20E-01	5.50E+01	4.038E-01	3.818E-03
Am-241	9.30E+01	9.30E-02	5.20E-01	5.50E+01	1.788E-01	1.691E-03
Cm-244*	4.60E+00	4.60E-03	5.20E-01	5.50E+01	8.846E-03	8.364E-05
		RATIO TOTALS			1.649E+00	1.128E-02
KGs of Uranium to exceed thresholds (includes transuranics and fps)					0.606578948	88.67031947

The threshold Kgs are equivalent to 0.027 and 3.91 fifty pound MKIV assemblies for cat 3 and cat 2 respectively.

* - Threshold values not provided in DOE Standard 1027-92, values were per footnote 1 for Cat 2, Cat 3 values were ratioed from Sr 90 and then kept the same for beta-gamma emitter and Pu-239 value used for alpha emitters.

(1) Ci/MTU taken from WHC-SD-WM-HC-012 REV 0, (now WHC-SD-SNF-HC-001 Rev 0) K BASINS FUEL ENCAPSULATION AND STORAGE HAZARD CATEGORIZATION - N Reactor fuel burned to 12 % Pu-240 and aged ten years.

RHM 8/10/95

MEMORANDUM OF UNDERSTANDING
ACTIVITY A-1 CARTRIDGE FILTER REPLACEMENT, ALARA SOURCE TERM

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MEMORANDUM OF UNDERSTANDING
ACTIVITY A-1 CARTRIDGE FILTER REPLACEMENT, DOSE RATES AND SOURCE FOR ALARA REVIEW

This memorandum of understanding (MOU) has been prepared to document the anticipated dose and source of dose be used for the ALARA review on the process of removing and packaging spent cartridge filters from K East and West Basin.

Beginning in 1973, KE Basin was reactivated for the purpose of storing spent fuel from N Reactor. At that time, the basin was provided with a recirculated water treatment loop that included two cartridge filters and a heat exchanger

The cartridge filters are presently out of service in both KE and KW Basins. Their operation became untenable due to high dose rates (ALARA considerations) and the fact that they typically exceed the limit that defines transuranic waste. KE and KW Basins each have 2 filters located in the Tech View Pit.

The filter assemblies now installed in the cartridge filter housing are approximately 32 inches in diameter and 34 inches tall. The assembly has 88 filter elements spring loaded in-between two carbon steel disc. The filter system has an outside in flow path for the basin water which captures the particulate on the outside of the filters. Removal of these filters results in some of the caking dropping into the filter housing.

The cartridge filter system is being upgraded. The housing for the existing system will be retro-fitted with an internal adaptor that will hold seven (7) filter cartridges. Each filter will be constructed out of a perforated stainless steel can with a polypropylene pleated filter inside. The flow will be directed from the inside out to retain the filter cake within the individual filter elements during filter change outs. This filter upgrade will increase the dirt loading capacity of the filter elements and the source term for used filters.

The source term and associated dose rates were determined using historical date and 2 surveys of the filters in their housings (K-East) completed in 1995.

Recently 13 grout/culvert packaged cartridge filters have been sent to Solid Waste Disposal. Information on the amount of Cs 137 in these cartridge filters was obtained from WHC-SD-SNF-TA-005, Safety Evaluation - Spent Water Treatment System Components Inventory Release. Filters removed from the K East Basin had a maximum of 4.25 Ci of Cs 137, a low of 0.75 Ci and a mean of 1.75 Ci. The numbers for K West Basin are 1.16, .08, and .14.

The amount of Cs 137 on the cartridge filters in K West

basin is significantly lower then in K East basin due to the water quality maintained in KW basin. KW basin does not and never has stored fuel in open canisters. The numbers found in TA-005 will be used for both old and new filters until activities in the K basin warrant a change in source term.

Cartridge filters that were left in the basin housing in K East were surveyed in February and September. The dose readings on the out side of the housings were input into a computer code for calculations of the CS 137 loading. The Ci count was similar for each survey, 7.22 for February and 7.1 for September. 7.1 Ci of Cs will be used to estimate the dose for the filters presently in K East Basin.

The cartridge filter loop has a composite sampling system to allow mass balance calculation for determination of cartridge filter loading. The method has been determined invalid due to the release of material from the filter into the housing during replacement. This would cause a high initial pass through number. Internal Memo 95-SPB-035 shows a Cs inventory as high as 178 Ci for a cartridge filter in K East Basin this would give a dose rate of approximately 70 R/hr on contact. The surveys had a maximum reading of 4.5 R, too low to even consider this number valid.

The following Cs numbers and associated dose will be used for the ALARA review of the Cartridge filter change out activity.

Old filters in K East
7.1 Ci of Cs 137
Dose readings in a 2" steel liner
contact 245.7 mR/hr
@ 1 foot 137.9 mR/hr
@ 2 foot 80.7 mR/hr
@ 3 foot 51.0 mR/hr

Old filters and new filters in K West
1.16 Ci of Cs 137.
Dose readings in a 2" steel liner
contact 40.1 mR/hr
@ 1 foot 22.2 mR/hr
@ 2 foot 13.1 mR/hr
@ 3 foot 8.3 mR/hr

Dose estimates for the cartridge filters from K East basin in a ECO ROK over pack
contact 1.2 mR/ hr

It has been estimated that the new filters will hold up to 5 X the sludge loading as the old filters. With 5 X the loading of sludge there will probably be 5 X the quantity of Cs 137. Taking the mean number for Cs loading on the cartridge filters from TA-005, this would give a Cs 137 number of 12.75 Ci.

Calculating the amount of sludge that each filter can hold and determining the percentage of Cs in the sludge (using the amount in the basin floor sludge WHC-SD-SNF-TI-009) the Cs 137 number is 3.71 Ci.

The basin water sampling number is approximately 3.12 uCi/l. Using this number and flow rate of 500 gpm, running the filters for 30 days, and assuming that 2% of the Cs 137 will stay with the filters the Cs 137 number is 5.1 Ci. If the filters fill in only 15 days the Cs 137 number will be 2.5 Ci.

WHC-SD-SNF-TA-005 has two Cs numbers from samples of sludge on cartridge filters in K East 1.12 Ci and 3.27 Ci.

Determination of the actual amount of Cs that will be collected on the new cartridge filters at K East will require sampling of the new filters after they have been loaded. Until that information can be obtained a mid number of 4 Ci of Cs will be used for ALARA review.

New cartridge filters
K East basin
4 Ci of Cs
Dose readings in a 2" steel liner
contact 138.4 mR/hr
@ 1 foot 76.4 mR/hr
@ 2 foot 45.1 mR/hr
@ 3 foot 28.7 mR/hr

The attached table shows the dose rate in 1" and 2" steel liners atthe different Ci content.

Dose Rates for Spent Cartridge Filters

source document	Ci of Cs	1 " steel liner				2" steel liner			
K WEST BASIN		dose on contact	dose at 1'	dose at 2'	dose at 3'	dose on contact	dose at 1'	dose at 2'	dose at 3'
WHC-SD-SNF-TA-005		mR/hr	mR/hr	mR/hr	mR/hr	mR/hr	mR/hr	mR/hr	mR/hr
worst case	4.25	688.2	330.1	180.8	109.7	147	81.18	48.35	30.52
best case	0.075	121.5	58.26	31.91	19.36	25.95	14.33	8.53	5.38
mean	1.75	283.5	135.9	74.46	45.18	60.55	33.43	19.91	12.57
Survey 198144									
hot spot	7.22	1,170.00	560.8	307.2	186.4	249.8	137.9	82.14	51.85
Survey 225670									
average dose reading	7.1	1,150	551.5	302.1	183.3	245.7	135.6	80.77	50.99
at 12' down from top									
Source term for									
7 new filters	4	587.9	294.4	170.1	103.2	138.4	76.37	45.11	28.72
K EAST BASIN									
WHC-SD-SNF-TA-005									
worst case	1.16	175.5	85.3	49.3	29.9	40.1	22.2	13.1	8.3
best case mean	0.08	11.7	5.9	3.4	2.1	2.8	1.5	0.9	0.6
mean	0.14	20.6	10.3	5.9	3.6	4.8	2.7	1.6	1