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<b>Re:</b> Missing Pages From the 6 Boxes	<b>CC:</b>

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● **Comments:**

Amy, following are some missing pages I just received. The first 2 pages (no. 1-8 and 1-9) are for document number DOE/EA-0279, Nonnuclear Consolidation Environmental Assessment (Scan ID# 124620-02D10) – it was in Box No. 4 of 6 – this was our Reference No. 52-1. The last group (pages A-2, A-4, A-6, A-8, A-10 and A-12) is for Appendix A of Old F-Area Seepage Basin Mixing Zone Application, WSRC-RP-97-39, (Scan ID# 124620-02B12) – it was in Box 2 of 6 – this was our Reference No. 13-1.

This is the last of it.

Mark

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## Nonnuclear EA

development for several years. This section presents a summary of the plans and reports completed to develop the nonnuclear consolidation proposal, and details the foundation on which the nonnuclear proposal is based. Section 1.6.1 summarizes the background of Complex reconfiguration beginning with the direction from Congress to complete a study and plan for modernization of the Complex through the preparation of the Nonnuclear Consolidation Plan (NCP). Section 1.6.2 describes the basis for nonnuclear consolidation as presented in the NCP and the modifications that have been made due to changing world events and additional detailed studies. The resulting revised basis for nonnuclear consolidation is then described. This is the basis for the activities that make up the nonnuclear consolidation proposal which is assessed in the EA.

### 1.6.1 Summary of Reconfiguration Planning

Recognizing that a comprehensive approach was needed to address current problems of the Complex, Congress directed, in the *National Defense Authorization Act for Fiscal Years 1988/1989* (P.L. 100-180), that a study be conducted and a plan be prepared for modernizing the Complex, taking into account the overall size, productive capacity, technology base, and investment strategy necessary to support long-term security objectives. The product of that study, entitled the *Nuclear Weapons Complex Modernization Report* (Modernization Report) (DOE, 1989), was submitted to Congress on January 12, 1989. It called for extensive modernization of facilities over a 15- to 20-year period. The report also called for a major environmental restoration and waste management program.

Fundamental changes in DOE policy direction and in the structure of international political and military forces raised questions about the continued validity of assumptions underlying the Modernization Report and the adequacy of proposed solutions for the more serious problems of the Complex. Consequently,

in September 1989, former Secretary Watkins ordered the establishment of a Modernization Review Committee to reexamine the modernization issue. The committee was directed to review the assumptions and recommendations of the original Modernization Report; assess the capacity and capability requirements of the Complex; and review the processes by which immediate and future requirements for maintaining, updating, and cleaning up the Complex are developed.

In August 1990, the Secretary reviewed the progress of the study and issued additional guidance focusing the analysis on the realities of the emerging international security environment. This ensured flexibility to accommodate the likely range of deterrent contingencies and emphasized the objective of achieving a Complex that is smaller, less diverse, and less expensive to operate than the current Complex. Subsequently, the Modernization Review Committee was redesignated the Complex Reconfiguration Committee. The Committee's product, the *Nuclear Weapons Complex Reconfiguration Study* (Reconfiguration Study) (DOE, 1991c), was published in February 1991 and replaced the January 1989 Modernization Report.

The Reconfiguration Study presented an overview of problems within the Complex; outlined a vision of the future Complex, including potential configurations and transitional activities; and described a process for a future Secretarial decision on whether and how to reconfigure the Complex. In preparing the Reconfiguration Study, the Complex Reconfiguration Committee focused on six major areas: stockpile sizing criteria; environment, safety and health (ES&H); Complex configuration; management structure; capital asset management; and the PEIS. Separate study teams, formed for each major area, produced analyses and recommendations. The PEIS Study Team developed a NEPA strategy for reconfiguration, including investigation of the scope and proposed content of the PEIS and any subsequent project-specific EISs. This effort was coordinated with other DOE projects

*Introduction*

and activities that involve NEPA documentation pertinent to reconfiguration to avoid potential duplications and future conflicts.

To assist with the reconfiguration planning process, DOE chartered several internal panels and work groups. Of primary importance to this EA were the activities of the Privatization Planning Panel and the NCP Work Group.

The Privatization Planning Panel was chartered in June 1990 to evaluate nonnuclear functions and identify those functions that could be provided more cost-effectively through the private sector. The panel completed the first phase of its activities and prepared a report describing the privatization potential of DOE's nonnuclear products and manufacturing processes used in the Complex (DOE, 1991b). This document includes a list of processes and products that are candidates for privatization, and reports on the associated costs, benefits, and risks. The panel concluded that most of the activities that could be accomplished more economically by the private sector had already been privatized. Consequently, large-scale privatization was considered inappropriate in the absence of other consolidation decisions. Upon completion of this phase, DOE formed the NCP Work Group to develop a plan for consolidation of nonnuclear functions.

### **1.6.2 Basis for Nonnuclear Consolidation**

At the height of the "Cold War" in the 1960's and 1970's, the Complex was required to support a very large stockpile of weapons to meet nuclear deterrence requirements set forth in the annual Nuclear Weapons Stockpile Memorandum signed by the President. To support such a large number of weapons, in turn, required large facilities, utilizing multiple production lines and employing workers on multiple shifts to: keep up with the required new weapons manufacturing rate; perform surveillance on and repair or replace weapons components as necessary to maintain the stockpile; and retire the weapons and components that were being replaced.

Thus, the capacity of these large facilities was fully utilized to meet the then-current requirements.

In the mid-to-late 1980's, the United States and the former Soviet Union reached agreement on the START I and Intermediate Nuclear Force Treaties, which contained substantial cuts in the nuclear forces of both sides. Then, with the fall of Communist governments in Eastern Europe and the breakup of the former Soviet Union, the tensions of the Cold War eased and United States and Russian leaders began to talk seriously about further significant cuts in the nuclear weapons stockpiles of each side. As a result of these events, Complex facilities in general, and nonnuclear manufacturing facilities in particular, were required to produce far fewer weapons components. This, in turn, resulted in a change from three-shift-per-day operations, which fully utilized the capacity of several production lines, to single-shift operations, which in some instances did not even fully utilize the capacity of a single production line.

It was against this background that the reconfiguration planning described in section 1.6.1 was completed, and the NCP Work Group was chartered to develop a plan with recommendations for consolidation of the nonnuclear manufacturing facilities at a single site as a first step in making the Complex smaller, less diverse, and less expensive to operate. The team began its effort in April 1991 and completed the NCP in September 1991 (DOE, 1991f). During the course of preparing its recommendations, the team identified the basic capabilities and technologies required to manufacture the great variety of nonnuclear components necessary to build the weapons that are part of the enduring nuclear weapons stockpile. These capabilities also support the Stockpile Evaluation Program, the periodic replacement of limited-life components, and the repair or replacement of weapons components or subsystems as needed to maintain and upgrade stockpile reliability, safety, and security.

At the time that the NCP was prepared, there were ten different types of nuclear weapons that were

inputs to the OFASB flow model. Flow model calibration results are presented in the last section of this report.

Particle tracking indicates that groundwater flows northeast from the OFASB and then turns in a more northerly direction flowing into the unnamed stream that discharges to Upper Three Runs. Travel times of about 10 to 12 years are predicted from the OFASB to the unnamed stream (Figure A-3) assuming an effective porosity of 30%. Figure A-2 illustrates the vertical groundwater flow paths from the top and bottom of the FNB well screens in the vicinity of the OFASB. Figure A-4 illustrates the topography and simulated seepage faces within the boundaries of the OFASB model. The simulated seepage faces match well with the surveyed seepage areas in the region (Figure A-3). Because the Gordon confining unit (confining unit IIA-IIB) is relatively competent from the basin to its outcrop at Upper Three Runs, contaminant migration is confined mainly to the "lower" aquifer zone (aquifer zone IIB<sub>1</sub>), (Figure A-2).

**Table A-1: Input parameters for OFASB groundwater flow model.**

Input parameter	Value of parameter	Uncertainty in parameter	Model sensitivity to parameter	Model uncertainty from parameter
Horizontal conductivity				
UTR aquifer unit; "upper" zone	8.0 ft/d avg.	Low	High	Medium
UTR aquifer unit; "lower" zone	8.7 ft/d avg.			
Gordon aquifer unit	40 ft/d ave.			
Vertical conductivity				
UTR aquifer unit; "tan clay" zone	0.005 ft/d avg.	Low	High	Medium
Gordon confining unit	1.0x10 <sup>-5</sup> ft/d avg.			
Effective porosity	0.30	Medium	Low	Low
Average recharge	14.0 in/yr	Low	High	Medium

## Transport Model Discussion

The following constituents were modeled in the transport simulations:

- Tritium
- Nitrate (NO<sub>3</sub><sup>-</sup>)
- Iodine- 129
- Strontium-90
- Uranium (total)

**Table A-2: Input parameters for OFASB solute transport model.**

Input parameter	Value of parameter	Uncertainty in parameter	Model sensitivity to parameter	Model uncertainty from parameter
Distribution coeff. ( $K_d$ )				
Tritium	0.001 ml/g	Low	Low	Low
Uranium	4 ml/g	High	High	High
Strontium-90	3 ml/g	Medium	High	Medium
Iodine- 129	3.6 ml/g	Medium	High	Medium
Nitrate	0.01 ml/g	Low	Low	Low
Radioactive half-life				
Tritium	12.3 yr	Low	High	Low
Uranium	assumed inf.	Low	Low	Low
Strontium-90	28.8 yr	Low	High	Low
Iodine- 129	assumed inf.	Low	Low	Low
Nitrate	N/A			
Dispersivity				
Longitudinal	30 ft	Medium	Medium	Medium
Transverse horizontal	5 ft	Medium	Medium	Medium
Transverse vertical	0.1 ft	Medium	Low	Low
Effective porosity	0.30	Medium	Medium	Medium
Bulk density	1.6 g/ml	Low	Medium	Low

## Transport Model Results

The plume maps shown in the main text, based on recent FNB plume monitoring well data, define the initial conditions for transport simulation. These plan view maps were assumed to represent average contaminant concentration levels over a vertical region extending to 33' below the water table. The maps were digitized using Earthvision® software. Well average concentrations were computed at the plume wells and the Compliance Boundary Wells (CBW). For each contaminant, predicted concentration is compared to their MCL. Each simulation was continued until peak concentration was observed in the compliance boundary wells. Groundwater transport times between the basin and the compliance boundary are on the order of 10 to 12 years. For each contaminant, concentration break-through curves at the CBWs and plume contour plots in plan and cross-sectional views at key times are provided below. Concentration levels presented in the break-through plots represent average concentration over well screens. Concentration levels presented in the plan view plots represent average concentration for the entire thickness of the "lower" aquifer zone (IIB 1). Concentration levels presented in the cross-sectional view plots represent local concentration. A discussion for each constituent follows.

compliance well predicted to exceed the current MCL in 180 years. The remaining CBWs are all well below the MCL.

### **Strontium-90**

The strontium-90 inventory in the initial plume is about 0.028 Ci. The retardation factor (R) for strontium-90 is 17 based on the  $K_d$  value given in Table A-2. The center of mass of the plume is therefore predicted to reach the compliance boundary in 170 years. However, with a radioactive half-life of 28.8 years (Table A-2), virtually all the plume activity will decay in transit. Wells FNB 2, 3 and 5 are currently above the 8 pCi/l MCL for strontium-90. In the assumed absence of a source term, these wells are predicted to fall below the MCL after 20 to 40 years (Figure A-17). Figure A-18 illustrates strontium-90 break-through at the compliance boundary wells. A maximum value of 0.23 pCi/l is predicted to occur in CBW 2c after 110 years. From that point on there is a steady decline in strontium-90 values at CBW 2c. Figures A-19 and A-20 illustrate plan and cross-sectional views of the plume at 50, 100, 150, and 200 years into the future. Strontium-90 concentrations are not predicted to exceed the MCL at the compliance boundary nor even reach the compliance boundary.

### **Uranium (Total)**

The total uranium inventory in the initial plume is about 52 kg. The retardation factor (R) for uranium is 22 based on the  $K_d$  value given in Table A-2. The center of mass of the plume is therefore expected to reach the compliance boundary in about 220 years. Radioactive decay is neglected because the half-lives of uranium isotopes are large compared to the transport times. Wells FNB 2 and 5 are currently above the 20 µg/l MCL for uranium. In the assumed absence of a source term, these wells are predicted to fall below the MCL after 60 to 70 years (Figure A-21). Figure A-22 illustrates uranium break-through at the compliance boundary wells. A maximum value of 5.0 µg/l is predicted to occur in CBW 2d after 240 years, which is well below the MCL. Figures A-23 and A-24 illustrate plan and cross-sectional views of the plume at 50, 150, 250, and 350 years into the future. At no time does predicted total uranium concentration exceed the MCL at the compliance boundary.

### **Quantitative uncertainty analysis**

Additional numerical simulations were performed to quantify the uncertainty in the nominal break-through curve results for compliance boundary well with the largest peak concentration (CBW 2c or 2d depending on contaminant). Three settings for dispersivity were considered (Table A-3). The nominal settings are also shown for comparison in the table.

Figures A-25 through A-29 summarize the sensitivity results for all 5 contaminants. None of the sensitivity runs result in a large deviation from the nominal case.

### Detailed Discussion of Geochemical Analysis

The transport behavior of a dissolved constituent depends on the constituent, the groundwater composition, and the aquifer mineralogy. Site specific studies were used to estimate the water table aquifer mineralogy of the OFASB. The Geochemical Information Management System (GIMS) database was used to obtain an estimate of the groundwater composition. Where possible, site specific studies of individual constituent behavior were used to estimate  $IQ$  values, with supporting evidence from other published studies. For constituents not covered in site specific studies, pertinent scientific literature was used to estimate  $K_d$  values.

It must be noted that groundwater models using  $K_d$  values provide only limited estimations of the transport behavior of dissolved constituents in groundwater. A  $IQ$  value is a measure of the steady state partitioning of a constituent between the solid and aqueous phases. Most studies measure partitioning in a simple system consisting of one solid phase and one dissolved constituent with ionic strength variations achieved with relatively inert electrolytes. Such systems do not reflect the complexity of natural aquifer conditions. Aquifer solids are typically a blend of several different types of sorption surfaces and heterogeneities in the blend are common. In addition, the speciation of dissolved constituents can complicate transport behavior. Complexes that limit sorption are not considered in most measurements of  $K_d$  values and variations in contaminant speciation during transport are rarely considered.

The spatial distribution of aquifer heterogeneities is also an important factor in contaminant transport. Sedimentation and diagenetic processes result in aquifer heterogeneities that are not randomly distributed. Thus, transport behavior of a constituent at two sites with the same degree of heterogeneity may be very different if the distribution of heterogeneities is different. For example, linear heterogeneities that trend transverse to groundwater flow may cause different transport behavior than if they trend in the direction of groundwater flow. Thus, models that randomly vary  $K_d$  values and those that use  $K_d$  values measured in-situ at a site cannot accurately describe transport behavior of a constituent without knowledge of the spatial distribution of aquifer heterogeneities.

Therefore, the  $K_d$  values presented here are meant for use in estimating bounding conditions of contaminant transport rather than for use in models that attempt to accurately predict contaminant concentrations.

The retardation of most metals and radionuclides is strongly influenced by the mineralogy of the aquifer and the chemistry of the groundwater. Aquifer mineralogy is important because the surface properties of minerals control sorption of the contaminants and surface properties vary considerably among minerals. The chemistry of the groundwater is important because it determines the dominant species of contaminants present and

**Table A-5: Recommended IQ values for selected constituents at the OFASB in groundwater of pH=4.**

Constituent	K <sub>d</sub> Value (ml/g)
Tritium	0.001
Nitrate	0.01
Iodine- 129	3.6
Strontium-90	3
Uranium (total)	4

### **Tritium**

Tritium in groundwater is predominantly in the form of water and is virtually unretarded during groundwater flow. The value used in this model (0.001 ml/g) is that reported by Looney et al. (1987).

### **Nitrate**

Nitrate is an anionic species and may be adsorbed by soils under acidic conditions (Li et al., 1995; Bellini et al., 1996). However, in groundwater associated with the F-Area Seepage Basins nitrate concentrations show a linear trend with tritium concentrations (Figure A-30). The trend dissipates at very high nitrate and tritium concentrations. Groundwater with these concentrations also tends to be the most acidic, and thus under these conditions some nitrate retardation is apparent. However, because of the strong linear trend between tritium and nitrate and the fact that nitrate from F- and H-Area Seepage Basins has reached the seepline along Four Mile Branch (Haselow et al., 1990), it is assumed here that nitrate is slightly retarded relative to tritium. Thus, a K<sub>d</sub> value of 0.01 ml/g was chosen.

### **Iodine-129**

The dominant species of iodine-129 in the groundwater is iodide. Thus some retardation may be expected. The K<sub>d</sub> value chosen here (3.6 ml/g) is the minimum value measured in batch tests by Hoeffner (1985) using soils from the Savannah River Site. This value is consistent with those measured by Allard et al. (1980) for iodide sorption onto iron and aluminum hydroxides.

Analyses of four soil cores from within the OFASB suggest that significant retardation of iodine- 129 has occurred. Based on these cores the average activity of iodine-129 in the soils beneath the basin was 4.07 pCi/g (WSRC, 1995). From this activity and the area of the basin it is estimated that approximately 0.07 Ci remain in the top 2 meters of these soils. If this estimate is an order of magnitude high it still represents significant retardation of iodine-129, because only 0.006 Ci are in the initial plume. Hence, a K<sub>d</sub> value of 3.6 ml/g is reasonable.



Gordon Aquifer Unit Summary

rms of (FACT-data) differences: 0.970  
 avg of (FACT-data) differences: -0.623  
 avg of |FACT-data| differences: 0.892  
 max of (FACT-data) differences: -1.440

Well ID	model-x	model-y	zbot	zrow	head	data	residual
"FC 1A "	7089.90	12409.76	96.7	1b.7	143.5	143.8	0.3
"FC 2B "	9434.23	12485.73	78.8	83.8	148.0	147.5	-0.5
"FC 2C "	9432.21	12493.79	129.5	134.5	146.7	147.3	0.6
"FC 4C "	7324.74	15108.45	116.3	121.3	137.6	136.2	-1.4
"FNB 1A "	8136.07	13133.07	107.9	117.9	144.5	143.6	-0.9
"FNB 2A "	8139.19	13440.64	111.1	121.1	143.9	142.7	-1.2
"FNB 3A "	7883.91	13491.17	109.2	119.2	143.4	142.2	-1.2

Lower Aquifer Zone Summary

rms of (FACT-data) differences: 2.874  
 avg of (FACT-data) differences: 1.372  
 avg of |FACT-data| differences: 2.309  
 max of (FACT-data) differences: -6.276

Well ID	model-x	model-y	zbot	zrow	head	data	residual
"FBP 3A "	4900.05	12122.59	141.0	171.0	194.2	195.2	1.0
"FBP 7D "	4873.21	12082.94	183.2	203.2	194.7	196.7	2.0
"FBP 8D "	5476.46	11685.78	172.8	192.8	207.4	204.5	-2.9
"FBP 9D "	5114.07	11888.16	177.9	197.9	200.6	201.3	0.7
"FC 1B "	7088.16	12417.46	151.8	156.8	210.8	212.7	1.9
"FC 1C "	7086.65	12425.01	183.9	188.9	214.0	213.6	-0.4
"FC 4E "	7331.13	15123.61	176.4	181.4	185.2	178.9	-6.3
"FNB 1 "	8119.87	13126.56	177.2	207.2	210.5	213.2	2.7
"FNB 2 "	8147.93	13429.82	180.8	210.8	206.8	210.5	3.7
"FNB 3 "	7874.20	13484.92	182.1	212.1	209.0	211.5	2.5
"FNB 4 "	7647.42	13290.21	179.6	209.6	213.2	212.9	-0.3
"FNB 5 "	8058.84	13527.23	193.5	203.5	207.1	209.7	2.6
"FNB 6 "	7808.88	13746.44	200.2	210.2	209.4	210.6	1.2
"FNB 7 "	8140.50	13639.77	192.0	202.0	205.3	208.1	2.8
"FNB 8 "	8315.60	13546.39	195.0	205.0	203.8	208.5	4.7
"NBG 4 "	8427.66	11955.57	196.1	227.5	217.0	218.4	1.4
"NBG 5 "	8609.72	11995.59	194.9	226.4	217.7	217.8	0.1
"ZW 2 "	8120.06	13688.89	194.8	204.8	207.3	207.8	0.5
"FC 2D "	9429.97	12500.98	159.2	164.2	208.3	213.3	5.0
"FC 2E "	9428.91	12509.34	188.9	193.9	209.4	214.1	4.7
"FC 2F "	9426.60	12516.82	207.3	212.3	216.1	217.4	1.3

Upper Aquifer Zone Summary

rms of (FACT-data) differences: 2.874  
 avg of (FACT-data) differences: -0.719  
 avg of |FACT-data| differences: 2.233  
 max of (FACT-data) differences: 5.240

Well ID	model-x	model-y	zbot	zrow	head	data	residual
"FC 1D "	7084.36	12432.91	217.2	222.2	223.6	222.4	-1.2
"FCA 16A "	7692.74	11755.80	215.1	235.1	225.2	224.3	-0.9
"FCA 16D "	7840.35	11786.16	221.1	241.1	225.0	224.2	-0.8
"FSL 1D "	7095.02	11796.01	208.5	228.6	224.4	224.5	0.1
"NBG 1 "	7913.10	12212.50	200.9	232.3	224.4	220.4	-4.0
"NBG 2 "	8032.18	12032.73	203.6	233.6	224.8	221.4	-3.4
"NBG 3 "	8172.79	11898.84	202.1	233.5	217.6	222.8	5.2

**Aquifer Restoration Times**

Maximum point concentration levels as a function of time are provided in Figure A-34 along with each contaminant's MCL value. The point of intersection between these two curves (solid and dash, respectively) represents the predicted time required for natural attenuation to restore the Upper Three Runs Aquifer Unit.