

SRNL-EST-2005-00105

June 21, 2005

TO: Mark A. Phifer, 773-42A
FROM: Kenneth L. Dixon, 773-42A

APPROVED for Release for
Unlimited (Release to Public)
6/23/2005

Re: Concrete Mixes for Saltstone Vault 4

The mix of concrete used in the construction of the work slab, foundation, exterior walls, and interior walls, and roof for Saltstone Disposal Vault 4 has been determined. The original construction on Vault 4 included the work slab, foundation, exterior walls, and interior walls. This work was performed in 1988 and, at that time the vault was referred to as Vaults 6 and 7. These vaults later became known as Vault 4. Subsequently, the vault walls (exterior and interior) were extended and a concrete roof was added. This work was performed in 1996.

The original construction work on the vault was conducted under Purchase Requisition AXC-220532 Project 9S2295. From this package, drawing W828992 indicates in the notes section that Class "Z2" concrete was used for the foundation and walls and, Class "A" concrete was used in the work slab per Specification #9304, Division 3. Specification #9304 was found in records; however, the copy was incomplete and did not contain Division 3. There was no mention of concrete type in the portion of the document obtained. A search of the project files for 9S2295 produced a Design Change Form (DCF) D-0001 that contained Page 1 of Specification 9304, Division 3. This page corroborates the drawing notes that Class Z2 concrete ($f'c = 4000$ psi) was used in the foundation and walls and Class A ($f'c = 2000$ psi) concrete was used for the work slab. This document did not give the mix for either of the two types of concrete mentioned.

Further review of the project files, produced the delivery tickets for the concrete as it was poured during the construction of the facility. These tickets proved useful in determining the type and mix of concrete used in the construction of the vault. The vendor for the concrete (Sherman Industries, Inc., Joe Kelley) was contacted to ensure that the delivery tickets were correctly interpreted. From these tickets, Class Z2 was determined to be mix Z2-4000-5C. This mix of concrete was used in the foundation and walls for the vault as indicated on the delivery tickets. The mix contained cement, sand, aggregate and an admixture called NewCem manufactured by Lafarge North America, Inc. NewCem has been determined to be a granulated blast furnace slag compliant with ASTM C989 and meets the specification requirements of Grade 120. The manufacturer's product description for NEWCEM may be found at www.lafargenorthamerica.com. Type II Portland cement conforming to ASTM C 150 was used in the vault construction according to an Engineering Design File prepared by EG&G Idaho, Inc. (Project File SALT-92-002, Concrete Degradation Calculations For Z-Area Vaults). Based on the delivery tickets, the recipe for the mix is given in Table 1. Figure 1 shows a typical delivery ticket for the Z2-4000-5C mix.

Class A concrete was determined to be mix AP-2000-6C. As indicated by the delivery tickets, this mix was used in the work slab and contained cement, sand, aggregate, and fly ash. No information was found in the project files on the type of cement used in this mix. Based on the delivery tickets, the recipe for the mix is given in Table 1. Figure 2 shows a typical delivery ticket for the AP-2000-6C mix.

THE WSRC TEAM

Table 1. Concrete mixes used in original 1988 construction of Saltstone Disposal Vault 4

Mix	Location	Cement (lb/yd ³)	Water (gal/yd ³)	Sand (lb/yd ³)	Aggregate (lb/yd ³)	Flyash (lb/yd ³)	NEWCEM ¹ (lb/yd ³)
Z2-4000-5C	Foundation/Walls	419	30.4	1133	1798	0	278
AP-2000-6C	Work Slab	413	32.7	1356	1698	73	0

¹granulated blast furnace slag

In 1996, the walls of the vault (exterior and interior) were extended and a concrete roof was added. This work was performed under contract QB00040K. Supplier Deviation Disposition Request (SDDR) 2916 was issued to change the type of concrete used for the interior walls, the roof slab, and the transformer foundation. Per C-DCF-Z-00015, the concrete used in the exterior walls on Vault 4 was mix C-4000-8-S-2-AB per site specification C-SPS-G-00041. C-DCF-Z-00018 superseded C-DCF-Z-00015 and changed the mix for the exterior walls to C-4000-6-P-2-A. Table 2 gives the recipe for this mix of concrete. This mix of concrete contained cement, sand, aggregate, and fly ash and did not include the slag that was used in the original wall construction. Type II Portland cement conforming to ASTM C 150 was used in the mix. The original wall height for Vault 4 was 25 ft and the wall extension was 1 ft. The purpose of the wall extension was to allow for the installation of the roof. The maximum waste height in the vault is 24.75 ft and will not contact the wall extension. Mix C-4000-6-P-2-A was also used for the interior walls, roof slab, and transformer foundation.

Table 2. Concrete mixes used in 1996 Saltstone Disposal Vault 4 Modification

Mix	Location	Cement (lb/yd ³)	Water (gal/yd ³)	Sand (lb/yd ³)	Aggregate (lb/yd ³)	Flyash (lb/yd ³)	Slag (lb/yd ³)
C-4000-6-P-2-A	Exterior, Interior Walls, Roof Slab, Transformer Foundation	466	35.5	1190	1800	62	0

cc: Ed Stevens, 773-A
Tom Butcher, 773-43A
Mary Harris, 773-42A
Bob Aylward, 773-42A
Chris Langton, 773-43A
Elmer Wilhite, 773-43A
Jim Cook, 773-43A
Dennis Thompson, 704-Z
Patrick Schneider, 704-Z
Tim Chandler, 704-Z
Aaron Staub, 704-27S
Jeff Ray, 704-S
ESTD File

SHERMAN INDUSTRIES, INC.
CONCRETE GROUP

No. 03181

OK
go
220532

INSPECTOR <i>[Signature]</i>		SLUMP A	AIR CONTENT A	TEMPERATURE A	
		B	B	B	
		C	C	C	
DRIVER <i>[Signature]</i>	TIME ARRIVED @ JOB SITE 7:14	TIME DISCHARGE COMPLETED	WATER ADDED @ JOB SITE 25	RECEIVED BY <i>[Signature]</i>	
	TIME DISCHARGE STARTED	TIME ARRIVED @ PLANT SITE			

INVOICE TO E. I. DUPONT SAVANNAH RIVER PLANT JACKSON S.C. 29831		DELIVER TO 2295-7451-4000 K.E. / Z AREA SLAB 6B / VAULT 6		COMMENTS ORDERED BY: RONNIE 400 1					
DATE 04/07/88	MIX NO. 5	YARDAGE 10.00	QTY. ORD'D 77.00	QTY. DELV'D 70.00	TRUCK NO. 73	PLANT NO. 1	BATCH 13	DISK NO.	TERMS
#67 AGG. 18240 < .40/ .10> (1.50)		CEMENT 4213* < .45/ .05>		MICROAIR 59					
SAND 29750 (1.50)		NEWCEM 6981		300N 400					
NITROGEN TIME 0		WATER 233/1943 < .00/ .00>		TRIM -3.00					
AGG TARE 0 CNT TARE 16		SLUMP 41 0		MAX WATER 3351 19					
TIME 10:59:31		39		<i>[Signature]</i>		4-7-88			
DESCRIPTION	CLASS Z2-4000-5C COOLED NEWCEM 4000 P.S.I.	QUANTITY	UNIT PRICE	EXTENDED	FREIGHT	SALES TAX	TOTAL		

Figure 1. Typical Delivery Ticket for Concrete Mix Z2-4000-5C used in Vault 4 (formerly Vault 6/7) Construction.

THE WSRC TEAM

SHERMAN INDUSTRIES, INC.

CONCRETE GROUP

No. 02896

INSPECTOR		SLUMP A	AIR CONTENT A	TEMPERATURE A
		B	B	B
		C	C	C
DRIVER	TIME ARRIVED @ JOB SITE	TIME DISCHARGE COMPLETED	WATER ADDED @ JOB SITE 17	RECEIVED BY <i>Randy Johnson</i>
	TIME DISCHARGE STARTED	TIME ARRIVED @ PLANT SITE		

INVOICE TO E. I. DUPONT SAVANNAH RIVER PLANT JACKSON S.C. 29831		DELIVER TO 2295-2451-4000 K.E. / WORKSLAB VAULTS 6 & 7		COMMENTS ORDERED BY: RONNIE 400					
DATE 03/24/88	MIX NO. 3	YARDAGE 10.00	QTY. ORD'D 800.00	QTY. DEL'V'D 650.00	TRUCK NO. 52	PLANT NO. 1	BATCH 77	DISK NO.	TERMS
#67 AGG. 17170 < .40/ .10> (1.00)		CEMENT 4148 < .45/ .05>		MICROAIR 29					
SAND 31030 (2.50)		FLYASH 4863		300N 240					
		WATER 246/2051 < .00/ .00>		TRIM .00					
NITROGEN TIME 0		SLUMP 0/ 0		MAX WATER 324/ 17					
AGG TARE 0 CNT TARE 12									
TIME 16:51:05									
DESCRIPTION CLASS AP-2000-6C COOLED 2000 PSI	QUANTITY	UNIT PRICE	EXTENDED	FREIGHT	SALES TAX	TOTAL			

Figure 2. Typical Delivery Ticket for Concrete Mix AP-2000-6C used in Vault 4 (formerly Vault 6/7) Construction.