ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Document: Phase III Test Report **Revision 0**

The signature below of the Lead Reviewer records that:
- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☐ **Design Verification Review** ☐ **Engineering Review** ☒ **Owner's Review**
- ☐ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

☐ **Special Engineering Review**____________________

☐ YES ☐ N/A **Other Records are attached.**

John Holliday	Civil	08/10/09
Lead Reviewer (print/sign)	**Discipline**	**Date**

Item No.	Deficiency	Resolution
1.	NONE	
2.		
3.		

FORM EGR-NGGC-0003-2-10
This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

0/85

S&ME

S&ME, INC. KNOXVILLE BRANCH

PHASE III TEST REPORT
Mix Acceptance Testing

FOR
CRYSTAL RIVER UNIT 3 STEAM GENERATOR REPLACEMENT PROJECT
S&ME PROJECT NUMBER 1439-08-208
Contract 373812

Prepared for:
Mr. John Holliday
PROGRESS ENERGY FLORIDA, INC.

15760 West Powerline Street
Crystal River, Florida 34428-6708

June 19, 2009

PREPARED BY: [signature]

REVIEWED BY: [signature]

QA BY: [signature]

APPROVED BY: [signature]

All work contained in this report was conducted in accordance with the requirements of the referenced procurement documents and the S&ME, Inc., Knoxville Branch Quality Assurance Manual, Volume I, Revision 4, dated December 5, 2003.

S&ME, INC. / 1413 Topside Road / Louisville, TN 37777 / p 865.970.0003 f 865.970.2312 / www.smeinc.com

BACKGROUND

S&ME, Inc. (S&ME) and our subcontractor CTLGroup (CTL) have completed the Phase III Mix Acceptance Testing for the Crystal River Unit 3 Steam Generator Replacement Project. The testing was performed as outlined in Contract 373812, Laboratory Testing Requirements for Concrete Proportioning Revision 3, and the Phase III Test Plan Rev. 0 dated January 30, 2009 with modifications based upon discussions with Progress Energy (Progress) and Sargent & Lundy (S&L) personnel. The purpose of the testing program was to perform acceptance testing on the selected mix chosen by Progress based upon the results of the Phase II testing program. Phase III testing was performed under our 10CFR50 Appendix B Program. Qualification testing of ingredient materials was performed in Phase I and has already been reported.

MATERIAL PROPORTIONS

The ingredient materials and target mixture proportions (on a cubic yard basis) for the Phase III Mix Acceptance Testing program were as follows:

	Weight	Volume
Holly Hill Type I Cement	560	2.86
Class F Fly Ash (Proash)	140	0.93
Maryville #67 Coarse Agg.	1613	9.23
Natural Sand (Lilesville, NC)	1515	9.23
Water	262.5	4.21
Target Air Content (2%)		0.54

Target w/c	0.375
Theoretical unit weight	151.5 pcf
ADVA CAST 575	Dosed as required to achieve desired fresh properties
Recover	Dosed as required to achieve desired fresh properties

TESTING/EQUIPMENT

Phase II (mix development testing), concluded with performance testing on two concrete mixes. Based on the results of the Phase II testing, Progress selected the mix to be tested in Phase III. Phase III (acceptance testing) included repeating the same performance tests as were performed in Phase II, with the addition of 91 day creep/shrinkage tests and total evaporable water tests. Current approved changes from the project specification that were identified during Phase II, and were in requested by Progress to be implemented for the Phase III testing included the following:

- The required slump at discharge was to be between 6 and 9 inches.
- The 0.35 maximum water to cementitious ratio did not apply.

- The mixes were to be performed near laboratory air temperature. No cooling of the ingredients or mix was required.
- The total mixing time was to be extended by two minutes from that defined in ASTM C 192-06.

Electronic digital scales were used for weighing the materials prior to batching. The mixing was performed using a revolving drum mixer in accordance with ASTM C 192-06, except, as noted above; the final mixing time was extended by two minutes. Standard test equipment was used for the fresh property testing (slump, air content, unit weight, and temperature). The cylinders were cast in 6 x 12 inch plastic single-use, lipped, cylinder molds. The autogenous curing containers specified for the five day accelerated curing were constructed to meet the requirements of ASTM C 684-99, Method C. These containers consisted of metal cans, lined with insulation. The insulation encapsulated a PVC sleeve sized so that the cylinder with mold could be placed into the container. Each container contained "i-button" temperature sensors. Subsequent to the required accelerated cure, the molded, sealed specimens were stored in a moisture cabinet with the exception of the creep and shrinkage specimens. Subsequent storage of the creep and shrinkage specimens is described in the next section. Cylinders for compression testing were capped with sulfur capping compound and tested in a compression machine. Modulus data was obtained using a compressometer with an 8 inch gage length, fitted with a digital dial gage. Thermal diffusivity temperature readings were performed using thermocouples and a digital readout. Equipment for the total evaporable water test included a boiling water chamber with a calibrated thermometer, a balance, and a laboratory drying oven. Total evaporable water was determined by drying fragments of the tested 5 day compression specimens following the procedure described in section 5.1 (oven –dry mass) of ASTM C 642-06. Evaporable moisture was calculated by dividing the weight of evaporated water by the weight of the dry concrete sample. After obtaining this information the remainder of the referenced test procedure was completed for informational purposes.

The creep and shrinkage specimens were transported to CTL in their autogenous curing containers prior to an age of 5 days. Following the initial 5 day curing period, creep and shrinkage test specimens were removed from the autogenous curing containers and molds while inside the controlled the controlled environmental room where the testing was to be performed. The controlled environment was maintained at 73.4+/-2° F and 50+/-4% relative humidity (See Notice of Anomaly/Corrective Action section). The environmental control system consisted of a chilled water/steam generator, a pneumatic thermostat, and a pneumatic humidistat. The system had independent supply and feedback control. A separate monitoring system was used to provide a record of the environmental conditions. In addition, temperature and humidity was manually recorded concurrent with the creep measurements. The test specimens for basic creep and autogenous shrinkage were sealed to prevent moisture loss immediately after demolding using self-adhesive aluminum tape. The end surfaces of the creep test specimens were prepared by capping with sulfur capping compound to meet the requirements of ASTM C 617-98 (03) immediately after demolding to ensure a uniform load distribution. External strain gage points were instrumented after demolding. The specimens used for total creep and total shrinkage were temporarily wrapped in plastic to prevent drying during the end preparation and gage point installation.

This wrapping was removed prior to the start of testing.

Creep tests were conducted in loading frames in which springs were used to maintain the required load. Creep load was applied using a portable hydraulic jack equipped with a pressure measuring gage. Creep and shrinkage strains were measured using a portable external strain gage referenced to a constant-length standard bar. A Soiltest Model CT-171 Multi-Position Strain Gage equipped with a Mitutoyo digital dial gage with a resolution of 0.00005 in. was used to measure deformation between gage points positively affixed to the specimens. A gage length of 10 inches was used. Brass gage points with suitable seats for the strain gage were affixed to test specimens with rapid-set two-part epoxy adhesive. Three gage lines were used to measure deformation on creep and shrinkage specimens.

All creep specimens were preloaded to produce a stress of 200 psi in the test specimens. The preloading period did not exceed 15 minutes and was used to verify uniformity of load application. A sustained load of 2000 psi was applied at 5 days +/- 1 hour from the time that the specimens were molded. The sustained load remained applied for 91 days.

Autogenous shrinkage was determined from the two sealed specimens. Total shrinkage was determined from the two non-sealed specimens. Total deformation under sustained load, including instantaneous, basic and drying creep strains, as well as the elastic and creep recovery after creep testing, was determined. Basic creep was determined from the two sealed specimens. Total deformation, including basic and drying creep strains, were determined from the two non-sealed specimens.

The creep and shrinkage deformation measurements for each one of the creep and shrinkage specimens in a test set was as follows:
Before loading:

- Immediately before specimens start drying
- Immediately before loading

During the first day after loading:

- Within 5 minutes
- At 15 to 20 minutes
- At ~ one hour
- At ~ 2 hour 45 minutes
- Between 6 and 8 hours

First week:

- Daily within +/-1/2 hour of the time of loading

After first week:

- Weekly +/-6 hours of the time of loading until 28 days, after which the readings will be taken weekly +/-1 day of the time of loading

Measurements with mechanical strain gages were completed along the three gage lengths on each test specimen, before taking the readings on any other specimens in the creep frame.

The readings on each specimen were taken within two minutes and the time of reading reported for each specimen individually. The time of measurement readings were recorded to the nearest minute, and reported as a fraction of a day. The strain readings were plotted within the hour of measurement and evaluated to detect irregularities or inconsistencies. Elastic recovery was measured at the time the sustained load was removed. Creep recovery was measured for approximately 8 days after load removal. CTL's test report, the creep and shrinkage data, and recorded temperature and humidity values at the time of creep and shrinkage readings are included in Appendix A.

A list of the Phase III equipment that required calibration is included in Appendix B. Laboratory accreditation certificates and information on the test personnel are included in Appendix C.

NOTICE OF ANOMALY/CORRECTIVE ACTION

During the creep testing program, one Notice of Anomaly (NOA) and two Corrective Action Reports (CARs) were issued.

The NOA was to document isolated instances where the temperature logger showed some readings approximately 0.5 degrees outside specified tolerance and to document some gaps in the continuous recording of the temperature and humidity data. (Continuous recording is not required by the test specification.)

The first CAR was issued to address where the temperature and humidity were temporarily out of specification due to equipment outages. The outages were considered to have had negligible impact on the creep testing for several reasons.

1. It was observed that the test results continued to conform to predicted trend lines that were established before the outages occurred.
2. The outages did not occur on the same days as deformation measurements, and the conditions had returned to normal by the time the measurements were taken.
3. Creep and shrinkage are relatively slow occurring phenomena and short term changes in environment do not significantly effect measurements.
4. The total time the room was out of specification was small relative to the total test time (3 days out of a 91 day test) and occurred near the end of the testing period, when measured behavior is the least sensitive to changes in environmental conditions.

The second CAR was issued to address a temporary malfunction of the chart recorder. According to an internal CTL procedure and the test plan a chart recorder was to be used to document temperature and humidity. During two periods the pen on the chart recorder registering humidity was not marking clearly on the chart and on another occasion the pen/chart stuck in one position. An independent temperature and humidity device had been placed in the room since the beginning of the test as a back-up system. This back-up recorder was calibrated at the end of the project to provide acceptable objective evidence for the environmental conditions for the creep and shrinkage testing.

A copy of the CARs and the NOA is included in Appendix D.

RESULTS

Certified Materials Test Reports (CMTR's) for the ingredient material qualification testing were provided in the Phase I test report. A summary of the results of the Phase III Mix Acceptance Testing is attached.

S&ME

Testing Summary
Mix Proportions and Fresh Properties

Client:	Progress Energy	Material:	Concrete Mix 1A
Project:	Crystal River	Source:	Laboratory Mix
S&ME Project No.:	1439-08-208	Quantity:	4.5 cubic foot
Contract/P.O. No.:	373812	Date / Time Mixed:	February 12, 2009, 9:57 am (Eastern)
		S&ME Log No.:	09-019-001

Mixture Proportions (calculations based on one cubic yard)			
Constituent Materials	S&ME Log No.	Weight (lbs)	Volume (ft^3)
Type I/II Portland Cement (Holly Hill)	08-040-001	560	2.86
Class F Fly Ash (Proash)	08-034-001	140	0.93
No. 67 Stone (Maryville)	08-037-001	1613	9.23
Natural Sand (Lilesville)	08-032-001	1515	9.23
Water	N/A	262.5	4.21
Target Air (2%)	N/A	---	0.54
Totals	---	4,090	27.0

Actual Admixture Dosages		
Constituent Materials	S&ME Log No.	Dosage Rate (oz/cwt)
ADVA CAST 575	09-012-001	8
Recover	09-004-001	2

Target water/cementitious ratio	0.375
Theoretical Unit Weight (pcf)	151.5

Measured Plastic Properties		
Property	ASTM Designation	Result
Slump (in)	ASTM C 143-05a	8.75
Air content (%)	ASTM C 231-04	1.6
Measured Unit Weight (pcf)	ASTM C 138-01	153.2
Concrete Temperature (°F)	ASTM C 1064-05	75
Air Temperature (°F)	N/A	72

Notes Concrete batching performed in accordance with ASTM C 192-06, except that final mixing time was extended by 2 minutes.
Admixtures dosed to achieve desired fresh properties.

1413 Topside Road Louisville, Tennessee 37777 Phone: 865-970-0003 Fax: 865-970-2312

S&ME

Testing Summary
Hardened Properties

Client:	Progress Energy	Material:	Concrete Mix 1A
Project:	Crystal River	Source:	Laboratory Mix
S&ME Project No.:	1439-08-208	Quantity:	4.5 cubic foot
Contract/P.O. No.:	373812	Date / Time Mixed:	February 12, 2009, 9:57 am (Eastern)
		S&ME Log No.:	09-019-001

Hardened Properties			
Property	ASTM Designation	Result (5-days)	Result (28-days)
Thermal Diffusivity, (ft^2/hr)	CRD-C 36-73	N/A	0.048 [1]
Evaporable Water, (%)	ASTM C 642-06	4.1 [2]	N/A
Compressive Strength, (psi)	ASTM C 39-05$^{\epsilon 1}$	7,160 [1] 7,030 [1,3]	---
Modulus of Elasticity, (psi)	ASTM C469-02$^{\epsilon 1}$	5.25×10^6 [1]	---
Compressive Strength, (psi)	ASTM C 39-05$^{\epsilon 1}$	---	8,330 [1] 8,230 [1,3]
Modulus of Elasticity, (psi)	ASTM C 469-02$^{\epsilon 1}$	---	5.80×10^6 [1]

Notes: All cylinders cured in autogenous containers (ASTM C 684-99 Method C) for five days.
1 Average of two specimens
2 Evaporable water determined by oven drying portion of ASTM C 642-06 Section 5.1.
3 Cylinders tested for compressive strength following moduli tests.

Hardened Property, Creep Coefficient (ASTM D 512-02)	
Creep Coefficient (sealed specimens)	0.698
Creep Coefficient (unsealed specimens)	1.139

Notes: All cylinders cured in autogenous containers (ASTM C 684-99 Method C) for five days then were maintained at 73.4 +/- 2 °F and 50 +/- 4 % relative humidity (See CTL CAR 09-002, CAR 09-003 and NOA-09001) following removal from autogenous containers. A load of 2,000 psi was applied at an age of 5 days and remained on the specimens for 91 days.

Hardened Properties on creep and shrinkage specimens after Creep Recovery (105 day age)		
Specimen Identification	Compressive Strength (psi) ASTM C 39-05$^{\epsilon 1}$	Modulus of Elasticity (psi) ASTM C 469-02$^{\epsilon 1}$
Sealed Shrinkage Specimen	9,530	---
Sealed Shrinkage Specimen Modulus Cylinder	9,650 [1]	6.70×10^6
Sealed Creep Specimen	9,530	---
Sealed Creep Specimen Modulus Cylinder	9,620 [1]	6.70×10^6
Unsealed Shrinkage Specimen	8,930	---
Unsealed Shrinkage Specimen Modulus Cylinder	9,170 [1]	5.80×10^6
Unsealed Creep Specimen	9,030	---
Unsealed Creep Specimen Modulus Cylinder	9,230 [1]	6.10×10^6

Notes: All cylinders cured in autogenous containers (ASTM C 684-99 Method C) for five days then were maintained at 73.4 +/- 2 °F and 50 +/- 4 % relative humidity following removal from autogenous containers through creep recovery readings.
1 Cylinders tested for compressive strength following moduli tests.

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Appendix A

CTL Test Report with Creep and Shrinkage Data

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June 12, 2009

Mr. John B. Pearson
S&ME
1413 Topside Rd.
Louisville, TN 37777

Phase III ASTM C 512 Creep Test Results for Mix 1A - Crystal River Unit 3 SGRP
CTLGroup Project No. 109151
S&ME Project No. 1439-08-208
Progress Energy Contract No. 373812

Dear Mr. Pearson:

Attached are the results of ASTM C 512 creep tests for Phase III of the above referenced project. You submitted two sets of five 6x12 in. concrete test cylinders that arrived at CTLGroup on February 16, 2009. The samples, identified as "09-019-001" were received sealed in autogenous curing chambers and sample receiving was overseen by your QA representative, Mr. John Coffey. The mixture was reportedly cast on February 12, 2009. On the morning of February 17, 2009 the samples were removed from the curing chambers in the testing environment, maintained at 73.4±2°F (23.0±1.1°C) and 50±4% relative humidity, and they were instrumented in preparation for testing.

Testing commenced in accordance with ASTM C 512 – 02, "Standard Test Method for Creep of Concrete in Compression" on February 17, 2009. All specimens were loaded at 5 days to 2000 psi as you requested. Results and calibration documents are attached. In addition to the formal report, we are providing the electronic data file as requested. This data file is intended for use only by personnel affiliated with this project and is not to be distributed.

We appreciate this opportunity to provide specialized testing services for you. Should you have any questions, please contact me.

Sincerely,

Matthew D'Ambrosia
Project Manager
Materials Consulting

mdambrosia@ctlgroup.com
Phone: (847) 972-3264

Attachment(s)

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Client	S&ME	CTL Project Number	109151
Project	Crystal River	Project Manager	M. D'Ambrosia
Contact	John Pearson	Technician	G. Neiweem
Date:	June 12, 2009	Approved	R. Burg

CTLGroup Project #109151
ASTM C 512 - Creep of Concrete in Compression
Mix: 09-019-001-1A, Sealed Cylinders, Loaded at 5 days to 2000 psi

Days Loaded	Shrinkage (μstrain)	Load induced deformation* (μstrain)	Specific creep (μstrain/psi)	Creep coefficient	Condition
-0.0306	0	0			No load, out of frame
-0.0188	- 16	0			Immediately before loading
-0.0097	- 17	33			Preload
0.0000	- 20	341	0.000	0.000	Loaded
0.0062	- 16	335	-0.003	-0.020	" "
0.0118	- 20	361	0.010	0.059	" "
0.0431	- 8	361	0.010	0.057	" "
0.1146	- 9	383	0.021	0.122	" "
0.2507	- 10	389	0.024	0.140	" "
1.0014	7	398	0.028	0.167	" "
2.0028	11	400	0.029	0.172	" "
3.0028	2	416	0.037	0.219	" "
4.0028	6	434	0.047	0.273	" "
5.0007	16	439	0.049	0.286	" "
6.0125	18	439	0.049	0.287	" "
7.0111	23	451	0.055	0.322	" "
13.9507	45	470	0.064	0.378	" "
20.9361	36	509	0.084	0.492	" "
27.9924	69	514	0.086	0.506	" "
34.9653	48	541	0.100	0.584	" "
42.1951	66	529	0.094	0.549	" "
49.0444	80	535	0.097	0.567	" "
56.2222	69	536	0.097	0.571	" "
62.9847	80	549	0.104	0.607	" "
70.0167	79	552	0.105	0.616	" "
76.6861	92	564	0.111	0.652	" "
84.0076	107	561	0.110	0.644	" "
91.2125	114	580	0.119	0.698	" "
91.2194	113	286			Unloaded
91.2382	108	303			" "
93.0882	105	312			" "
94.0139	104	283			" "
98.0285	103	266			" "
98.9208	96	268			" "

Notes:

*Adjusted for drying shrinkage

Test specimens are 6x12-in. cylinders delivered to CTLGroup on February 16, 2009

Compressive strength at the age of loading:	Measured by S&ME
Applied stress:	2000 psi (13.8 MPa)
Age at loading:	5 days
Preload environment:	5 days autogenous curing (ASTM C 684) then 73.4±2°F (23.0±1.1°C) and 50±4% RH
Loaded environment:	73.4±2°F (23.0±1.1°C) and 50±4% RH

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Client	S&ME	CTL Project Number	109151
Project	Crystal River	Project Manager	M. D'Ambrosia
Contact	John Pearson	Technician	G. Neiweem
Date:	June 12, 2009	Approved	R. Burg

CTLGroup Project #109151
ASTM C 512 - Creep of Concrete in Compression
Mix: 09-019-001-1A, Unsealed Cylinders, Loaded at 5 days to 2000 psi

Days Loaded	Shrinkage (μstrain)	Load induced deformation* (μstrain)	Specific creep (μstrain/psi)	Creep coefficient	Condition
-0.0292	0	0			Immediately before drying
-0.0174	38	0			Immediately before loading
-0.0083	15	72			Preload
0.0000	51	383	0.000	0.000	Loaded
0.0035	26	391	0.004	0.022	" "
0.0104	53	401	0.009	0.047	" "
0.0424	38	421	0.019	0.099	" "
0.1194	38	462	0.040	0.208	" "
0.2500	44	485	0.051	0.269	" "
1.0000	74	494	0.056	0.290	" "
2.0007	102	507	0.062	0.325	" "
3.0035	118	525	0.071	0.372	" "
4.0069	108	553	0.085	0.446	" "
5.0056	117	570	0.094	0.490	" "
6.0069	119	582	0.100	0.522	" "
6.9986	128	585	0.101	0.530	" "
14.0417	197	626	0.122	0.637	" "
21.0049	220	678	0.148	0.771	" "
28.0667	249	716	0.167	0.871	" "
35.0576	265	729	0.173	0.906	" "
42.2708	281	754	0.186	0.971	" "
49.1201	295	763	0.190	0.994	" "
56.2910	301	775	0.196	1.025	" "
63.0785	319	780	0.199	1.038	" "
70.0896	312	793	0.205	1.073	" "
77.2757	351	795	0.206	1.079	" "
84.0812	347	836	0.227	1.185	" "
91.3083	358	818	0.218	1.139	" "
91.3153	356	521			Unloaded
91.3264	354	511			" "
93.1757	353	483			" "
94.1007	339	486			" "
98.1160	348	473			" "
99.0083	346	469			" "

Notes:

*Adjusted for drying shrinkage
Test specimens are 6x12-in. cylinders delivered to CTLGroup on February 16, 2009

Compressive strength at the age of loading:	Measured by S&ME
Applied stress:	2000 psi (13.8 MPa)
Age at loading:	5 days
Preload environment:	5 days autogenous curing (ASTM C 684) then 73.4±2°F (23.0±1.1°C) and 50±4% RH
Loaded environment:	73.4±2°F (23.0±1.1°C) and 50±4% RH

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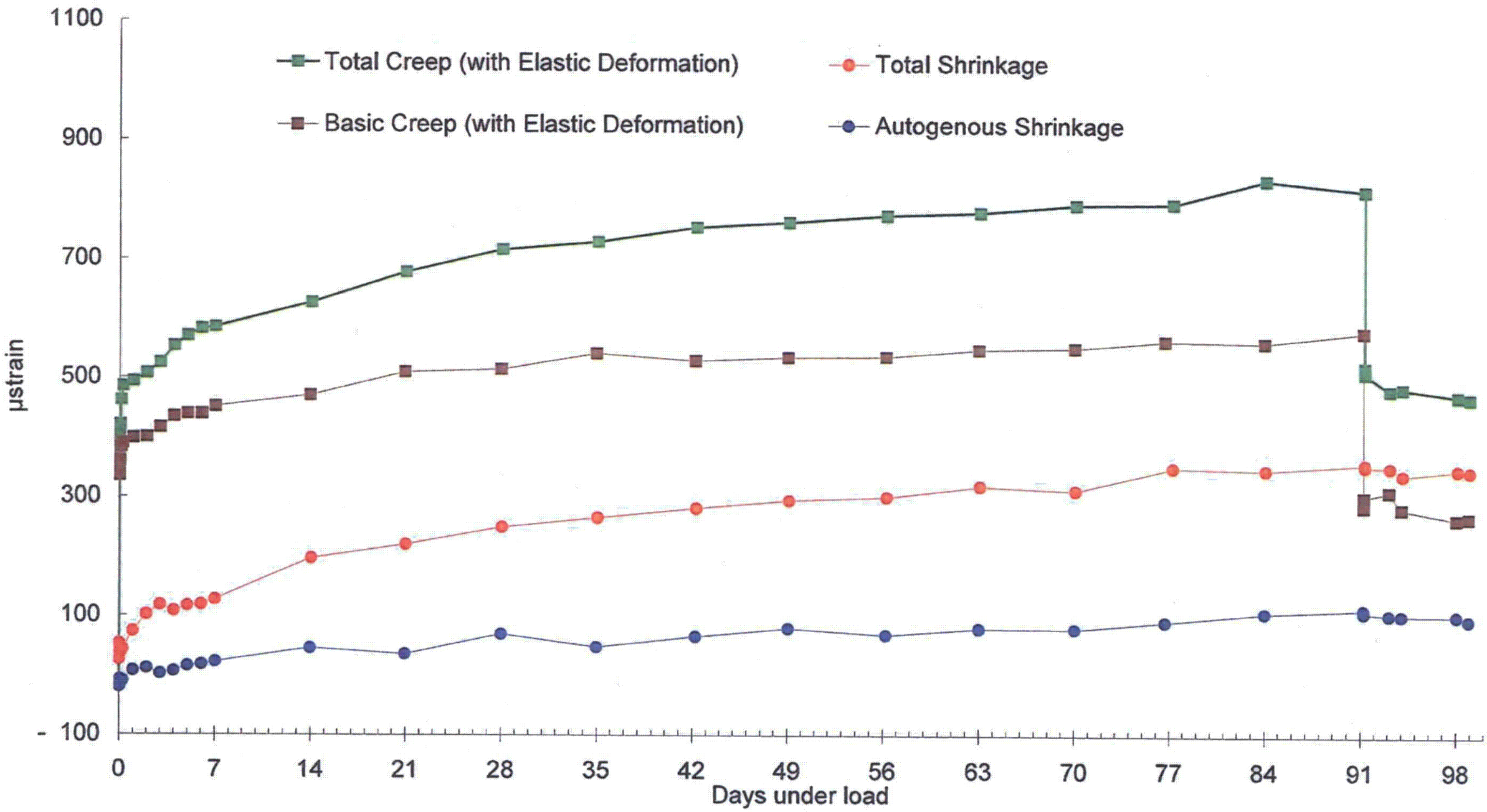
CTLGroup Project #109151
ASTM C 512 - Creep of Concrete in Compression
Mix: 09-019-001-1A, Cast February 12, 2009, Loaded at 5 days to 2000 psi



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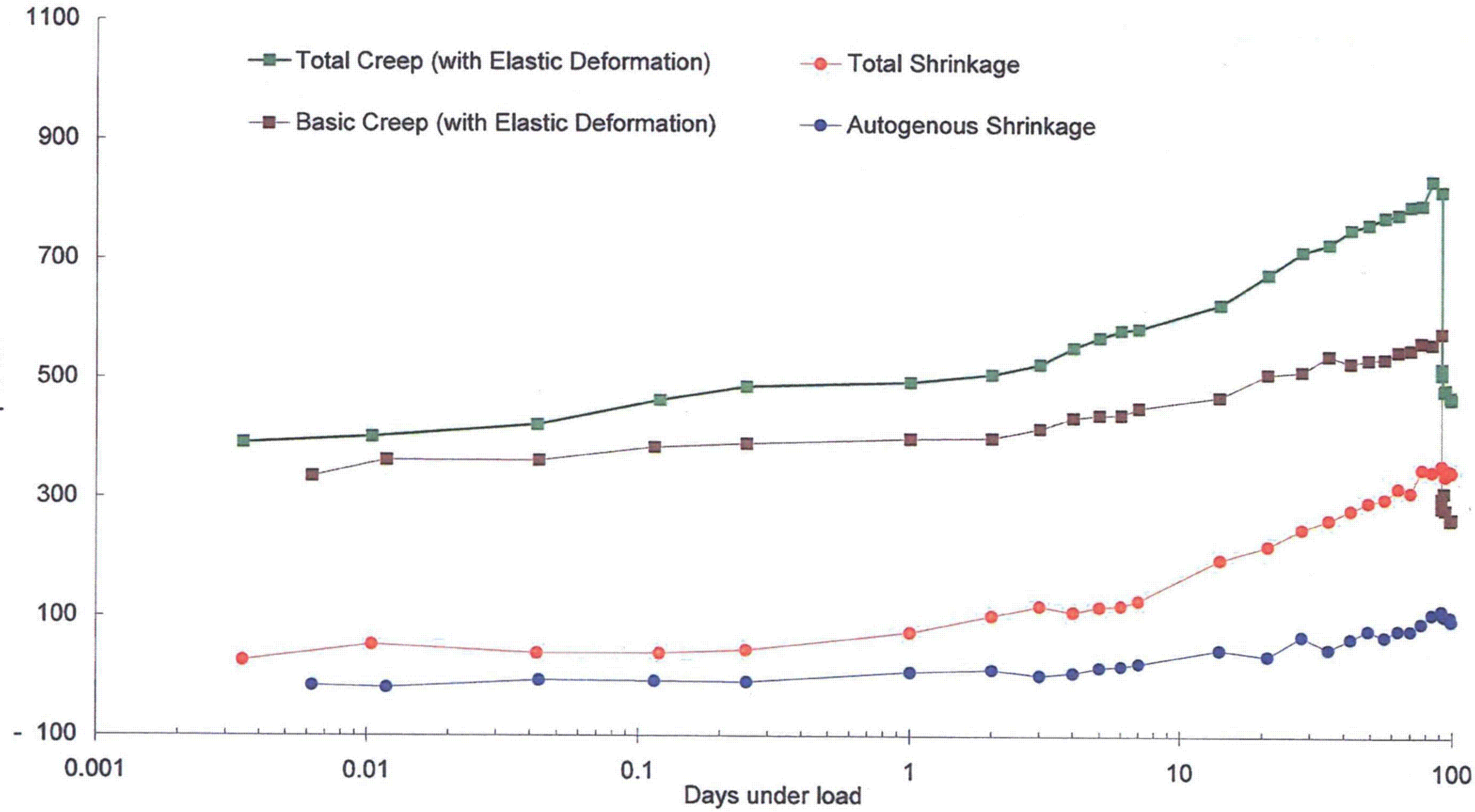
CTLGroup Project #109151
ASTM C 512 - Creep of Concrete in Compression
Mix: 09-019-001-1A, Cast February 12, 2009, Loaded at 5 days to 2000 psi



Creep Of Concrete in Compression (ASTM C 512)
Creep Frame No. HSF#19, Mix: 09-019-001, Mix 1A, Sealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.	Project:	Crystal River Unit 3 SGRP
Contact:	John Pearson	CTL Project Number	109151
CTL Project Manager	M. D'Ambrosia	Technicians	G. Neiweem

Specimen Information

Mix ID/Set #	**09-019-001, Mix 1A**
Curing:	Sealed
Specimens Cast:	2/12/09 9:35 AM
Loaded:	2/17/09 10:30 AM

Loading Information

Age:		5	days
Intensity:	n/a f'c	2000	psi
Preload		200	psi
Compressive Strength, f'c		Measured by S&ME	psi

Measurement Information

Creep Frame ID:	HSF#19
Strain Measuring Device:	Soiltest with digital gage
Gage Length:	10 in.
Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.)						Shrinkage Data (x 0.00001 in.)						Initial
				Cylinder: 1 (chamber #1)			Cylinder: 2 (chamber #10)			Cylinder: 3 (chamber #12)			Cylinder: 4 (chamber #11)			
				Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	
-0.0306	No load, out of frame	0	0	-157	-192	-58	5	-128	-323	-25	-202	0	-458	-1630	30	
Date & Time =	Tue, Feb 17 '09 9:50 AM	Reading No. 1		-155	-195	-50	5	-120	-310	-25	-195	-5	-450	-1635	25	GN/MD
Temperature (°F) =	71.8	Reading No. 2		-155	-185	-65	5	-135	-330	-20	-205	10	-460	-1635	35	GN/MD
RH (%) =	51.2	Reading No. 3		-160	-195	-60	5	-130	-330	-30	-205	-5	-465	-1620	30	GN/MD
-0.0188	Immediately before loading	0	0	-172	-210	-57	-20	-128	-332	-13	-193	3	-435	-1602	52	
Date & Time =	Tue, Feb 17 '09 10:07 AM	Reading No. 1		-175	-205	-55	-25	-135	-320	-15	-185	5	-435	-1600	50	GN/MD
Temperature (°F) =	71.8	Reading No. 2		-165	-210	-60	-15	-120	-335	-15	-185	5	-435	-1605	55	GN/MD
RH (%) =	53.1	Reading No. 3		-175	-215	-55	-20	-130	-340	-10	-210	0	-435	-1600	50	GN/MD
-0.0097	In frame, preload	300	200	-213	-237	-60	-65	-172	-362	-2	-195	-3	-433	-1598	50	
Date & Time =	Tue, Feb 17 '09 10:20 AM	Reading No. 1		-215	-251	-60	-60	-175	-360	5	-185	-5	-435	-1600	55	GN/MD
Temperature (°F) =	71.7	Reading No. 2		-215	-225	-50	-65	-170	-360	-5	-200	0	-430	-1605	45	GN/MD
RH (%) =	50.6	Reading No. 3		-210	-235	-70	-70	-170	-365	-5	-200	-5	-435	-1590	50	GN/MD
0.0000	Loaded	3000	2000	-512	-538	-330	-450	-453	-660	-8	-207	7	-420	-1600	63	
Date & Time =	Tue, Feb 17 '09 10:34 AM	Reading No. 1		-515	-535	-320	-450	-455	-665	-15	-210	5	-430	-1600	60	GN/MD
Temperature (°F) =	71.7	Reading No. 2		-510	-535	-340	-450	-455	-655	-5	-210	10	-415	-1600	60	GN/MD
RH (%) =	52.3	Reading No. 3		-510	-545	-330	-450	-450	-660	-5	-200	5	-415	-1600	70	GN/MD
0.0062		3000	2000	-562	-512	-325	-407	-448	-672	-10	-192	-3	-433	-1598	50	
Date & Time =	Tue, Feb 17 '09 10:43 AM	Reading No. 1		-560	-520	-325	-405	-450	-665	-10	-190	-5	-430	-1600	40	GN/MD
Temperature (°F) =	71.8	Reading No. 2		-560	-500	-325	-410	-445	-675	-15	-195	-10	-435	-1595	55	GN/MD
RH (%) =	50.3	Reading No. 3		-565	-515	-325	-405	-450	-675	-5	-190	5	-435	-1600	55	GN/MD
0.0118		3000	2000	-603	-525	-355	-447	-455	-680	-2	-202	-7	-422	-1585	50	
Date & Time =	Tue, Feb 17 '09 10:51 AM	Reading No. 1		-590	-520	-350	-445	-455	-680	-5	-205	-10	-415	-1600	60	GN/MD
Temperature (°F) =	71.9	Reading No. 2		-605	-530	-360	-445	-455	-685	0	-200	5	-425	-1580	45	GN/MD
RH (%) =	53.9	Reading No. 3		-615	-525	-355	-450	-455	-675	0	-200	-15	-425	-1575	45	GN/MD

Creep Of Concrete in Compression (ASTM C 512)
Creep Frame No. HSF#19, Mix: 09-019-001, Mix 1A, Sealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.	Project:	Crystal River Unit 3 SGRP
Contact:	John Pearson	CTL Project Number	109151
CTL Project Manager	M. D'Ambrosia	Technicians	G. Neiweem

Specimen Information

Mix ID/Set #	09-019-001, Mix 1A
Curing:	Sealed
Specimens Cast:	2/12/09 9:35 AM
Loaded:	2/17/09 10:30 AM

Loading Information

Age:		5	days
Intensity:	n/a f'c	2000	psi
Preload		200	psi
Compressive Strength, f'c		Measured by S&ME	psi

Measurement Information

Creep Frame ID:	HSF#19
Strain Measuring Device:	Soiltest with digital gage
Gage Length:	10 in.
Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.) Cylinder: 1 (chamber #1) Side 1	Side 2	Side 3	Cylinder: 2 (chamber #10) Side 1	Side 2	Side 3	Shrinkage Data (x 0.00001 in.) Cylinder: 3 (chamber #12) Side 1	Side 2	Side 3	Cylinder: 4 (chamber #11) Side 1	Side 2	Side 3	Initial
0.0431		3000	2000	-642	-507	-352	-495	-453	-685	-3	-208	-2	-447	-1618	40	
Date & Time =	Tue, Feb 17 '09 11:36 AM	Reading No. 1		-640	-510	-340	-490	-455	-695	15	-195	5	-440	-1620	35	GN/MD
Temperature (°F) =	71.8	Reading No. 2		-640	-505	-355	-505	-455	-680	-5	-215	-5	-445	-1620	45	GN/MD
RH (%) =	53.9	Reading No. 3		-645	-505	-360	-490	-450	-680	-20	-215	-5	-455	-1615	40	GN/MD
0.1146		3000	2000	-653	-517	-370	-525	-502	-693	-13	-207	-22	-435	-1603	48	
Date & Time =	Tue, Feb 17 '09 1:19 PM	Reading No. 1		-655	-515	-370	-525	-495	-690	-15	-200	-15	-435	-1600	55	GN/MD
Temperature (°F) =	71.8	Reading No. 2		-655	-515	-375	-525	-505	-690	-10	-200	-20	-435	-1605	45	GN/MD
RH (%) =	53.9	Reading No. 3		-650	-520	-365	-525	-505	-700	-15	-220	-30	-435	-1605	45	GN/MD
0.2507		3000	2000	-678	-538	-358	-535	-492	-690	-27	-192	-5	-438	-1620	55	
Date & Time =	Tue, Feb 17 '09 4:35 PM	Reading No. 1		-675	-535	-360	-540	-495	-690	-25	-190	-5	-435	-1615	55	GN/MD
Temperature (°F) =	71.5	Reading No. 2		-680	-540	-360	-535	-490	-690	-25	-200	0	-440	-1620	55	GN/MD
RH (%) =	51.5	Reading No. 3		-680	-540	-355	-530	-490	-690	-30	-185	-10	-440	-1625	55	GN/MD
1.0014		3000	2000	-712	-588	-363	-563	-523	-698	-45	-198	-15	-452	-1650	32	
Date & Time =	Wed, Feb 18 '09 10:36 AM	Reading No. 1		-705	-580	-365	-560	-525	-695	-45	-195	-10	-450	-1655	35	GN/MD
Temperature (°F) =	72.0	Reading No. 2		-710	-590	-365	-565	-525	-700	-45	-205	-20	-455	-1650	30	GN/MD
RH (%) =	53.6	Reading No. 3		-720	-595	-360	-565	-520	-700	-45	-195	-15	-450	-1645	30	GN/MD
2.0028		3000	2000	-712	-592	-362	-575	-535	-708	-48	-197	-5	-467	-1657	20	
Date & Time =	Thu, Feb 19 '09 10:38 AM	Reading No. 1		-710	-590	-360	-565	-535	-705	-50	-195	-5	-470	-1660	15	GN/MD
Temperature (°F) =	72.6	Reading No. 2		-715	-590	-365	-580	-535	-710	-50	-195	-5	-465	-1655	25	GN/MD
RH (%) =	51.9	Reading No. 3		-710	-595	-360	-580	-535	-710	-45	-200	-5	-465	-1655	20	GN/MD
3.0028		3000	2000	-720	-593	-378	-585	-535	-713	-32	-190	-13	-453	-1650	40	
Date & Time =	Fri, Feb 20 '09 10:38 AM	Reading No. 1		-715	-590	-375	-585	-535	-710	-30	-180	-10	-455	-1650	40	GN/MD
Temperature (°F) =	74.00	Reading No. 2		-720	-595	-380	-585	-535	-715	-35	-190	-10	-450	-1650	30	GN/MD
RH (%) =	49.00	Reading No. 3		-725	-595	-380	-585	-535	-715	-30	-200	-20	-455	-1650	50	GN/MD

Creep Of Concrete in Compression (ASTM C 512)
Creep Frame No. HSF#19, Mix: 09-019-001, Mix 1A, Sealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.
Contact:	John Pearson
Project:	Crystal River Unit 3 SGRP
CTL Project Number	109151
CTL Project Manager	M. D'Ambrosia
Technicians	G. Neiweem

Specimen Information

Mix ID/Set #	09-019-001, Mix 1A
Curing:	Sealed
Specimens Cast:	2/12/09 9:35 AM
Loaded:	2/17/09 10:30 AM

Loading Information

Age:		5	days
Intensity:	n/a f'c	2000	psi
Preload		200	psi
Compressive Strength, f'c		Measured by S&ME	psi

Measurement Information

Creep Frame ID:	HSF#19
Strain Measuring Device:	Soiltest with digital gage
Gage Length:	10 in.
Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.) Cylinder: 1 (chamber #1)			Cylinder: 2 (chamber #10)			Shrinkage Data (x 0.00001 in.) Cylinder: 3 (chamber #12)			Cylinder: 4 (chamber #11)			Initial
				Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	
4.0028		3000	2000	-773	-642	-400	-587	-548	-710	-42	-197	-18	-448	-1650	32	
Date & Time =	Sat, Feb 21 '09 10:38 AM	Reading No. 1		-765	-635	-395	-585	-550	-710	-35	-200	-10	-450	-1645	30	GN/MD
Temperature (°F) =	71.80	Reading No. 2		-770	-635	-410	-585	-545	-710	-45	-195	-25	-445	-1650	30	GN/MD
RH (%) =	50.30	Reading No. 3		-785	-655	-395	-590	-550	-710	-45	-195	-20	-450	-1655	35	GN/MD
5.0007		3000	2000	-758	-655	-413	-613	-568	-735	-57	-207	-25	-458	-1658	27	
Date & Time =	Sun, Feb 22 '09 10:35 AM	Reading No. 1		-760	-650	-405	-610	-570	-740	-55	-205	-25	-455	-1655	25	GN/MD
Temperature (°F) =	72.10	Reading No. 2		-750	-660	-415	-615	-570	-735	-55	-200	-25	-460	-1665	30	GN/MD
RH (%) =	55.20	Reading No. 3		-765	-655	-420	-615	-565	-730	-60	-215	-25	-460	-1655	25	GN/MD
6.0125		3000	2000	-777	-640	-413	-605	-572	-752	-55	-208	-25	-467	-1650	13	
Date & Time =	Mon, Feb 23 '09 10:52 AM	Reading No. 1		-770	-640	-410	-605	-565	-750	-45	-210	-20	-460	-1655	10	GN/MD
Temperature (°F) =	71.40	Reading No. 2		-780	-640	-410	-610	-570	-750	-60	-205	-25	-470	-1655	15	GN/MD
RH (%) =	54.80	Reading No. 3		-780	-640	-420	-600	-580	-755	-60	-210	-30	-470	-1640	15	GN/MD
7.0111		3000	2000	-788	-662	-417	-625	-583	-783	-65	-220	-47	-462	-1655	28	
Date & Time =	Tue, Feb 24 '09 10:50 AM	Reading No. 1		-790	-660	-415	-635	-580	-785	-65	-210	-45	-465	-1655	25	GN/MD
Temperature (°F) =	70.90	Reading No. 2		-785	-665	-415	-620	-585	-785	-65	-235	-50	-460	-1660	30	GN/MD
RH (%) =	52.50	Reading No. 3		-790	-660	-420	-620	-585	-780	-65	-215	-45	-460	-1650	30	GN/MD
13.9507		3000	2000	-837	-713	-472	-677	-622	-788	-82	-232	-55	-488	-1695	-5	
Date & Time =	Tue, Mar 3 '09 9:23 AM	Reading No. 1		-840	-710	-470	-680	-625	-790	-85	-235	-50	-485	-1690	-5	GN/MD
Temperature (°F) =	71.50	Reading No. 2		-830	-710	-475	-680	-620	-790	-80	-230	-60	-490	-1700	-5	GN/MD
RH (%) =	48.90	Reading No. 3		-840	-720	-470	-670	-620	-785	-80	-230	-55	-490	-1695	-5	GN/MD
20.9361		3000	2000	-877	-750	-507	-693	-635	-823	-80	-225	-27	-492	-1678	3	
Date & Time =	Tue, Mar 10 '09 9:02 AM	Reading No. 1		-880	-750	-505	-690	-635	-820	-80	-220	-25	-490	-1680	5	GN/MD
Temperature (°F) =	72.90	Reading No. 2		-875	-750	-505	-695	-635	-820	-80	-230	-30	-495	-1675	0	GN/MD
RH (%) =	52.90	Reading No. 3		-875	-750	-510	-695	-635	-830	-80	-225	-25	-490	-1680	5	GN/MD

Creep Of Concrete in Compression (ASTM C 512)
Creep Frame No. HSF#19, Mix: 09-019-001, Mix 1A, Sealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.
Contact:	John Pearson

Project:	Crystal River Unit 3 SGRP
CTL Project Number	109151

CTL Project Manager	M. D'Ambrosia
Technicians	G. Neiweem

Specimen Information

Mix ID/Set #	09-019-001, Mix 1A
Curing:	Sealed
Specimens Cast:	2/12/09 9:35 AM
Loaded:	2/17/09 10:30 AM

Loading Information

Age:		5	days
Intensity:	n/a f'c	2000	psi
Preload		200	psi
Compressive Strength, f'c		Measured by S&ME	psi

Measurement Information

Creep Frame ID:	HSF#19
Strain Measuring Device:	Soiltest with digital gage
Gage Length:	10 in.
Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.) Cylinder: 1 (chamber #1) Side 1	Side 2	Side 3	Cylinder: 2 (chamber #10) Side 1	Side 2	Side 3	Shrinkage Data (x 0.00001 in.) Cylinder: 3 (chamber #12) Side 1	Side 2	Side 3	Cylinder: 4 (chamber #11) Side 1	Side 2	Side 3	Initial
27.9924		3000	2000	-915	-798	-522	-738	-695	-845	-95	-262	-80	-525	-1710	-27	
Date & Time =	Tue, Mar 17 '09 10:23 AM	Reading No. 1		-915	-795	-520	-740	-695	-845	-95	-265	-80	-525	-1710	-25	GN/AP
Temperature (°F) =	72.0	Reading No. 2		-915	-800	-525	-735	-695	-845	-90	-255	-80	-525	-1710	-25	GN/AP
RH (%) =	47.4	Reading No. 3		-915	-800	-520	-740	-695	-845	-100	-265	-80	-525	-1710	-30	GN/AP
34.9653		3000	2000	-938	-815	-543	-745	-672	-832	-97	-228	-58	-502	-1678	-7	
Date & Time =	Tue, Mar 24 '09 9:44 AM	Reading No. 1		-935	-810	-545	-740	-670	-830	-90	-225	-55	-500	-1690	-5	GN/MD
Temperature (°F) =	72.6	Reading No. 2		-940	-820	-540	-745	-670	-835	-100	-230	-60	-505	-1675	-10	GN/MD
RH (%) =	47.0	Reading No. 3		-940	-815	-545	-750	-675	-830	-100	-230	-60	-500	-1670	-5	GN/MD
42.1951		3000	2000	-940	-797	-543	-758	-698	-845	-118	-257	-75	-515	-1697	-17	
Date & Time =	Tue, Mar 31 '09 3:15 PM	Reading No. 1		-935	-795	-545	-760	-700	-845	-115	-250	-75	-515	-1700	-15	GN/MD
Temperature (°F) =	71.8	Reading No. 2		-940	-805	-540	-760	-705	-845	-120	-260	-80	-515	-1695	-15	GN/MD
RH (%) =	48.9	Reading No. 3		-945	-790	-545	-755	-690	-845	-120	-260	-70	-515	-1695	-20	GN/MD
49.0444		3000	2000	-970	-830	-563	-780	-713	-847	-128	-272	-78	-530	-1715	-40	
Date & Time =	Tue, Apr 7 '09 11:38 AM	Reading No. 1		-970	-825	-560	-780	-720	-850	-130	-260	-80	-525	-1715	-35	GN/MD
Temperature (°F) =	71.8	Reading No. 2		-970	-830	-565	-780	-710	-845	-125	-280	-75	-535	-1715	-40	GN/MD
RH (%) =	50.0	Reading No. 3		-970	-835	-565	-780	-710	-845	-130	-275	-80	-530	-1715	-45	GN/MD
56.2222		3000	2000	-957	-818	-547	-775	-712	-838	-118	-263	-75	-525	-1680	-37	
Date & Time =	Tue, Apr 14 '09 3:54 PM	Reading No. 1		-955	-815	-545	-770	-710	-830	-120	-265	-70	-520	-1680	-35	GN/MD
Temperature (°F) =	72.0	Reading No. 2		-955	-820	-545	-770	-715	-845	-115	-260	-80	-530	-1680	-35	GN/MD
RH (%) =	52.8	Reading No. 3		-960	-820	-550	-785	-710	-840	-120	-265	-75	-525	-1680	-40	GN/MD
62.9847		3000	2000	-977	-835	-558	-788	-733	-895	-122	-273	-80	-530	-1718	-42	
Date & Time =	Tue, Apr 21 '09 10:12 AM	Reading No. 1		-975	-830	-550	-785	-735	-895	-125	-275	-80	-520	-1715	-45	GN/MD
Temperature (°F) =	72.3	Reading No. 2		-975	-835	-560	-790	-735	-895	-120	-270	-80	-530	-1725	-35	GN/MD
RH (%) =	46.6	Reading No. 3		-980	-840	-565	-790	-730	-895	-120	-275	-80	-540	-1715	-45	GN/MD

Creep Of Concrete in Compression (ASTM C 512)

Creep Frame No. HSF#19, Mix: 09-019-001, Mix 1A, Sealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.	Project:	Crystal River Unit 3 SGRP
Contact:	John Pearson	CTL Project Number	109151
CTL Project Manager	M. D'Ambrosia	Technicians	G. Neiweem

Specimen Information

Mix ID/Set #	09-019-001, Mix 1A
Curing:	Sealed
Specimens Cast:	2/12/09 9:35 AM
Loaded:	2/17/09 10:30 AM

Loading Information

Age:		5	days
Intensity:	n/a f'c	2000	psi
Preload		200	psi
Compressive Strength, f'c		Measured by S&ME	psi

Measurement Information

Creep Frame ID:	HSF#19
Strain Measuring Device:	Soiltest with digital gage
Gage Length:	10 in.
Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.) Cylinder: 1 (chamber #1) Side 1	Side 2	Side 3	Cylinder: 2 (chamber #10) Side 1	Side 2	Side 3	Shrinkage Data (x 0.00001 in.) Cylinder: 3 (chamber #12) Side 1	Side 2	Side 3	Cylinder: 4 (chamber #11) Side 1	Side 2	Side 3	Initial
70.0167		3000	2000	-1003	-860	-487	-815	-765	-872	-110	-267	-92	-540	-1717	-37	
Date & Time =	Tue, Apr 28 '09 10:58 AM	Reading No. 1		-1005	-860	-490	-820	-765	-865	-105	-265	-90	-545	-1720	-40	GN/MD
Temperature (°F) =	72.7	Reading No. 2		-1000	-860	-485	-825	-765	-875	-115	-270	-90	-535	-1720	-35	GN/MD
RH (%) =	46.7	Reading No. 3		-1005	-860	-485	-800	-765	-875	-110	-265	-95	-540	-1710	-35	GN/MD
76.6861		3000	2000	-995	-872	-580	-818	-778	-908	-133	-293	-108	-545	-1712	-47	
Date & Time =	Tue, May 5 '09 3:02 AM	Reading No. 1		-990	-870	-580	-820	-775	-905	-130	-295	-115	-545	-1710	-45	GN/MD
Temperature (°F) =	70.8	Reading No. 2		-995	-870	-580	-820	-780	-910	-135	-295	-110	-545	-1710	-40	GN/MD
RH (%) =	49.7	Reading No. 3		-1000	-875	-580	-815	-780	-910	-135	-290	-100	-545	-1715	-55	GN/MD
84.0076		3000	2000	-1030	-890	-583	-837	-803	-883	-158	-317	-105	-545	-1733	-70	
Date & Time =	Tue, May 12 '09 10:45 AM	Reading No. 1		-1020	-885	-585	-835	-805	-875	-160	-320	-105	-545	-1740	-60	GN/MD
Temperature (°F) =	72.0	Reading No. 2		-1035	-900	-585	-835	-805	-885	-155	-310	-105	-545	-1730	-70	GN/MD
RH (%) =	46.2	Reading No. 3		-1035	-885	-580	-840	-800	-890	-160	-320	-105	-545	-1730	-80	GN/MD
91.2125		3000	2000	-1052	-910	-605	-885	-820	-903	-138	-317	-125	-575	-1738	-73	
Date & Time =	Tue, May 19 '09 3:40 PM	Reading No. 1		-1050	-905	-610	-885	-820	-900	-135	-310	-120	-570	-1730	-75	GN/MD
Temperature (°F) =	71.8	Reading No. 2		-1050	-910	-600	-885	-820	-910	-135	-320	-125	-580	-1745	-75	GN/MD
RH (%) =	49.4	Reading No. 3		-1055	-915	-605	-885	-820	-900	-145	-320	-130	-575	-1740	-70	GN/MD
91.2194		3000	2000	-693	-632	-425	-530	-450	-680	-140	-313	-122	-568	-1753	-65	
Date & Time =	Tue, May 19 '09 3:50 PM	Reading No. 1		-690	-625	-425	-535	-450	-680	-130	-305	-120	-560	-1760	-60	GN/MD
Temperature (°F) =	71.9	Reading No. 2		-695	-625	-425	-525	-450	-680	-145	-315	-120	-570	-1750	-65	GN/MD
RH (%) =	46.8	Reading No. 3		-695	-645	-425	-530	-450	-680	-145	-320	-125	-575	-1750	-70	GN/MD
91.2382		3000	2000	-677	-623	-422	-533	-532	-695	-153	-317	-122	-553	-1733	-57	
Date & Time =	Tue, May 19 '09 4:17 PM	Reading No. 1		-680	-610	-415	-525	-525	-690	-155	-305	-120	-545	-1730	-60	GN/MD
Temperature (°F) =	72.1	Reading No. 2		-675	-625	-420	-535	-535	-695	-150	-325	-125	-555	-1745	-50	GN/MD
RH (%) =	47.9	Reading No. 3		-675	-635	-430	-540	-535	-700	-155	-320	-120	-560	-1725	-60	GN/MD

Creep Of Concrete in Compression (ASTM C 512)
Creep Frame No. HSF#19, Mix: 09-019-001, Mix 1A, Sealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.
Contact:	John Pearson
Project:	Crystal River Unit 3 SGRP
CTL Project Number	109151
CTL Project Manager	M. D'Ambrosia
Technicians	G. Neiweem

Specimen Information

Mix ID/Set #	09-019-001, Mix 1A
Curing:	Sealed
Specimens Cast:	2/12/09 9:35 AM
Loaded:	2/17/09 10:30 AM

Loading Information

Age:	5	days
Intensity: n/a f'c	2000	psi
Preload	200	psi
Compressive Strength, f'c	Measured by S&ME	psi

Measurement Information

Creep Frame ID:	HSF#19
Strain Measuring Device:	Soiltest with digital gage
Gage Length:	10 in.
Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.)						Shrinkage Data (x 0.00001 in.)						
				Cylinder: 1 (chamber #1)			Cylinder: 2 (chamber #10)			Cylinder: 3 (chamber #12)			Cylinder: 4 (chamber #11)			
				Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	Initial
93.0882		3000	2000	-692	-603	-463	-548	-530	-680	-158	-303	-127	-538	-1732	-57	
Date & Time =	Thu, May 21 '09 12:41 PM	Reading No. 1		-690	-595	-460	-555	-525	-690	-155	-305	-120	-545	-1740	-50	GN/MD
Temperature (°F) =	71.7	Reading No. 2		-690	-610	-470	-540	-530	-675	-160	-300	-130	-540	-1735	-60	GN/MD
RH (%) =	46.7	Reading No. 3		-695	-605	-460	-550	-535	-675	-160	-305	-130	-530	-1720	-60	GN/MD
94.0139		3000	2000	-658	-590	-400	-483	-520	-687	-155	-292	-107	-548	-1735	-72	
Date & Time =	Fri, May 22 '09 10:54 AM	Reading No. 1		-655	-585	-395	-470	-520	-690	-155	-290	-100	-545	-1730	-70	GN/MD
Temperature (°F) =	72.8	Reading No. 2		-660	-585	-405	-490	-520	-680	-155	-290	-110	-540	-1740	-70	GN/MD
RH (%) =	49.2	Reading No. 3		-660	-600	-400	-490	-520	-690	-155	-295	-110	-560	-1735	-75	GN/MD
98.0285		3000	2000	-633	-590	-402	-477	-477	-648	-148	-282	-115	-575	-1722	-62	
Date & Time =	Tue, May 26 '09 11:15 AM	Reading No. 1		-630	-580	-395	-470	-470	-645	-145	-275	-105	-570	-1715	-65	GN/MD
Temperature (°F) =	74.2	Reading No. 2		-635	-590	-410	-485	-480	-650	-150	-285	-120	-575	-1730	-60	GN/MD
RH (%) =	52.0	Reading No. 3		-635	-600	-400	-475	-480	-650	-150	-285	-120	-580	-1720	-60	GN/MD
98.9208		3000	2000	-628	-587	-377	-477	-498	-632	-138	-278	-97	-555	-1735	-57	
Date & Time =	Wed, May 27 '09 8:40 AM	Reading No. 1		-630	-590	-375	-485	-500	-625	-135	-270	-90	-550	-1745	-60	GN/MD
Temperature (°F) =	74.8	Reading No. 2		-630	-590	-375	-475	-500	-635	-145	-280	-100	-560	-1730	-50	GN/MD
RH (%) =	49.8	Reading No. 3		-625	-580	-380	-470	-495	-635	-135	-285	-100	-555	-1730	-60	GN/MD

Creep Of Concrete in Compression (ASTM C 512)
Creep Frame No. HSF#25, Mix: 09-019-001, Mix 1A, Unsealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.	Project:	Crystal River Unit 3 SGRP	CTL Project Manager	M. D'Ambrosia
Contact:	John Pearson	CTL Project Number	109151	Technicians	G. Neiweem

Specimen Information		Loading Information			Measurement Information	
Mix ID/Set #	09-019-001, Mix 1A	Age:	5	days	Creep Frame ID:	HSF#25
Curing:	Unsealed	Intensity: n/a f'c	2000	psi	Strain Measuring Device:	Soiltest with digital gage
Specimens Cast:	2/12/09 9:35 AM	Preload	200	psi	Gage Length:	10 in.
Loaded:	2/17/09 8:45 AM	Compressive Strength, f'c	Measured by S&ME	psi	Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.) Cylinder: 1 (chamber #3) Side 1	Side 2	Side 3	Cylinder: 2 (chamber #13) Side 1	Side 2	Side 3	Shrinkage Data (x 0.00001 in.) Cylinder: 3 (chamber #14) Side 1	Side 2	Side 3	Cylinder: 4 (chamber #2) Side 1	Side 2	Side 3	Initial
-0.0292	Immediately before drying	0	0	-25	-657	-262	-287	-118	4453	-107	-93	-85	-135	-185	-107	
Date & Time =	Tue, Feb 17 '09 7:53 AM	Reading No. 1		-20	-655	-265	-280	-120	4450	-105	-95	-90	-130	-185	-110	GN/MD
Temperature (°F) =	71.4	Reading No. 2		-25	-655	-265	-290	-120	4460	-110	-90	-85	-140	-190	-100	GN/MD
RH (%) =	51.9	Reading No. 3		-30	-660	-255	-290	-115	4450	-105	-95	-80	-135	-180	-110	GN/MD
-0.0174	Immediately before loading	0	0	-47	-663	-253	-303	-127	4443	-153	-125	-138	-172	-210	-140	
Date & Time =	Tue, Feb 17 '09 8:10 AM	Reading No. 1		-45	-660	-260	-300	-130	4445	-155	-130	-145	-165	-215	-150	GN/MD
Temperature (°F) =	71.6	Reading No. 2		-45	-660	-250	-300	-130	4445	-155	-120	-135	-180	-200	-130	GN/MD
RH (%) =	54.0	Reading No. 3		-50	-670	-250	-310	-120	4440	-150	-125	-135	-170	-215	-140	GN/MD
-0.0083	In frame, preload	300	200	-100	-710	-307	-360	-173	4407	-127	-110	-107	-153	-183	-122	
Date & Time =	Tue, Feb 17 '09 8:23 AM	Reading No. 1		-100	-710	-305	-360	-165	4395	-120	-110	-110	-155	-195	-125	GN/MD
Temperature (°F) =	71.5	Reading No. 2		-100	-710	-305	-360	-175	4410	-125	-105	-100	-150	-185	-120	GN/MD
RH (%) =	50.1	Reading No. 3		-100	-710	-310	-360	-180	4415	-135	-115	-110	-155	-170	-120	GN/MD
0.0000	Loaded	3000	2000	-397	-1113	-648	-680	-572	4088	-168	-145	-152	-183	-213	-153	
Date & Time =	Tue, Feb 17 '09 8:35 AM	Reading No. 1		-390	-1110	-655	-685	-570	4085	-160	-145	-150	-180	-210	-155	GN/MD
Temperature (°F) =	71.6	Reading No. 2		-400	-1120	-635	-680	-575	4090	-170	-145	-155	-180	-215	-155	GN/MD
RH (%) =	53.5	Reading No. 3		-400	-1110	-655	-675	-570	4090	-175	-145	-150	-190	-215	-150	GN/MD
0.0035		3000	2000	-395	-1103	-620	-660	-547	4100	-148	-113	-113	-150	-205	-138	
Date & Time =	Tue, Feb 17 '09 8:40 AM	Reading No. 1		-385	-1100	-620	-660	-550	4100	-140	-110	-115	-150	-205	-140	GN/MD
Temperature (°F) =	71.6	Reading No. 2		-405	-1105	-620	-670	-545	4100	-150	-110	-105	-140	-210	-140	GN/MD
RH (%) =	51.8	Reading No. 3		-395	-1105	-620	-650	-545	4100	-155	-120	-120	-160	-200	-135	GN/MD
0.0104		3000	2000	-423	-1145	-657	-698	-580	4060	-162	-140	-152	-177	-235	-163	
Date & Time =	Tue, Feb 17 '09 8:50 AM	Reading No. 1		-415	-1140	-660	-695	-580	4065	-160	-135	-160	-175	-245	-160	GN/MD
Temperature (°F) =	71.6	Reading No. 2		-425	-1140	-655	-700	-580	4060	-160	-135	-150	-180	-230	-160	GN/MD
RH (%) =	50.7	Reading No. 3		-430	-1155	-655	-700	-580	4055	-165	-150	-145	-175	-230	-170	GN/MD

Creep Of Concrete in Compression (ASTM C 512)

Creep Frame No. HSF#25, Mix: 09-019-001, Mix 1A, Unsealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.
Contact:	John Pearson
Project:	Crystal River Unit 3 SGRP
CTL Project Number	109151
CTL Project Manager	M. D'Ambrosia
Technicians	G. Neiweem

Specimen Information

Mix ID/Set #	09-019-001, Mix 1A
Curing:	Unsealed
Specimens Cast:	2/12/09 9:35 AM
Loaded:	2/17/09 8:45 AM

Loading Information

Age:		5	days
Intensity:	n/a f'c	2000	psi
Preload		200	psi
Compressive Strength, f'c		Measured by S&ME	psi

Measurement Information

Creep Frame ID:	HSF#25
Strain Measuring Device:	Soiltest with digital gage
Gage Length:	10 in.
Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.) Cylinder: 1 (chamber #3) Side 1	Side 2	Side 3	Cylinder: 2 (chamber #13) Side 1	Side 2	Side 3	Shrinkage Data (x 0.00001 in.) Cylinder: 3 (chamber #14) Side 1	Side 2	Side 3	Cylinder: 4 (chamber #2) Side 1	Side 2	Side 3	Initial
0.0424		3000	2000	-443	-1142	-655	-720	-582	4067	-155	-130	-132	-160	-210	-153	
Date & Time =	Tue, Feb 17 '09 9:36 AM	Reading No. 1		-440	-1135	-650	-720	-585	4075	-155	-135	-135	-165	-210	-155	GN/MD
Temperature (°F) =	71.6	Reading No. 2		-445	-1140	-655	-720	-580	4060	-155	-130	-135	-150	-210	-150	GN/MD
RH (%) =	51.2	Reading No. 3		-445	-1150	-660	-720	-580	4065	-155	-125	-125	-165	-210	-155	GN/MD
0.1194		3000	2000	-490	-1172	-693	-787	-602	4020	-137	-127	-122	-177	-210	-168	
Date & Time =	Tue, Feb 17 '09 11:27 AM	Reading No. 1		-490	-1165	-690	-785	-600	4020	-135	-130	-120	-175	-220	-170	GN/MD
Temperature (°F) =	71.8	Reading No. 2		-490	-1175	-695	-790	-600	4020	-140	-125	-125	-175	-200	-160	GN/MD
RH (%) =	51.9	Reading No. 3		-490	-1175	-695	-785	-605	4020	-135	-125	-120	-180	-210	-175	GN/MD
0.2500		3000	2000	-527	-1185	-730	-815	-617	3977	-157	-127	-135	-177	-210	-168	
Date & Time =	Tue, Feb 17 '09 2:35 PM	Reading No. 1		-530	-1185	-730	-815	-610	3980	-155	-120	-135	-175	-220	-170	GN/MD
Temperature (°F) =	71.4	Reading No. 2		-525	-1185	-730	-815	-620	3970	-155	-135	-135	-175	-200	-160	GN/MD
RH (%) =	50.9	Reading No. 3		-525	-1185	-730	-815	-620	3980	-160	-125	-135	-180	-210	-175	GN/MD
1.0000		3000	2000	-553	-1233	-782	-845	-650	3937	-180	-172	-150	-207	-243	-202	
Date & Time =	Wed, Feb 18 '09 8:35 AM	Reading No. 1		-550	-1230	-785	-845	-655	3925	-180	-175	-145	-200	-235	-190	GN/MD
Temperature (°F) =	72.0	Reading No. 2		-555	-1230	-775	-845	-650	3945	-185	-170	-150	-210	-250	-205	GN/MD
RH (%) =	50.3	Reading No. 3		-555	-1240	-785	-845	-645	3940	-175	-170	-155	-210	-245	-210	GN/MD
2.0007		3000	2000	-593	-1278	-815	-868	-707	3885	-212	-207	-178	-232	-275	-220	
Date & Time =	Thu, Feb 19 '09 8:36 AM	Reading No. 1		-595	-1280	-815	-865	-710	3890	-215	-205	-160	-230	-270	-215	GN/MD
Temperature (°F) =	72.0	Reading No. 2		-590	-1275	-815	-865	-700	3885	-210	-210	-185	-230	-280	-225	GN/MD
RH (%) =	53.9	Reading No. 3		-595	-1280	-815	-875	-710	3880	-210	-205	-190	-235	-275	-220	GN/MD
3.0035		3000	2000	-625	-1320	-835	-922	-753	3875	-230	-215	-197	-255	-288	-235	
Date & Time =	Fri, Feb 20 '09 8:40 AM	Reading No. 1		-625	-1320	-835	-925	-755	3870	-230	-220	-195	-255	-280	-230	GN/MD
Temperature (°F) =	71.10	Reading No. 2		-625	-1320	-835	-920	-750	3870	-230	-210	-195	-255	-300	-240	GN/MD
RH (%) =	51.90	Reading No. 3		-625	-1320	-835	-920	-755	3885	-230	-215	-200	-255	-285	-235	GN/MD

Creep Of Concrete in Compression (ASTM C 512)

Creep Frame No. HSF#25, Mix: 09-019-001, Mix 1A, Unsealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.
Contact:	John Pearson

Project:	Crystal River Unit 3 SGRP
CTL Project Number	109151

CTL Project Manager	M. D'Ambrosia
Technicians	G. Neiweem

Specimen Information

Mix ID/Set #	09-019-001, Mix 1A
Curing:	Unsealed
Specimens Cast:	2/12/09 9:35 AM
Loaded:	2/17/09 8:45 AM

Loading Information

Age:		5	days
Intensity:	n/a f'c	2000	psi
Preload		200	psi
Compressive Strength, f'c		Measured by S&ME	psi

Measurement Information

Creep Frame ID:	HSF#25
Strain Measuring Device:	Soiltest with digital gage
Gage Length:	10 in.
Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.) Cylinder: 1 (chamber #3) Side 1	Side 2	Side 3	Cylinder: 2 (chamber #13) Side 1	Side 2	Side 3	Shrinkage Data (x 0.00001 in.) Cylinder: 3 (chamber #14) Side 1	Side 2	Side 3	Cylinder: 4 (chamber #2) Side 1	Side 2	Side 3	Initial
4.0069		3000	2000	-648	-1330	-867	-945	-750	3848	-227	-202	-187	-247	-277	-223	
Date & Time =	Sat, Feb 21 '09 8:45 AM	Reading No. 1		-645	-1325	-860	-940	-750	3850	-225	-205	-190	-245	-285	-225	GN/MD
Temperature (°F) =	71.20	Reading No. 2		-650	-1330	-875	-945	-750	3845	-230	-200	-185	-250	-270	-225	GN/MD
RH (%) =	53.60	Reading No. 3		-650	-1335	-865	-950	-750	3850	-225	-200	-185	-245	-275	-220	GN/MD
5.0056		3000	2000	-668	-1348	-903	-953	-785	3813	-235	-213	-188	-255	-292	-230	
Date & Time =	Sun, Feb 22 '09 8:43 AM	Reading No. 1		-660	-1340	-900	-955	-785	3805	-240	-210	-185	-250	-285	-230	GN/MD
Temperature (°F) =	71.90	Reading No. 2		-675	-1355	-900	-950	-785	3810	-230	-220	-190	-265	-300	-230	GN/MD
RH (%) =	53.00	Reading No. 3		-670	-1350	-910	-955	-785	3825	-235	-210	-190	-250	-290	-230	GN/MD
6.0069		3000	2000	-690	-1392	-908	-962	-798	3818	-230	-215	-190	-257	-298	-237	
Date & Time =	Mon, Feb 23 '09 8:45 AM	Reading No. 1		-690	-1385	-910	-960	-805	3815	-230	-215	-190	-245	-295	-230	GN/MD
Temperature (°F) =	70.20	Reading No. 2		-690	-1395	-910	-960	-795	3820	-230	-215	-190	-265	-305	-240	GN/MD
RH (%) =	56.80	Reading No. 3		-690	-1395	-905	-965	-795	3820	-230	-215	-190	-260	-295	-240	GN/MD
6.9986		3000	2000	-690	-1385	-905	-993	-817	3788	-235	-232	-213	-262	-297	-240	
Date & Time =	Tue, Feb 24 '09 8:33 AM	Reading No. 1		-690	-1385	-910	-995	-815	3785	-245	-225	-215	-265	-295	-245	GN/MD
Temperature (°F) =	71.00	Reading No. 2		-690	-1385	-895	-990	-815	3790	-230	-235	-210	-260	-300	-240	GN/MD
RH (%) =	51.50	Reading No. 3		-690	-1385	-910	-995	-820	3790	-230	-235	-215	-260	-295	-235	GN/MD
14.0417		3000	2000	-805	-1483	-1038	-1097	-900	3662	-305	-283	-272	-348	-370	-315	
Date & Time =	Tue, Mar 3 '09 9:35 AM	Reading No. 1		-800	-1475	-1045	-1095	-900	3660	-300	-285	-270	-345	-365	-315	GN/MD
Temperature (°F) =	71.30	Reading No. 2		-810	-1485	-1035	-1100	-900	3655	-305	-280	-270	-350	-370	-315	GN/MD
RH (%) =	47.70	Reading No. 3		-805	-1490	-1035	-1095	-900	3670	-310	-285	-275	-350	-375	-315	GN/MD
21.0049		3000	2000	-882	-1558	-1107	-1172	-978	3587	-330	-307	-288	-375	-393	-340	
Date & Time =	Tue, Mar 10 '09 8:42 AM	Reading No. 1		-875	-1555	-1110	-1170	-980	3585	-340	-310	-290	-370	-390	-340	GN/MD
Temperature (°F) =	72.30	Reading No. 2		-885	-1560	-1100	-1170	-980	3585	-325	-305	-290	-375	-395	-340	GN/MD
RH (%) =	54.50	Reading No. 3		-885	-1560	-1110	-1175	-975	3590	-325	-305	-285	-380	-395	-340	GN/MD

Creep Of Concrete in Compression (ASTM C 512)

Creep Frame No. HSF#25, Mix: 09-019-001, Mix 1A, Unsealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.
Contact:	John Pearson
Project:	Crystal River Unit 3 SGRP
CTL Project Number	109151
CTL Project Manager	M. D'Ambrosia
Technicians	G. Neiweem

Specimen Information

Mix ID/Set #	09-019-001, Mix 1A
Curing:	Unsealed
Specimens Cast:	2/12/09 9:35 AM
Loaded:	2/17/09 8:45 AM

Loading Information

Age:		5	days
Intensity:	n/a f'c	2000	psi
Preload		200	psi
Compressive Strength, f'c		Measured by S&ME	psi

Measurement Information

Creep Frame ID:	HSF#25
Strain Measuring Device:	Soiltest with digital gage
Gage Length:	10 in.
Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.) Cylinder: 1 (chamber #3) Side 1	Side 2	Side 3	Cylinder: 2 (chamber #13) Side 1	Side 2	Side 3	Shrinkage Data (x 0.00001 in.) Cylinder: 3 (chamber #14) Side 1	Side 2	Side 3	Cylinder: 4 (chamber #2) Side 1	Side 2	Side 3	Initial
28.0667		3000	2000	-912	-1655	-1180	-1213	-1070	3517	-348	-328	-318	-415	-430	-367	
Date & Time =	Tue, Mar 17 '09 10:11 AM	Reading No. 1		-905	-1655	-1175	-1210	-1070	3515	-350	-325	-315	-415	-435	-360	GN/AP
Temperature (°F) =	72.00	Reading No. 2		-915	-1655	-1180	-1215	-1070	3520	-345	-335	-320	-415	-425	-370	GN/AP
RH (%) =	44.10	Reading No. 3		-915	-1655	-1185	-1215	-1070	3515	-350	-325	-320	-415	-430	-370	GN/AP
35.0576		3000	2000	-950	-1675	-1205	-1253	-1090	3483	-368	-357	-337	-422	-435	-385	
Date & Time =	Tue, Mar 24 '09 9:58 AM	Reading No. 1		-950	-1675	-1205	-1255	-1090	3480	-375	-350	-335	-415	-435	-385	GN/MD
Temperature (°F) =	72.40	Reading No. 2		-950	-1675	-1200	-1250	-1090	3485	-360	-360	-335	-425	-435	-385	GN/MD
RH (%) =	46.80	Reading No. 3		-950	-1675	-1210	-1255	-1090	3485	-370	-360	-340	-425	-435	-385	GN/MD
42.2708		3000	2000	-1012	-1723	-1233	-1305	-1118	3457	-373	-373	-360	-445	-450	-398	
Date & Time =	Tue, Mar 31 '09 3:05 PM	Reading No. 1		-1010	-1730	-1230	-1305	-1115	3455	-370	-375	-355	-445	-450	-395	GN/MD
Temperature (°F) =	71.60	Reading No. 2		-1015	-1720	-1230	-1305	-1120	3460	-375	-375	-360	-440	-450	-400	GN/MD
RH (%) =	53.00	Reading No. 3		-1010	-1720	-1240	-1305	-1120	3455	-375	-370	-365	-450	-450	-400	GN/MD
49.1201		3000	2000	-1023	-1740	-1267	-1305	-1153	3420	-397	-383	-362	-457	-470	-412	
Date & Time =	Tue, Apr 7 '09 11:28 AM	Reading No. 1		-1025	-1735	-1265	-1305	-1155	3420	-390	-385	-365	-450	-465	-405	GN/MD
Temperature (°F) =	71.60	Reading No. 2		-1025	-1740	-1270	-1305	-1150	3420	-400	-385	-360	-455	-470	-415	GN/MD
RH (%) =	50.30	Reading No. 3		-1020	-1745	-1265	-1305	-1155	3420	-400	-380	-360	-465	-475	-415	GN/MD
56.2910		3000	2000	-1038	-1745	-1287	-1335	-1170	3398	-395	-395	-358	-478	-472	-418	
Date & Time =	Tue, Apr 14 '09 3:34 PM	Reading No. 1		-1035	-1735	-1295	-1335	-1170	3395	-395	-395	-360	-470	-470	-415	GN/MD
Temperature (°F) =	71.80	Reading No. 2		-1045	-1750	-1280	-1335	-1170	3400	-395	-395	-360	-485	-470	-425	GN/MD
RH (%) =	47.80	Reading No. 3		-1035	-1750	-1285	-1335	-1170	3400	-395	-395	-355	-480	-475	-415	GN/MD
63.0785		3000	2000	-1088	-1772	-1282	-1377	-1168	3372	-422	-412	-390	-488	-478	-435	
Date & Time =	Tue, Apr 21 '09 10:28 AM	Reading No. 1		-1085	-1780	-1280	-1375	-1170	3365	-415	-420	-390	-490	-475	-435	GN/MD
Temperature (°F) =	72.60	Reading No. 2		-1090	-1765	-1285	-1375	-1165	3375	-425	-400	-385	-490	-480	-435	GN/MD
RH (%) =	52.20	Reading No. 3		-1090	-1770	-1280	-1380	-1170	3375	-425	-415	-395	-485	-480	-435	GN/MD

ENGINEERING CHANGE

0000063016R003

Creep Of Concrete in Compression (ASTM C 512)
Creep Frame No. HSF#25, Mix: 09-019-001, Mix 1A, Unsealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.	Project:	Crystal River Unit 3 SGRP	CTL Project Manager	M. D'Ambrosia
Contact:	John Pearson	CTL Project Number	109151	Technicians	G. Neiweem

Specimen Information		Loading Information				Measurement Information	
Mix ID/Set #	09-019-001, Mix 1A	Age:		5	days	Creep Frame ID:	HSF#25
Curing:	Unsealed	Intensity: n/a f'c		2000	psi	Strain Measuring Device:	Soiltest with digital gage
Specimens Cast:	2/12/09 9:35 AM	Preload		200	psi	Gage Length:	10 in.
Loaded:	2/17/09 8:45 AM	Compressive Strength, f'c		Measured by S&ME	psi	Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.) Cylinder: 1 (chamber #3)			Cylinder: 2 (chamber #13)			Shrinkage Data (x 0.00001 in.) Cylinder: 3 (chamber #14)			Cylinder: 4 (chamber #2)			Initial
				Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	Side 1	Side 2	Side 3	
70.0896		3000	2000	-1102	-1757	-1283	-1397	-1190	3375	-413	-393	-363	-487	-490	-437	
Date & Time =	Tue, Apr 28 '09 10:44 AM	Reading No. 1		-1100	-1755	-1285	-1390	-1190	3375	-415	-395	-360	-480	-490	-435	GN/MD
Temperature (°F) =	72.80	Reading No. 2		-1100	-1755	-1285	-1395	-1185	3375	-410	-390	-360	-490	-490	-440	GN/MD
RH (%) =	52.50	Reading No. 3		-1105	-1760	-1280	-1405	-1195	3375	-415	-395	-370	-490	-490	-435	GN/MD
77.2757		3000	2000	-1118	-1813	-1353	-1440	-1218	3343	-445	-435	-413	-520	-522	-482	
Date & Time =	Tue, May 5 '09 3:12 PM	Reading No. 1		-1120	-1805	-1350	-1445	-1215	3345	-450	-430	-410	-515	-515	-480	GN/MD
Temperature (°F) =	71.70	Reading No. 2		-1115	-1815	-1360	-1440	-1220	3345	-445	-435	-415	-520	-525	-485	GN/MD
RH (%) =	54.50	Reading No. 3		-1120	-1820	-1350	-1435	-1220	3340	-440	-440	-415	-525	-525	-480	GN/MD
84.0812		3000	2000	-1203	-1863	-1390	-1452	-1247	3333	-447	-432	-407	-530	-510	-470	
Date & Time =	Tue, May 12 '09 10:32 AM	Reading No. 1		-1195	-1860	-1385	-1450	-1240	3325	-440	-435	-405	-530	-515	-470	GN/MD
Temperature (°F) =	72.00	Reading No. 2		-1205	-1860	-1395	-1455	-1250	3335	-450	-425	-410	-535	-510	-470	GN/MD
RH (%) =	48.00	Reading No. 3		-1210	-1870	-1390	-1450	-1250	3340	-450	-435	-405	-525	-505	-470	GN/MD
91.3083		3000	2000	-1155	-1852	-1388	-1435	-1253	3305	-452	-443	-427	-525	-533	-477	
Date & Time =	Tue, May 19 '09 3:59 PM	Reading No. 1		-1150	-1855	-1380	-1435	-1255	3305	-450	-440	-420	-525	-525	-480	GN/MD
Temperature (°F) =	71.90	Reading No. 2		-1160	-1850	-1395	-1435	-1255	3305	-455	-445	-430	-525	-540	-475	GN/MD
RH (%) =	47.70	Reading No. 3		-1155	-1850	-1390	-1435	-1250	3305	-450	-445	-430	-525	-535	-475	GN/MD
91.3153		0	0	-868	-1550	-1075	-1170	-942	3620	-452	-445	-418	-533	-523	-473	
Date & Time =	Tue, May 19 '09 4:09 PM	Reading No. 1		-865	-1545	-1080	-1170	-945	3620	-445	-435	-415	-535	-520	-470	GN/MD
Temperature (°F) =	72.10	Reading No. 2		-870	-1560	-1070	-1170	-940	3620	-450	-450	-415	-535	-525	-475	GN/MD
RH (%) =	47.70	Reading No. 3		-870	-1545	-1075	-1170	-940	3620	-460	-450	-425	-530	-525	-475	GN/MD
91.3264		0	0	-868	-1560	-1045	-1138	-937	3635	-462	-442	-412	-522	-513	-487	
Date & Time =	Tue, May 19 '09 4:25 PM	Reading No. 1		-860	-1555	-1045	-1130	-940	3635	-460	-435	-415	-520	-505	-480	GN/MD
Temperature (°F) =	72.10	Reading No. 2		-870	-1560	-1045	-1145	-935	3635	-460	-445	-415	-525	-520	-490	GN/MD
RH (%) =	47.90	Reading No. 3		-875	-1565	-1045	-1140	-935	3635	-465	-445	-405	-520	-515	-490	GN/MD

Creep Of Concrete in Compression (ASTM C 512)
Creep Frame No. HSF#25, Mix: 09-019-001, Mix 1A, Unsealed Cylinders, Loaded at 5 days to 2000 psi

Client:	S&ME, Inc.	Project:	Crystal River Unit 3 SGRP	CTL Project Manager	M. D'Ambrosia
Contact:	John Pearson	CTL Project Number	109151	Technicians	G. Neiweem

Specimen Information		Loading Information		Measurement Information	
Mix ID/Set #	09-019-001, Mix 1A	Age:	5 days	Creep Frame ID:	HSF#25
Curing:	Unsealed	Intensity: n/a f'c	2000 psi	Strain Measuring Device:	Soiltest with digital gage
Specimens Cast:	2/12/09 9:35 AM	Preload	200 psi	Gage Length:	10 in.
Loaded:	2/17/09 8:45 AM	Compressive Strength, f'c	Measured by S&ME psi	Unit press/gage press factor	1.4981

Days from loading	Date Read	Gage Press, psi	Unit Press, psi	Creep Data (x 0.00001 in.) Cylinder: 1 (chamber #3) Side 1	Side 2	Side 3	Cylinder: 2 (chamber #13) Side 1	Side 2	Side 3	Shrinkage Data (x 0.00001 in.) Cylinder: 3 (chamber #14) Side 1	Side 2	Side 3	Cylinder: 4 (chamber #2) Side 1	Side 2	Side 3	Initial
93.1757		0	0	-848	-1492	-1023	-1112	-907	3648	-450	-428	-415	-530	-525	-478	
Date & Time =	Thu, May 21 '09 12:48 PM	Reading No. 1		-850	-1495	-1020	-1100	-905	3645	-445	-435	-415	-525	-515	-480	GN/MD
Temperature (°F) =	71.80	Reading No. 2		-845	-1490	-1025	-1120	-900	3650	-450	-425	-415	-530	-530	-475	GN/MD
RH (%) =	47.80	Reading No. 3		-850	-1490	-1025	-1115	-915	3650	-455	-425	-415	-535	-530	-480	GN/MD
94.1007		0	2000	-825	-1493	-1015	-1112	-907	3678	-440	-430	-415	-500	-505	-458	
Date & Time =	Fri, May 22 '09 11:00 AM	Reading No. 1		-820	-1495	-1015	-1115	-910	3670	-425	-430	-415	-490	-505	-450	GN/MD
Temperature (°F) =	73.30	Reading No. 2		-830	-1490	-1010	-1110	-900	3680	-445	-425	-410	-505	-505	-460	GN/MD
RH (%) =	52.60	Reading No. 3		-825	-1495	-1020	-1110	-910	3685	-450	-435	-420	-505	-505	-465	GN/MD
98.1160		0	0	-818	-1487	-1012	-1100	-895	3662	-458	-432	-422	-512	-515	-463	
Date & Time =	Tue, May 26 '09 11:22 AM	Reading No. 1		-810	-1490	-1005	-1100	-895	3655	-455	-435	-425	-505	-515	-455	GN/MD
Temperature (°F) =	74.40	Reading No. 2		-820	-1480	-1015	-1100	-895	3665	-460	-430	-420	-510	-520	-465	GN/MD
RH (%) =	54.00	Reading No. 3		-825	-1490	-1015	-1100	-895	3665	-460	-430	-420	-520	-510	-470	GN/MD
99.0083		0	0	-820	-1472	-1007	-1095	-892	3675	-442	-427	-415	-523	-505	-473	
Date & Time =	Wed, May 27 '09 8:47 AM	Reading No. 1		-820	-1475	-1000	-1095	-895	3675	-440	-420	-415	-520	-505	-465	GN/MD
Temperature (°F) =	74.80	Reading No. 2		-820	-1470	-1010	-1095	-885	3675	-450	-430	-415	-525	-505	-475	GN/MD
RH (%) =	46.40	Reading No. 3		-820	-1470	-1010	-1095	-895	3675	-435	-430	-415	-525	-505	-480	GN/MD

Appendix B

Equipment Calibration Summary

S&ME

Form No:11.1-2
Revision 2
Revision Date 11/04/08

INSTRUMENT AND/OR EQUIPMENT USAGE

(The following summarizes the equipment used and their calibration interval while in use.)

Project: 1439-08-208 Activity: Phase III Testing

ID Number	Equipment Name	Model Number	Calibration Date	Calibration Due Date
16115	Slump Cone Set	Humboldt	10/2/2008	10/2/2009
18312	Pressure Meter	Humboldt	1/8/2009	4/8/2009
16219	60lb Scale	FG-30K	8/21/2008	8/21/2009
18562	Thermometer	Humboldt	3/3/2008	3/3/2009
16077	Mallet	N/A	3/31/2003	N/A
16233	Stopwatch	N/A	12/16/08	06/16/09
1500	Universal Testing Machine	600V	07/11/08	07/11/09
6/25/08 Shipment	Sulfur Capping Compound	Test Mark	1/9/2009	4/9/2009
2044	Temperature Recorder	N/A	11/2/2008	5/2/2009
16062	Extensometer	N/A	10/6/2008	10/6/2009
004-820	6" x 12" Cylinder Molds	Lot No. 96526	2/12/2009	Each Shipment
2189	Outside Micrometer	N/A	2/4/2009	2/4/2010
16060 T2-1	Thermocouple	Type T	11/18/2008	11/18/2009
16060 T2-4	Thermocouple	Type T	11/18/2008	11/18/2009
16060 T1-2	Thermocouple	Type T	11/18/2008	11/18/2009
16060 T1-3	Thermocouple	Type T	11/18/2008	11/18/2009
16561	Vibrator	Dewalt DC530	09/16/08	09/16/09
16060	Omega Thermocouple Readout	HH801B	11/18/08	11/18/09
B60000001CD6CE21	I button temperature sensor	DS1921G	09/18/08	09/18/09
B20000001CC8FF21	I button temperature sensor	DS1921G	09/18/08	09/18/09
F90000001CBFAC21	I button temperature sensor	DS1921G	09/18/08	09/18/09
C10000001CC15B21	I button temperature sensor	DS1921G	09/18/08	09/18/09
950000001D0D7921	I button temperature sensor	DS1921G	09/18/08	09/18/09
2C0000001F8B6F21	I button temperature sensor	DS1921G	09/18/08	09/18/09
BC0000001D4EA421	I button temperature sensor	DS1921G	09/18/08	09/18/09
DB0000001D47BE21	I button temperature sensor	DS1921G	09/18/08	09/18/09
020000001E60B521	I button temperature sensor	DS1921G	09/18/08	09/18/09

Reviewed By: [signature] Date: JUN 19 2009

S&ME

Form No:11.1-2
Revision 2
Revision Date 11/04/08

INSTRUMENT AND/OR EQUIPMENT USAGE

(The following summarizes the equipment used and their calibration interval while in use.)

Project: 1439-08-208 Activity: Phase III Testing

ID Number	Equipment Name	Model Number	Calibration Date	Calibration Due Date
9D0000001D46C021	I button temperature sensor	DS1921G	09/18/08	09/18/09
340000001D315F21	I button temperature sensor	DS1921G	09/18/08	09/18/09
C20000001CD60B21	I button temperature sensor	DS1921G	09/18/08	09/18/09
1D0000001D4AC821	I button temperature sensor	DS1921G	09/18/08	09/18/09
750000001D0AE921	I button temperature sensor	DS1921G	09/18/08	09/18/09
B40000001D33C921	I button temperature sensor	DS1921G	09/18/08	09/18/09
B90000001D44FD21	I button temperature sensor	DS1921G	09/18/08	09/18/09
1B0000001CF0F121	I button temperature sensor	DS1921G	09/18/08	09/18/09
160000001CFAE421	I button temperature sensor	DS1921G	09/18/08	09/18/09
A30000001CC44E21	I button temperature sensor	DS1921G	09/18/08	09/18/09
8D0000001CC62C21	I button temperature sensor	DS1921G	09/18/08	09/18/09
940000001F8B3621	I button temperature sensor	DS1921G	09/18/08	09/18/09
080000001F5EAE21	I button temperature sensor	DS1921G	09/18/08	09/18/09
1F0000001F39D421	I button temperature sensor	DS1921G	09/18/08	09/18/09
970000001F783321	I button temperature sensor	DS1921G	09/18/08	09/18/09
2F0000001F003621	I button temperature sensor	DS1921G	09/18/08	09/18/09
A50000001F9A9221	I button temperature sensor	DS1921G	09/18/08	09/18/09
1F0000001F609A21	I button temperature sensor	DS1921G	09/18/08	09/18/09
DD0000001F73DD21	I button temperature sensor	DS1921G	09/18/08	09/18/09
F10000001D209A21	I button temperature sensor	DS1921G	09/18/08	09/18/09
D90000001F34A221	I button temperature sensor	DS1921G	09/18/08	09/18/09
790000001F7BBE21	I button temperature sensor	DS1921G	09/18/08	09/18/09
DB0000001F436A21	I button temperature sensor	DS1921G	09/18/08	09/18/09
C50000001F6A5121	I button temperature sensor	DS1921G	09/18/08	09/18/09
D80000001F304321	I button temperature sensor	DS1921G	09/18/08	09/18/09
B0000001F3FF321	I button temperature sensor	DS1921G	09/18/08	09/18/09
A10000001F02D921	I button temperature sensor	DS1921G	09/18/08	09/18/09

Reviewed By: [signature] Date: JUN 19 2009

S&ME

Form No:11.1-2
Revision 2
Revision Date 11/04/08

INSTRUMENT AND/OR EQUIPMENT USAGE

(The following summarizes the equipment used and their calibration interval while in use.)

Project: 1439-08-208 Activity: Phase III Testing

ID Number	Equipment Name	Model Number	Calibration Date	Calibration Due Date
3B0000001F902D21	I button temperature sensor	DS1921G	09/18/08	09/18/09
9B0000001F830221	I button temperature sensor	DS1921G	09/18/08	09/18/09
16582	60lb Scale	EB Series	01/06/09	01/06/10
1475	Oven	Blue M	10/07/08	10/7/2009
12543	Scale	Mettler	01/08/09	01/08/10
16227	Compression Test Machine	F-401F-Pilot	07/11/08	07/11/09
18466	Reference Thermometer	H-2600.113F	01/27/09	01/27/10
12583	Balance	Mettler	01/08/09	01/08/10
12730	Straightedge	N/A	10/02/08	10/02/09
12682	Feeler Gauges	N/A	09/12/08	09/12/09
18525	Mitutoyo Digital Caliper	CD-12"PS	02/27/09	02/28/10
	CTL Equipment Summary			
RAM2	Hydraulic Pressure Gauge	RAM	06/09/08	6/9/2009
M024758	Mitutoyo Digital Indicator (with Soiltest CT-171 gauge)	543-180	04/17/08	4/17/2009
			04/16/09	4/16/2010
7116253	Chart Recorder	Dickson TH803	5/22/2008	5/22/2009
HSF#19	Creep Frame	#19	2/13/2009	next use
HSF#25	Creep Frame	#25	2/13/2009	next use
CYLCAP	Sulfur Capping compound	CYLCAP	01/07/09	04/07/09
			04/01/09	07/01/09
260000000ADF7241	I button temperature sensor	DS1923	06/02/09	06/02/10
	NOTHING FOLLOWS			

Reviewed By: [signature] Date: JUN 1 9 2009

Appendix C

Laboratory Accreditation Certificates

Personnel Qualification Summary

American Association of State Highway and Transportation Officials

AASHTO Accreditation Program - Certificate of Accreditation

This is to signify that

S&ME, Inc.

Louisville, Tennessee

**has demonstrated proficiency for the testing of construction materials
and has met the minimum requirements in AASHTO R18
set forth by the AASHTO Highway Subcommittee on Materials.**

**The scope of accreditation can be obtained by viewing
the AAP Directories of Accredited Laboratories (www.nist.gov/amrl)
or by contacting AMRL.**

Executive Director

**Chair, AASHTO Highway
Subcommittee on Materials**

AASHTO R18

American Association of State Highway and Transportation Officials

AASHTO Accreditation Program - Certificate of Accreditation

This is to signify that

Construction Technology Laboratories, Inc.

Skokie, Illinois

has demonstrated proficiency for the testing of construction materials
and has met the minimum requirements in AASHTO R18
set forth by the AASHTO Highway Subcommittee on Materials.

The scope of accreditation can be obtained by viewing
the AAP Directories of Accredited Laboratories (www.nist.gov/amrl)
or by contacting AMRL.

Executive Director

Chair, AASHTO Highway Subcommittee on Materials

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AASHTO R18

Phase III Testing Personnel Table [1]

Testing Personnel Name	Initials	Applicable Technical External Certifications [2]	Extent of testing involvement
Jason B. Burgess	JBB	ACI Field Testing – Grade 1 ACI Concrete Lab Testing – Level 1 ACI Strength Testing	Concrete Batching Operations Fresh Property Testing Hardened Property Testing
Tommy Jeff Webb	TJW	ACI Field Testing – Grade 1 ACI Concrete Lab Testing – Level 1 ACI Strength Testing NICET Concrete Level II	Concrete Batching Operations Fresh Property Testing Hardened Property Testing
Matthew D'Ambrosia	MD	ACI Field Testing – Grade 1	Creep Testing – Recording Creep Measurements, Data Reduction, Reporting
Greg Neiweem	GN	ACI Field Testing – Grade 1 ACI Strength Testing	Creep Testing – Capping Specimens Taking Creep Measurements
Agata Pyc	AP	N/A	Creep Testing – Recording Creep Measurements
Fred Blaul	FB	ACI Field Testing – Grade 1 ACI Strength Testing	Creep Testing – Instrumenting Capping Specimens
Julia Johnson	JJ	ACI Field Testing – Grade 1 ACI Strength Testing	Creep Testing – Instrumenting Capping Specimens
Phil Brindise	PB	ACI Field Testing – Grade 1 ACI Concrete Lab Testing – Level 1 ACI Concrete Lab Testing – Grade II ACI Strength Testing	Supervisor, Scheduling and Assigning Tasks, Equipment Calibrations

1. Engineering and supervisory personnel not included in table of testing personnel.
2. Personnel also received internal project and task specific training.

Appendix D

Corrective Actions

Notices of Anomaly

CTLGroup Skokie, IL 60077	NOTICE OF ANOMALY	DATE: 6/18/09

Notice No.: NOA-09001 P.O. No.: ____ Project No.: 109151

Customer/Vendor: S&ME Job No.: 1439-08-208

Notification Made To: John Coffey, S&ME Notification Date: 6-18-09

Notification Made By: M.D'Ambrosia Via: e-mail

Category: Specimen ____ Procedure ____ Test Equipment X
Other Date of Anomaly: multiple

Part Name: ibutton Hygrochron Part No.: DS1923

Test: Creep I.D. No. SN: 260000000ADF7241

Specification ASTM C 512 Paragraph No. ____

Requirements: Record temperature and humidity

Description of Anomaly

Temperature readings were anomalous on several occasions, showing deviation from the specified requirements by approximately 0.5°F.

Temperature and humidity record shows several gaps during the history of the project, the longest occurring between 4/1/09 and 4/6/09. During this period, the memory capacity was exceeded on the logger and the oldest datapoints were overwritten with new data for approximately 4 days.

Disposition-Comments-Recommendations

Reduce frequency of door opening for controlled room to minimize anomalous temperature readings.

Increase frequency of datalogger downloads to eliminate gaps in data.

INITIATOR M. D'Ambrosia
PROJECT MANAGER, OR
PROJECT ENGINEER [signature] DATE 6/18/09

QUALITY ASSURANCE [signature] DATE 6/18/09

Form QF-15 NOA
Rev. 0 / 17-Jun-09

CTLGroup Corrective Action Request

Client: S&ME	CAR No. 09-002	Date: 5-11-2009
Project No. 109151	Project Description: ASTM C 512 Creep testing	
Responsible Person: R. Burg	Initiator: J. Johnson	

Description of Nonconformance: Room B 132 temperature and humidity temporarily out of specification. See attached sheet for more detail.

Root Cause Analysis: It was determined that the primary causal factor for the compressor malfunction was that the compressor engine was getting flooded with fuel. This prevents the compressor from turning on to cool the water, which in turn humidifies the room.

Recommended Corrective Action: On May 4th, a permanent solution was found. Mr. Liska and Mr. Kerr permanently fixed the problem by retrofitting the natural gas driven engine compressor with an adjustable electric time delay on the fuel valve. This time delay device clears the pistons of any fuel before the compressor turns on and prevents the compressor engine from getting flooded with fuel.

Review and Acceptance of Corrective Action by QA Manager	Date
[signature]	

Distribution	
Signatures	Date
Initiator [signature]	6/5/09
Project Manager/Responsible Person [signature]	6/5/09
Quality Assurance Manager [signature]	6/8/09

Brief Instructions for completing Corrective Action Request
(More detailed information may be found in QP-03 *Control of Nonconforming Work.*)

Anyone in the Company may initiate a Corrective Action Request.

Initiator shall complete Description of Nonconformance, and pass form electronically to the Project Manager/Responsible Person. A copy of the e-mail shall be sent to the Quality Manager.

Project Manager/Responsible Person shall complete Root Cause Analysis and Recommended Corrective Action sections and forward electronically to Quality Manager.

Quality Manager shall review and accept recommended corrective action. This review does not preclude the Project Manager/Responsible Person from proceeding with the corrective action in an effort to correct the nonconformance in a timely fashion.

Following implementation of the corrective action, Initiator, Project Manager/Responsible Person, Quality Assurance Manager and other stakeholders as deemed necessary shall sign the Corrective Action Request. In so doing, all are indicating that the nonconformance has been resolved satisfactorily.

Necessary documentation shall be attached.

Summary of Conditions Leading to Corrective Action Report 09-002

Room B132 temperature and humidity were temporarily out of specification on several occasions between Friday April 24, 2009 and Monday May 4, 2009. Ed Liska, CTLGroup building services, was alerted to a mechanical failure via cell phone at 9:31 P.M. on Friday April 24, 2009. The cooling system chiller motor had ceased to operate when the water temperature exceeded 60°F. When Mr. Liska arrived approximately 1-1/2 hours after receiving the alert, he restarted the chiller motor to bring the room back into specification. The problem occurred again on Sunday April 26, 2009, May 2, 2009, and May 3, 2009. After each occurrence, Mr. Liska performed a manual system reboot to bring the system back online. Between April 24, 2009 and May 4, 2009, Mr. Liska and Mr. Steve Kerr worked to determine the cause of these outages and develop a solution. A detailed description of each period when the room was out of specification is shown in the table below.

The outages are considered to have had a negligible impact on the ASTM C 512 creep testing for several reasons.

1. It was observed that the test results continued to conform to predicted trend lines that were established before the outages occurred.
2. The outages did not occur on the same days as deformation measurements, and the conditions had returned to normal by the time measurements were taken.
3. Creep and shrinkage are relatively slow occurring phenomena and short term changes in environment do not significantly effect measurements.
4. The total time the room was out of specification was small relative to the total test time (3 days out of a 90 day test) and occurred near the end of the testing period, when the measured behavior is the least sensitive to changes in environmental conditions.

It was determined that the primary causal factor for the compressor malfunction was that the compressor engine was getting flooded with fuel. This prevents the compressor from turning on to cool the water, which in turn humidifies the room.

On May 4, 2009 a permanent solution was implemented. Mr. Liska and Mr. Kerr permanently fixed the problem by retrofitting the natural gas driven engine compressor with an adjustable electric time delay on the fuel valve. This time delay device clears the pistons of any fuel before the compressor turns on and prevents the compressor engine from getting flooded with fuel.

Estimated Times						
RH out	RH in	Time	Est Peak	High or Low	Differential	24 hour average out
4/24/09 9:30 PM	4/24/09 11:30 PM	2.0	82.2	high	28.2	0
4/25/09 10:13 PM	4/25/09 11:30 PM	1.3	63.9	high	9.9	0
4/26/09 2:00 AM	4/26/09 4:00 AM	2.0	62.4	high	8.4	0
4/26/09 3:00 PM	4/26/09 10:00 PM	7.0	57.8	high	3.8	0
5/4/09 7:30 AM	5/4/09 8:30 AM	1.0	62.7	high	8.7	0
	Total Time	13.28			Total Time	0.00
	Test time	2376			Test time	2376
	% out of spec	0.56%			% out of spec	0.00%

Estimated Times						
Temp out	Temp in	Time	Est Peak	High or Low	Differential	24 hour average out
4/24/09 9:53 AM	4/24/09 9:43 PM	11.8	70.1	low	-1.3	12
4/24/09 11:23 PM	4/25/09 2:00 PM	14.6	70	low	-1.4	12
4/26/09 8:23 AM	4/26/09 10:03 PM	13.7	79	high	3.6	7.2
4/27/09 2:03 AM	4/27/09 2:53 PM	12.8	70.2	low	-1.2	0
5/2/09 4:30 PM	5/2/09 9:00 PM	4.5	77.2	high	1.8	0
5/3/09 6:30 AM	5/3/09 10:30 PM	16.0	79	high	3.6	20.3
5/4/09 11:00 AM	5/4/09 5:30 PM	6.5	69	low	-2.4	0
	Total Time	73.4			Total Time	51.5
	Test time	2376.00			Test time	2376.00
	% out of spec	3.09%			% out of spec	2.17%

CTLGroup Corrective Action Request

Client: S&ME	CAR No. 09-003	Date: 6-19-09
Project No. 109151	Project Description: Crystal River Creep Test	
Responsible Person: M. D'Ambrosia	Initiator: J. Johnson	

Description of Nonconformance: CTLGroup work instruction WI-39012, Section 6.2 states in part a separate monitoring system with a chart recorder is to be used to provide a record of the environmental conditions of temperature range of 73.4° F +/- 2° F and at relative humidity of 20 +/- 4%.

Contrary to this during the creep testing it was observed the pen recording the relative humidity did not mark the readings on two periods (03-11-09 to 03-16-09) and then on (03-16-09 to 03-23-09). In addition for four days (04-06-09 to 04-10-09) the pen stuck in the same position.

Root Cause Analysis: Preliminary RCA indicates that the frequency of inspection of the recorder was not sufficient to prevent the occurrence of this issue. An additional internal corrective action and more detailed RCA will be performed by QA to formulate recommendations for prevention of this issue in the future.

Recommended Corrective Action: An independent temperature and humidity recording device, an I-Button ID# 60226389/155550 was put into service at the start of the testing to serve as a backup system. At the end of the testing this I-Button was verified using the CTL reference temperature standard. The results of this verification demonstrated the I-Button was in calibration and produced acceptable objective evidence that the temperature and relative humidity reading were within specification during the performance of the testing activity. No further action on this issue relative to this particular test is required.

Review and Acceptance of Corrective Action by QA Manager	Date 6/19/09

Distribution	
Signatures	Date
Initiator [signature]	6/19/09
Project Manager/Responsible Person [signature]	6/19/09
Quality Assurance Manager [signature]	6/19/09

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Document: Phase III Test Plan **Revision 0**

The signature below of the Lead Reviewer records that:
- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☐ **Design Verification Review** ☐ **Engineering Review** ☒ **Owner's Review**
- ☐ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

☐ **Special Engineering Review**____________________

☐ YES ☐ N/A **Other Records are attached.**

John Holliday	John Holliday (signature)	Civil	08/10/09
Lead Reviewer	**(print/sign)**	**Discipline**	**Date**

Item No.	Deficiency	Resolution
1.	NONE	
2.		
3.		

FORM EGR-NGGC-0003-2-10
This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

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PHASE III TEST PLAN
MIX ACCEPTANCE TESTING

FOR
CRYSTAL RIVER UNIT 3 STEAM GENERATOR REPLACEMENT PROJECT
PROJECT NUMBER 1439-08-208

Prepared for:
Mr. John Holliday
PROGRESS ENERGY FLORIDA, INC.

15760 West Powerline Street
Crystal River, Florida 34428-6708

Revision 0
January 30, 2009

PREPARED BY: [signature]

REVIEWED BY: [signature]

QA BY: [signature]

APPROVED BY: [signature]

BACKGROUND

This Phase III testing plan was developed based upon S&ME Proposal 3908110R1, Contract 373812 between S&ME and Progress Energy, e-mail and telephone correspondence with Progress Energy and Sargent & Lundy, and the requirements of *Laboratory Testing Requirements For Concrete Proportioning for Crystal River 3 Steam Generator Replacement Restoration of the Containment Opening Revision 3 section 3.8.2.1.* The purpose of the testing plan is to provide our understanding of the testing to be performed, so that any questions or concerns can be addressed prior to the start of the testing program. Phase III testing is classified as Safety-Related and will be conducted under S&ME's 10CFR50 Appendix B Quality Assurance Program.

MATERIAL PROPORTIONS

The ingredient materials and proportions listed below are planned to be used in the Phase III Mix Acceptance Testing program:

	Weight	Volume
Holly Hill Type I Cement	560	2.86
Class F Fly Ash (Proash)	140	0.93
Maryville #67 Coarse Agg.	1613	9.23
Natural Sand (Lilesville, NC)	1515	9.23
Water	262.5	4.21
Target Air Content (2%)		0.54

Target w/c	0.375
Theoretical unit weight	151.5 pcf
ADVA CAST 575	Dosed as required to achieve desired fresh properties
Recover	Dosed as required to achieve desired fresh properties

MIX ACCEPTANCE TESTING

Phase III testing will include repeating the same tests as were performed on the final mixes in Phase II, with the addition of 91 day creep/shrinkage tests and total evaporable water. As directed by Progress, the mix will be proportioned as Mix 1A, as submitted in the Phase II test report dated January 13, 2009. Admixture dosages will be adjusted as needed to achieve the desired fresh properties. Current approved changes from the project specification that were identified during Phase II, and will be in effect for the Phase III testing include the following:

- The required slump at discharge is to be between 6 and 9 inches.
- The 0.35 max water to cementitious ratio will not apply.
- The mixes will be performed near laboratory air temperature. No cooling of the ingredients or mix is required.
- The total mixing time will be extended by two minutes from that defined in ASTM C 192.

The mix (approximately 4.5 cubic feet) will be batched and testing will be performed as outlined below:

The temperature test will be begun on the fresh concrete immediately after discharge from the mixer and will be performed using *ASTM C 1064-05 Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.*

Slump of the fresh concrete will be determined using ASTM C 143-05a *Standard Test Method for Slump of Hydraulic-Cement Concrete.*

Unit Weight of the fresh concrete will be determined using ASTM C 138-01 *Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete.*

Air content of the fresh concrete will be determined using ASTM C 231-04 *Standard Test Method for Air Content of Freshly Mixed Concrete by Pressure Method.*

Cylinders will be cast using *ASTM C 192-06 Standard Test Method for Making and Curing Concrete Test Specimens in the Laboratory.* A minimum of eighteen 6" x 12" cylinders will be cast from the mix. Plastic, single use molds will be used.

The first five days of cylinder curing will be performed using ASTM C 684-99 *Standard Method for Making, Accelerated Curing, and Testing Concrete Compression Test Specimens*, Method C.

The remaining cylinder curing will be performed following *ASTM C 192-06 Standard Test Method for Making and Curing Concrete Test Specimens in the Laboratory*, but the cylinders will remain sealed in their molds.

Compressive strength testing will be performed using ASTM C 39-05$^{\varepsilon 1}$ *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.* Two specimens will be tested at an age of 5 days and two specimens at an age of 28 days. After the creep recovery readings, compressive strength testing will be performed on the creep and shrinkage specimens.

Modulus of Elasticity testing will be performed using ASTM C 469-02$^{\varepsilon 1}$ *Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression.* Two specimens will be tested at an age of 5 days and two specimens at an age of 28 days. After the creep recovery readings, modulus of elasticity will be performed on the available creep and shrinkage specimens.

Thermal Diffusivity testing will be performed on one cylinder at an age of 28 days following CRD-C-36-73 *Handbook of Concrete and Cement Method of Test for Thermal Diffusivity of Concrete.*

Total evaporable water will be determined on remnants of specimens tested for compressive strength at 5 days of age using ASTM C 642-06 *Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete.*

Creep testing will be performed using ASTM C 512-02 *Standard Test Method for Creep of Concrete in Compression,* except as noted otherwise, in accordance with Progress Energy Laboratory Testing Requirements for Concrete Proportioning for Crystal River 3 Steam Generator Replacement, Restoration of the Containment Opening, Revision 3.

The creep and shrinkage specimens will be transported to CTL in their autogenous curing containers prior to an age of 5 days. Following the initial 5 day curing period, creep and shrinkage test specimens will be removed from the autogenous curing containers and molds while inside the controlled the controlled environmental room where the testing will be performed. The controlled environment will be maintained at 73.4+/-2° F and 50+/-4% relative humidity. The environmental control system consists of a chilled water/steam generator, a pneumatic thermostat, and a pneumatic humidistat. The system has independent supply and feedback control. A separate monitoring system with a chart recorder is used to provide a record of the environmental conditions. In addition, temperature and humidity will be manually recorded concurrent with the creep measurements. The test specimens for basic creep and autogenous shrinkage shall be sealed to prevent moisture loss immediately after demolding using self-adhesive aluminum tape.

The end surfaces of the creep test specimens will be prepared by capping with sulfur capping compound to meet the requirements of ASTM C 617-98 (03) immediately after demolding to ensure a uniform load distribution. External strain gage points shall be instrumented after demolding. The specimens used for total creep and total shrinkage will be temporarily wrapped in plastic to prevent drying during the end preparation and gage point installation. This wrapping will be removed prior to the start of testing.

Creep tests will be conducted in loading frames in which springs are used to maintain the required load. Creep load will be applied using a portable hydraulic jack equipped with a pressure measuring gage. Creep and shrinkage strains will be measured using a portable external strain gage referenced to a constant-length standard bar. A Soiltest Model CT-171 Multi-Position Strain Gage equipped with a Mitutoyo digital dial gage with a resolution of 0.00005 in. will be used to measure deformation between gage points positively affixed to the specimens. A gage length of 10 in, will be used. Brass gage points with suitable seats for the strain gage will be affixed to test specimens with rapid-set two-part epoxy adhesive. Three gage lines will be used to measure deformation on creep and shrinkage specimens.

All creep specimens will be preloaded to produce a stress of 200 psi in the test specimens. The preloading period will not exceed 15 minutes and will be used to verify uniformity of load application. A sustained load of 2000 psi will be applied at 5 days +/- 1 hour from the time that the specimens were molded. The sustained load will remain applied during at least 91 days, or to a later date if necessary, depending on the test results.

Autogenous shrinkage will be determined from the two sealed specimens. Total shrinkage will be determined from the two non-sealed specimens. Total deformation under sustained load, including instantaneous, basic and drying creep strains, as well as the elastic and creep recovery after creep testing, will be determined. Basic creep will be determined from the two sealed specimens. Total deformation, including basic and drying creep strains, will be determined from the two non-sealed specimens.

The minimum number of creep and shrinkage deformation measurements for each one of the creep and shrinkage specimens in a test set will be as follows:
Before loading:

- Immediately before specimens start drying
- Immediately before loading

During the first day after loading:

- Within 5 minutes
- At 15 to 20 minutes
- At one hour
- At 2 hour 45 minutes
- Between 6 and 8 hours

First week:

- Daily within +/-1/2 hour of the time of loading

After first week:

- Weekly +/-6 hours of the time of loading until 28 days, after which the readings will be taken weekly +/-1 day of the time of loading

Measurements with mechanical strain gages will be completed along the three gage lengths on each test specimen, before taking the readings on any other specimens in the creep frame. The readings on each specimen should be taken within two minutes and the time of reading reported for each specimen individually. The time of measurement readings shall be recorded to the nearest minute, and reported as a fraction of a day rounded to the nearest 0.0007 of a day. The strain readings will be plotted within the hour of measurement and evaluated to detect irregularities or inconsistencies. Additional readings will be taken immediately if irregularities or inconsistent readings are detected. Elastic recovery will be measured at the time the sustained load is removed. Creep recovery will be measured for at least a week after load removal.

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Document: Phase II Additional Creep Test Report **Revision 0**

The signature below of the Lead Reviewer records that:
- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☐ **Design Verification Review** ☐ **Engineering Review** ☒ **Owner's Review**
- ☐ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

☐ **Special Engineering Review**__________

☐ YES ☐ N/A **Other Records are attached.**

John Holliday [signature] Civil 08/10/09
Lead Reviewer **(print/sign)** **Discipline** **Date**

Item No.	Deficiency	Resolution
1.	NONE	
2.		
3.		

FORM EGR-NGGC-0003-2-10
This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

EGR-NGGC-0003	Rev. 10	

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PHASE II
ADDITIONAL CREEP TESTING

FOR
CRYSTAL RIVER UNIT 3 STEAM GENERATOR REPLACEMENT PROJECT
S&ME PROJECT NUMBER 1439-08-208

Prepared for:
Mr. John Holliday
PROGRESS ENERGY FLORIDA, INC.

15760 West Powerline Street
Crystal River, Florida 34428-6708

January 21, 2009

PREPARED BY: ____________________

REVIEWED BY: ____________________

QA BY: ____________________ QAS

APPROVED BY: ____________________

S&ME, INC. / 1413 Topside Road / Louisville, TN 37777 / p 865.970.0003 f 865.970.2312 / www.smeinc.com

SCOPE

S&ME, Inc. (S&ME) and our subcontractor CTLGroup (CTL) have completed the Phase II Additional Creep Testing for the Crystal River Unit 3 Steam Generator Replacement Project. The testing was performed as outlined in Contract 373812 Amendment 2 and S&ME Proposal for Additional Services dated November 25, 2008. The purpose of the testing program was to provide an indication of how the two Phase II mixes will perform during creep testing and to provide additional information to the project team prior to mix selection. Based upon the performance of the two mixes, one of the mixes, or a modification of one of the mixes will be retested in Phase III under our Appendix B Program.

TESTING

Creep tests were performed in general accordance with ASTM C 512. Initial curing was performed in the autogenous chambers for approximately 4 days, and then the specimens were shipped to CTLGroup for scheduled arrival at an age of five days. After the specimens arrived, gage points were installed to measure deformation (three readings per specimen). Creep specimens were loaded to 2000 psi as requested. Specimens were tested in the drying state only, to measure total creep and shrinkage through 28 days from time of loading.

Two creep specimens and two shrinkage specimens were tested for each mix. In addition, one specimen was tested for compressive strength at 5 days and two specimens were tested for modulus of elasticity at 5 days.

RESULTS

A summary of the Phase II Additional Creep testing results is included in the Attachments.

Phase II Additional Testing (Creep Mixes)

Target Mix	Option 1A Creep		Option 2A Creep	
	lb	**ft^3**	**lb**	**ft^3**
Holly Hill Cement	560	2.86	600	3.06
Fly Ash (Proash)	140	0.93	200	1.34
Maryville #67 Coarse Aggregate	1613	9.23	1835	10.5
Natural Sand (Lilesville, NC)	1515	9.23	1161	7.07
Water (incl. Admix.)	262.5	4.21	280	4.49
ADVA CAST 575 (8oz/cwt for 1A ,4.5oz/cwt for 2A)				
Recover (2 oz/cwt)				
Target Air (2%)		0.54		0.54
Totals	***4090***	***27.0***	***4076***	***27.0***
Target w/c	0.375		0.350	
Theoretical Unit Weight (pcf)	151.5		151.0	

Actual Admixture Dosages	Mix 1A	Mix 2A
ADVA CAST 575 (oz/cwt)	8	4.5
Recover (oz/cwt)	2	2

Measured Properties	Mix 1A	Mix 2A
Slump (in.)	9.0	8.75
Air (%)	1.4	1.6
Measured Unit Weight (pcf)	153.3	153.3
Concrete Temp (F)	74	77
Air Temp (F)	71	71
*5-day strength (psi)	8010	7130
*5-day strength (psi) *modulus cylinders*	7910	7310
*5-day modulus of elasticity (x10^6 psi)	5.80	5.65

* The first five days of curing were in the accelerated curing containers.

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Client	S&ME	CTL Project Number	109151
Project	Crystal River	Project Manager	M. D'Ambrosia
Contact	John Pearson	Technician	G. Neiweem
Date:	January 16, 2009	Approved	J. Zemajtis

CTLGroup Project #109151
ASTM C 512 - Creep of Concrete in Compression
Mixture 1A, cast December 4, 2008, Loaded at 5 days to 2000 psi

Days Loaded	Shrinkage (µstrain)	Load induced deformation* (µstrain)	Specific creep (µstrain/psi)	Creep coefficient	Condition
0.00	- 1	320	0.000	0.000	Instantaneous strain
0.01	- 2	322	0.001	0.007	" "
0.08	1	371	0.025	0.159	" "
1	31	405	0.043	0.268	" "
2	87	437	0.059	0.368	" "
3	40	451	0.066	0.412	" "
6	102	464	0.072	0.453	" "
8	128	489	0.084	0.528	" "
10	104	541	0.111	0.691	" "
14	118	574	0.127	0.795	" "
20	170	606	0.143	0.896	" "
28	205	600	0.140	0.877	" "

Notes:

*Adjusted for drying shrinkage

Test specimens are 6x12-in. cylinders delivered to CTLGroup on December 9, 2008

Compressive strength at the age of loading (measured by S&ME)	7940 psi	(54.7 MPa)
Applied stress 25% of compressive strength:	2000 psi	(13.8 MPa)
Age at loading:	5 days	
Preload environment:	4 days autogenous curing (ASTM C 684), 1 day sealed, then 73.4±2°F (23.0±1.1°C) and 50±4% RH	
Loaded environment:	73.4±2°F (23.0±1.1°C) and 50±4% RH	

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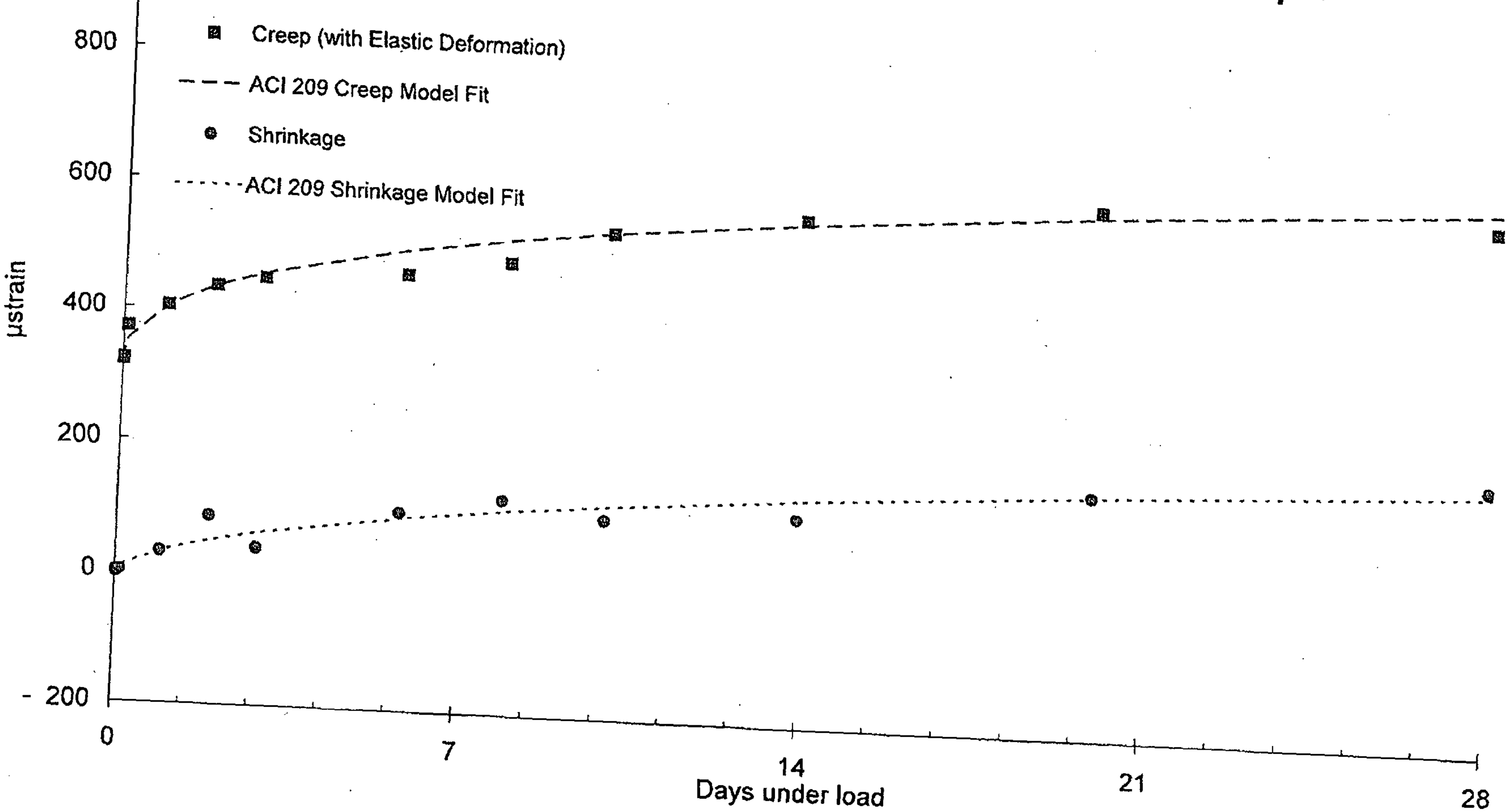
CTLGroup Project #109151
ASTM C 512 - Creep of Concrete in Compression
Mixture 1A, cast December 4, 2008, Loaded at 5 days to 2000 psi



ENGINEERING CHANGE

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Client	S&ME	CTL Project Number	109151
Project	Crystal River	Project Manager	M. D'Ambrosia
Contact	John Pearson	Technician	G. Neiweem
Date:	January 16, 2009	Approved	J. Zemajtis

CTLGroup Project #109151
ASTM C 512 - Creep of Concrete in Compression
Mixture 2A, cast December 4, 2008, Loaded at 5 days to 2000 psi

Days Loaded	Shrinkage (µstrain)	Load induced deformation* (µstrain)	Specific creep (µstrain/psi)	Creep coefficient	Condition
0.00	0	335	0.000	0.000	Instantaneous strain
0.01	- 41	360	0.012	0.075	" "
0.08	- 29	396	0.030	0.181	" "
1	- 20	438	0.051	0.307	" "
2	23	458	0.061	0.366	" "
3	10	469	0.067	0.400	" "
6	42	505	0.085	0.507	" "
8	69	500	0.082	0.490	" "
10	90	529	0.097	0.578	" "
14	113	552	0.108	0.646	" "
20	177	571	0.118	0.703	" "
28	196	613	0.139	0.827	" "

Notes:

*Adjusted for drying shrinkage

Test specimens are 6x12-in. cylinders delivered to CTLGroup on December 9, 2008

Compressive strength at the age of loading (measured by S&ME):	7250 psi	(50.0 MPa)
Applied stress 28% of compressive strength:	2000 psi	(13.8 MPa)
Age at loading:	5 days	
Preload environment:	4 days autogenous curing (ASTM C 684), 1 day sealed, then 73.4±2°F (23.0±1.1°C) and 50±4% RH	
Loaded environment:	73.4±2°F (23.0±1.1°C) and 50±4% RH	

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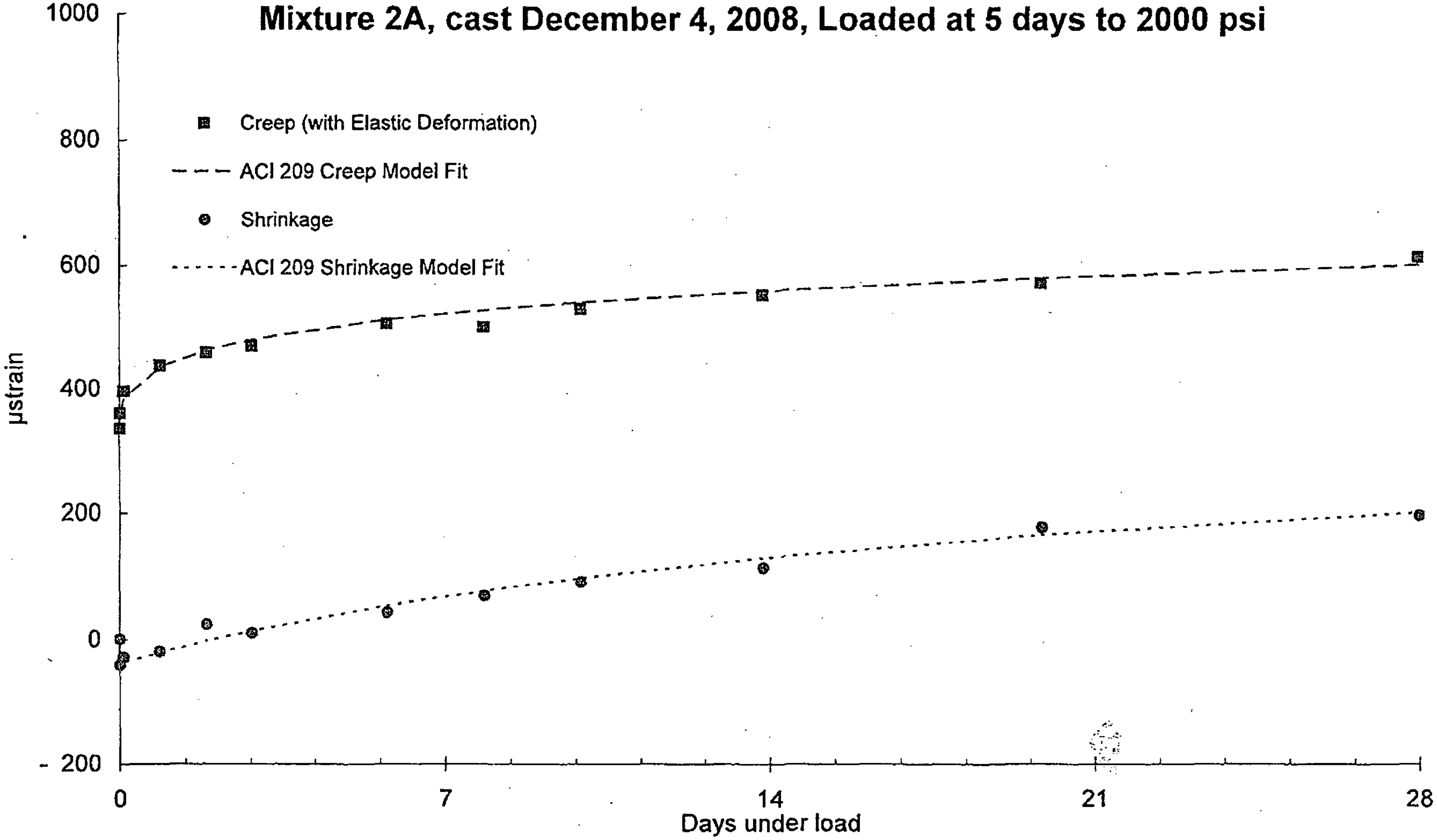
CTLGroup Project #109151
ASTM C 512 - Creep of Concrete in Compression
Mixture 2A, cast December 4, 2008, Loaded at 5 days to 2000 psi



PSC Machining and Engineering, Inc.

PSC MACHINING & ENG. INC.
6672 Melton Road (US20)
Portage, In. 46368

PHONE 219-764-4270
FAX 219-764-4280

September 17, 2007

Precision Surveillance Corp.
3468 Watling
East Chicago, In 46312
Attn. Paul Smith

Paul we have had our plate suppliers search for A.S.T.M. A514 Type E and came up with only 1 option for your material. We have found out in our search that only 2 domestic steel mills roll this grade. One mill only makes up 3" thick material and the other steel mill had a fire is running a minimum of 3 month delivery. Along with 3 month delivery we must also order 120 ton minimum quantity. The order for the stressing washers would be only be approximately 6 tons of material. We also had our supplier's check any warehouses that may have this in stock by chance and have not found any plate. I asked my supplier if the balance of material would be sellable and they said no as the chemical makeup keeps this grade from being used for most A514 uses. As it stands right now if your customer does not want to purchase 120 tons of plate we stand by our quote for A514 grade Q.

Bill Stockwell, General Manager

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Document: Phase II Test Report **Revision 0**

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☐ **Design Verification Review** ☐ **Engineering Review** ☒ **Owner's Review**
- ☐ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

☐ **Special Engineering Review**________________

☐ YES ☐ N/A **Other Records are attached.**

John Holliday [signature]	Civil	08/10/09
Lead Reviewer (print/sign)	**Discipline**	**Date**

Item No.	Deficiency	Resolution
1.	NONE	
2.		
3.		

FORM EGR-NGGC-0003-2-10
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EGR-NGGC-0003	Rev. 10	

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S&ME, INC. KNOXVILLE BRANCH

PHASE II TEST REPORT
TRIAL MIXTURE TESTING

FOR
CRYSTAL RIVER UNIT 3 STEAM GENERATOR REPLACEMENT PROJECT
S&ME PROJECT NUMBER 1439-08-208

Prepared for:
Mr. John Holliday
PROGRESS ENERGY FLORIDA, INC.

15760 West Powerline Street
Crystal River, Florida 34428-6708

January 13, 2009

PREPARED BY: ______________

REVIEWED BY: ______________

QA BY: ______________

APPROVED BY: ______________

S&ME, INC. / 1413 Topside Road / Louisville, TN 37777 / p 865.970.0003 f 865.970.2312 / www.smeinc.com

SCOPE

S&ME, Inc. (S&ME) and our subcontractor CTLGroup (CTL) have completed the Phase II Trial Mixture Testing for the Crystal River Unit 3 Steam Generator Replacement Project. The testing was performed as outlined in Contract 3738121, Laboratory Testing Requirements for Concrete Proportioning Revision 3, and the Phase II Test Plan Rev. 0 dated September 23, 2008 with modifications based upon discussions with Progress Energy (Progress) and Sargent & Lundy (S&L) personnel. The purpose of the testing program was to arrive at two mixes that had the potential to meet the desired physical properties, and to perform the requested tests on the two mixes. Based upon the performance of the two mixes, one of the mixes, or a modification of one of the mixes will be retested in Phase III under our Appendix B Program. After the Phase II testing was initiated, short-term creep testing was requested. This short-term creep testing will be included in a separate report.

INGREDIENT MATERIALS

The initial ingredient materials used in the Phase II testing were received and tested during Phase I. Of the materials provided, the following were used during Phase II testing.

Natural Sand (Lilesville)
Class F Fly ash (ProAsh-Sep. Tech.)
Rheomac SF 100 Silica Fume
No. 67 Stone (Maryville)
Type I/II Portland Cement (Holly Hill)
Eucon WR 91 water reducing Admixture
Plastol 100 high range water reducer (HRWR)

TEST EQUIPMENT

Electronic digital scales were used for weighing the materials prior to batching. All mixes were performed in revolving drum mixers. Standard test equipment was used for the fresh property testing (slump, air content, unit weight, and temperature). The cylinders were cast in 6 x 12 inch plastic single-use, lippped, cylinder molds. The autogenous curing containers specified for the five day accelerated curing were constructed to meet the requirements of ASTM C 684, method C. These containers consisted of metal cans, lined with insulation. The insulation encapsulated a PVC sleeve sized so that the cylinder with mold could be placed into the container. Each container contained i-button temperature sensors. Subsequent to the required accelerated cure, the molded, sealed specimens were stored in a moisture cabinet. Cylinders for compression testing were capped with sulfur capping compound and tested in a Satec Universal testing machine. Modulus data was obtained using a compressometer fitted with a digital dial gage. Thermal diffusivity temperature readings were performed using thermocouples and a digital readout. The above equipment and other miscellaneous equipment items that required calibration are included in the attached equipment usage log.

TESTING

On September 18, 2008 a conference call was held with representatives from Progress, S&L and S&ME. The discussion centered around the field placement conditions of the mix. Concerns were voiced by Progress construction personnel concerning slump and mix temperature. Since the mix would likely be pumped, they preferred a slump closer to seven inches. They were also concerned that a mix temperature of 50°F would not be achievable in the field. As a result of the call, Progress made the following decisions concerning the mix testing:

- The 4 (+/-) 1 inch slump requirement could be varied to suit the mix design.
- The 50°F concrete mix temperature requirement could be varied to suit the mix design.

Beginning on October 1, 2008, several trial mixes were batched using varying dosages of the supplied admixtures. The trial mixes were performed in general accordance with ASTM C 192. Initial mixes, approximately 0.75 cubic feet each, were performed in a small revolving drum mixer. Fresh properties were determined for each trial batch. Specimens were also cast on some of the batches for limited compressive strength and modulus of elasticity testing. It was determined during the testing program that the provided admixtures (Plastol 100 HRWR and Eucon WR 91 water reducer produced by the Euclid Chemical Company) in combination with the chosen ingredient materials, would not likely result in a placeable concrete mixture that would also meet the required physical properties. Due to these initial results, a mix was attempted using a polycarboxylate HRWR, ADVACAST 575 by GRACE Construction Products, that was available at our laboratory. This mix resulted in a more workable mixture. It was also noted that the Maryville coarse aggregate was resulting in higher modulus values than the Norcross aggregate. A conference call was held on October 14, 2008 to discuss the results to date and the path forward. The call included representatives form S&L, S&ME and CTL. Progress was not able to attend the call but was provided with a summary of our discussions. The following decisions were made as a result of the call:

- The Maryville coarse aggregate was to be used in all subsequent trial mixes.
- The use of the Euclid Plastol 100 and Eucon WR 91 admixtures should be discontinued for this testing program.
- Samples of polycarboxylate based HRWR's from GRACE Construction Products should be obtained to use in trial batches.
- Progress should be notified as to which admixtures should be considered for procurement for Phase III testing and placement based on the performance of the mixes.
- Some mixes should be performed with a w/cm ratio of up to 0.40 for consideration.
- Unless otherwise determined to be necessary, all mixes were to be performed at/near lab temperature.

ADVACAST 405 and ADVACAST 575 were selected for potential use as HRWR's for the testing program. Recover, a hydration stabilizer, was also selected for trial batches. Extended mixing times were used on some of the mixes for better distribution of the admixtures. Based on the trial mixes with these admixtures, it was determined that the ADVACAST 575, with the optional use of the Recover, had the greater likelihood of achieving the desired physical properties. Two mixes were selected for consideration as the final two mixes for Phase II testing (Option 1 and Option 2). In addition, the option of including the Recover admixture in these mixes was also presented to extend the length of time the mix would remain workable (Option 1A and Option 2A). A conference call was held on November 19, 2008 with representatives from Progress, S&L, S&ME and CTL to discuss the proposed mixes. Based on the call, the following decisions were made:

- The two mixes to be performed for the official Phase II testing should be Option 1A and Option 2A (which includes the Recover admixture).
- The target slump for the mixes should be between 6 to 9 inches.
- The mixing time specified in ASTM C 192 was to be extended by 2 minutes as in trials.

RESULTS

A summary of the Phase II mix proportions and test results is included in the Attachments. The results of the additional scope for short-term creep testing will be included in a separate report.

Phase II Mix Results

Target Mix	Option 1A		Option 2A	
	lb	**ft^3**	**lb**	**ft^3**
Holly Hill Cement	560	2.86	600	3.06
Fly Ash (Proash)	140	0.93	200	1.34
Maryville #67 Coarse Aggregate	1613	9.23	1835	10.5
Natural Sand (Lilesville, NC)	1515	9.23	1161	7.07
Water (incl. Admix.)	262.5	4.21	280	4.49
ADVA CAST 575 (8oz/cwt for 1A ,4oz/cwt for 2A)				
Recover (2 oz/cwt)				
Target Air (2%)		0.54		0.54
Totals	***4090***	***27.0***	***4076***	***27.0***
Target w/c	0.375		0.350	
Theoretical Unit Weight (pcf)	151.5		151.0	

Actual Admixture Dosages	Mix 1A	Mix 2A
ADVA CAST 575 (oz/cwt)	7.2	4.2
Recover (oz/cwt)	2	2

Measured Properties	Mix 1A	Mix 2A
Slump (in.)	8.0	8.0
Air (%)	2.5	2.1
Measured Unit Weight (pcf)	150.6	152.6
Concrete Temp (F)	73	74
Air Temp (F)	71	71
*5-day strength (psi)	7700	6890
*5-day strength (psi) *modulus cylinders*	7740	6840
*28-day strength (psi)	9080	8070
*28-day strength (psi) *modulus cylinders*	8950	8190
*5-day modulus of elasticity ($x10^6$ psi)	5.85	5.65
*28-day modulus of elasticity ($x10^6$ psi)	6.30	6.15
*Thermal Diffusivity on 28 day cylinder (ft^2/hr)	0.050	0.046

* The first five days of curing were in the accelerated curing containers.

S&ME

Form No:11.1-2
Revision 2
Revision Date 11/04/08

INSTRUMENT AND/OR EQUIPMENT USAGE

Project: 1439-08-208 Activity: Phase II Testing

ID Number	Equipment Name	Model Number	Calibration Date	Calibration Due Date
16115	Slump Cone Set	Humboldt	10/2/2008	10/2/2009
18312	Pressure Meter	Humboldt	10/6/2008	1/6/2009
16219	60lb Scale	FG-30K	8/21/2008	8/21/2009
18562	Thermometer	Humboldt	3/3/2008	3/3/2009
16077	Mallet	N/A	3/31/2003	N/A
18512	Stopwatch	N/A	01/10/08	01/10/09
1500	Universal Testing Machine	600V	07/11/08	07/11/09
6/25/08 Shipment	Sulfur Capping Compound	Test Mark	10/9/2008	1/9/2009
2044	Temperature Recorder	N/A	11/2/2008	5/2/2009
16062	Extensometer	N/A	10/6/2008	10/6/2009
4/7/08 Shipment	6" x 12" Cylinder Molds	Lot No. 94202	4/21/2008	Next Shipment
2189	Outside Micrometer	N/A	2/9/2008	2/9/2009
16060 T2-2	Thermocouple	Type T	11/18/2008	11/18/2009
16060 T2-5	Thermocouple	Type T	11/18/2008	11/18/2009
16060 T1-2	Thermocouple	Type T	11/18/2008	11/18/2009
16554	Vibrator	N/A	09/16/08	09/16/09
16561	Vibrator	Dewalt DC530	09/16/08	09/16/09
2044	Chart Recorder	Taylor	11/02/08	05/02/09
B60000001CD6CE21	I button temperature sensor	DS1921G	09/18/08	09/18/09
B20000001CC8FF21	I button temperature sensor	DS1921G	09/18/08	09/18/09
F90000001CBFAC21	I button temperature sensor	DS1921G	09/18/08	09/18/09
C10000001CC15B21	I button temperature sensor	DS1921G	09/18/08	09/18/09
950000001D0D7921	I button temperature sensor	DS1921G	09/18/08	09/18/09
240000001CEBD621	I button temperature sensor	DS1921G	09/18/08	09/18/09
BC0000001D4EA421	I button temperature sensor	DS1921G	09/18/08	09/18/09
DB0000001D47BE21	I button temperature sensor	DS1921G	09/18/08	09/18/09
020000001E60B521	I button temperature sensor	DS1921G	09/18/08	09/18/09

Reviewed By: [signature] Date: JAN 1 3 2009

S&ME

Form No:11.1-2
Revision 2
Revision Date 11/04/08

INSTRUMENT AND/OR EQUIPMENT USAGE

Project: 1439-08-208 Activity: Phase II Testing

ID Number	Equipment Name	Model Number	Calibration Date	Calibration Due Date
9D0000001D46C021	I button temperature sensor	DS1921G	09/18/08	09/18/09
340000001D315F21	I button temperature sensor	DS1921G	09/18/08	09/18/09
C20000001CD60B21	I button temperature sensor	DS1921G	09/18/08	09/18/09
1D0000001D4AC821	I button temperature sensor	DS1921G	09/18/08	09/18/09
750000001D0AE921	I button temperature sensor	DS1921G	09/18/08	09/18/09
B40000001D33C921	I button temperature sensor	DS1921G	09/18/08	09/18/09
B90000001D44FD21	I button temperature sensor	DS1921G	09/18/08	09/18/09
1B0000001CF0F121	I button temperature sensor	DS1921G	09/18/08	09/18/09
160000001CFAE421	I button temperature sensor	DS1921G	09/18/08	09/18/09
A30000001CC44E21	I button temperature sensor	DS1921G	09/18/08	09/18/09
8D0000001CC62C21	I button temperature sensor	DS1921G	09/18/08	09/18/09
940000001F8B3621	I button temperature sensor	DS1921G	09/18/08	09/18/09
080000001F5EAE21	I button temperature sensor	DS1921G	09/18/08	09/18/09
1F0000001F39D421	I button temperature sensor	DS1921G	09/18/08	09/18/09
970000001F783321	I button temperature sensor	DS1921G	09/18/08	09/18/09
2F0000001F003621	I button temperature sensor	DS1921G	09/18/08	09/18/09
A50000001F9A9221	I button temperature sensor	DS1921G	09/18/08	09/18/09
1F0000001F609A21	I button temperature sensor	DS1921G	09/18/08	09/18/09
DD0000001F73DD21	I button temperature sensor	DS1921G	09/18/08	09/18/09
7E0000001F95A121	I button temperature sensor	DS1921G	09/18/08	09/18/09
D90000001F34A221	I button temperature sensor	DS1921G	09/18/08	09/18/09
790000001F7BBE21	I button temperature sensor	DS1921G	09/18/08	09/18/09
DB0000001F436A21	I button temperature sensor	DS1921G	09/18/08	09/18/09
C50000001F6A5121	I button temperature sensor	DS1921G	09/18/08	09/18/09
D80000001F304321	I button temperature sensor	DS1921G	09/18/08	09/18/09
B0000001F3FF321	I button temperature sensor	DS1921G	09/18/08	09/18/09
A10000001F02D921	I button temperature sensor	DS1921G	09/18/08	09/18/09

Reviewed By: [signature] Date: JAN 1 3 2009

S&ME

Form No:11.1-2
Revision 2
Revision Date 11/04/08

INSTRUMENT AND/OR EQUIPMENT USAGE

Project: 1439-08-208   Activity: Phase II Testing

ID Number	Equipment Name	Model Number	Calibration Date	Calibration Due Date
3B0000001F902D21	I button temperature sensor	DS1921G	09/18/08	09/18/09
9B0000001F830221	I button temperature sensor	DS1921G	09/18/08	09/18/09
F10000001D209A21	I button temperature sensor	DS1921G	09/18/08	09/18/09
2C0000001F8B6F21	I button temperature sensor	DS1921G	09/18/08	09/18/09
	NOTHING FOLLOWS			

Reviewed By: [signature]   Date: JAN 13 2009

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Document: Phase II Test Plan **Revision 0**

The signature below of the Lead Reviewer records that:
- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☐ **Design Verification Review** ☐ **Engineering Review** ☒ **Owner's Review**
- ☐ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

☐ **Special Engineering Review**________________

☐ YES ☐ N/A **Other Records are attached.**

John Holliday [signature]	Civil	08/10/09
Lead Reviewer (print/sign)	**Discipline**	**Date**

Item No.	Deficiency	Resolution
1.	NONE	
2.		
3.		

FORM EGR-NGGC-0003-2-10
This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

EGR-NGGC-0003	Rev. 10	

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S&ME, INC. KNOXVILLE BRANCH

PHASE II TEST PLAN
TRIAL MIXTURE TESTING

FOR
CRYSTAL RIVER UNIT 3 STEAM GENERATOR REPLACEMENT PROJECT
PROJECT NUMBER 1439-08-208

Prepared for:
Mr. John Holliday
PROGRESS ENERGY FLORIDA, INC.

15760 West Powerline Street
Crystal River, Florida 34428-6708

Revision 0
September 23, 2008

PREPARED BY: [signature]

REVIEWED BY: [signature]

QA BY: [signature]

APPROVED BY: [signature]

BACKGROUND

This Phase II testing plan was developed based upon S&ME Proposal 3908110R1, Contract 373812 between S&ME and Progress Energy, e-mail and telephone correspondence with Progress Energy and Sargent & Lundy, and the requirements of *Laboratory Testing Requirements For Concrete Proportioning for Crystal River 3 Steam Generator Replacement Restoration of the Containment Opening Revision 3 section 3.8.2.1 items a and b.* Items c through f of section 3.8.2.1 are applicable to the creep testing which will be performed in Phase III. The purpose of the testing plan is to provide our understanding of the testing to be performed, so that any questions or concerns can be addressed prior to the start of the testing program. ***Phase II testing is classified as Non Safety-Related and is not required to be conducted under S&ME's 10CFR50 Appendix B Quality Assurance Program.***

INGREDIENT MATERIALS

The ingredient materials listed below are planned to be used in the Phase II Trial Mixture Testing program:

Cement	Holcim Type I – Artesia, Mississippi Plant Holcim Type I – Holly Hill, South Carolina Plant
Coarse Aggregate	Vulcan Materials No. 67 stone, Maryville, Tennessee Quarry Vulcan Materials No. 67 stone, Norcross, Georgia Quarry
Sand	Vulcan Materials manufactured sand, Maryville, Tennessee Quarry B.V. Hedrick Gravel & Sand natural sand, Lilesville, NC Quarry
Fly Ash	ProAsh Separation Technologies Class F Fly Ash
Silica Fume	Norchem's Silica Fume marketed by MasterBuilders/Global Metallurgical
Liquid Admixtures	EUCON WR 91 water reducing admixture, Euclid Chemical Co. Plastol 100 high range water reducing admixture, Euclid Chemical Co.

METHODOLOGY

Proportioning of the trial mixes will be based upon the absolute volume methodology described in ACI 211.1-91 *Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.*

The following are requirements that are included in the project specification for the concrete trial mix testing, and information on how we propose to address these requirements during the trial mixture testing program.

Maximum temperature as mixed shall not exceed 50°F
The mix temperature will be determined immediately after discharge from the mixer. Ingredient materials will be chilled as needed prior to mixing. Crushed ice will replace a portion of the mixing water as needed.

Unit Weight shall be at least 145 pcf
Since no air entrainment is specified, the coarse and fine aggregates have appropriate specific gravities and a low w/c is specified, no specific measures are anticipated at this time to meet this requirement.

Air content shall not exceed 2.5%
The only air anticipated in the mixtures is entrapped air, which is typically below the specified 2.5%. No specific measures are anticipated at this time to meet this requirement.

Bleeding shall not be measurable
No bleed testing is specified. The proposed use of silica fume and/or fly ash should reduce bleeding. Visual observations will be performed and comments made concerning observed bleedwater.

Slump shall be 4 +/-1 inch
Our understanding is that the final trial mixes will be required to have a slump in this range. The low required w/c ratio and high early strength requirement will result in a mix with little or no slump prior to the addition of chemical admixture(s). High range water reducer (Plastol 100) and/or water reducer/retarder (Eucon WR 91) will be used to achieve the required slump in the trial mixes.

Compressive Strength shall be at least 6000 psi at 5 days and 7000 psi at 28 days
The above strength requirements are based on an accelerated 5 day cure followed by standard moist curing. We understand these values are the target strength that the trial batch must achieve, however you are not requiring a specific overdesign for the mix.

Maximize the absolute volume of the aggregate, while reducing water content
Aggregate selection and proportioning will be evaluated in an attempt to optimize gradation to help reduce water requirements. High-range water-reducer (Plastol 100) and/or water reducer/retarder (Eucon WR 91) will be used to keep total water content down. It is anticipated that fly ash and low percentage of silica fume may also be used, and should allow for the use of lower total water content.

Water-to-cementitious materials ratio shall not exceed 0.35
The mix will be held to a maximum w/cm ratio of 0.35 unless otherwise approved by Progress Energy. The water in the admixtures will be considered when calculating w/cm.

Maximize the concrete modulus of elasticity
We plan to test various aggregate combinations to determine which combinations tested result in the most favorable modulus.

The ultimate creep coefficient shall not exceed 1.5
This requirement is a stringent, but achievable value depending on available mix constituents. Due to the constituent materials being outside of our control, the achievability of this coefficient for using the ingredient materials that we have been provided is unknown at this time. Since there is not time to perform creep testing on various mixes to directly determine the best achievable creep coefficient for the selected materials, the goal of the trial mixes will be to achieve a concrete mix that has a high modulus of elasticity, while keeping in check factors of the paste that are known to affect creep. We will attempt to keep cement and water contents to a minimum.

TRIAL MIXTURE TESTING

The trial mixture testing will be performed in two stages. In the first stage we will cast several small trail batches and perform limited tests to evaluate the different materials, determine the time and sequencing of the admixtures, and to modify the initial proposed proportions to achieve the desired fresh properties and early age strength properties. During this stage we will discuss our findings with Progress Energy and Sargent & Lundy engineering personnel. After some of the mix data becomes available, Progress and Sargent & Lundy may modify the original slump and mix temperature requirements. With Progress Energy and Sargent & Lundy input, two mixes will be chosen for larger trial batches (approximately 5 cubic feet), and the required Phase II testing will be performed on each of these two mixes.

The specific testing performed on the initial batches may vary, but will likely include no more than the following tests: slump, temperature, unit weight, air content, 5 - day compressive strength, 5 - day modulus of elasticity. It is anticipated that the compressive strength and modulus testing will be on specimens that receive accelerated curing.

The proposed (paper) mix proportions that will be used as a beginning for Phase II mixes is provided below. Option A will be an aggressive approach to obtain the best estimated creep and shrinkage performance while attempting to maintain other specification requirements. Option B will be a simplified approach that will use fewer ingredients and should be more "user-friendly" regarding the fresh properties and ease of production. In both mixtures, we are also considering autogenous shrinkage potential and hydration heat evolution, even though it was not a directive and these properties will not be tested. We believe they are important factors that should be considered when developing concrete mixtures for critical applications.

Target Proportions:	Option A	Option B
Total Cementitious Content	600 lb/yd^3	700 lb/yd^3
Supplementary Cementitious Materials	10-20% fly ash 2-4% silica fume	0-20% fly ash
w/cm ratio (maximum allowable by spec)	0.35	0.35
Admixtures	Plastol 100 HRWR	Euclid WR 91

Initial aggregate proportions were estimated based on optimization techniques. The optimization strategy considers particle packing (which should reduce creep) and flowability of the fresh concrete mixture. Based on the optimization, Vulcan crushed granite from Norcross, GA and the natural sand from B.V. Hedrick would make the most desirable two-aggregate blend at a ratio of 60/40 coarse to fine. The actual final two mixes proposed at the end of Phase II testing will likely vary from the above, based on the results of the initial Phase II Trial Mixture Testing.

The full Phase II testing on the final Phase II selected mixes is summarized below:

The temperature test will be begun on the fresh concrete immediately after discharge from the mixer and will be performed using *ASTM C 1064-05 Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.*

Slump of the fresh concrete will be determined using ASTM C 143-05a *Standard Test Method for Slump of Hydraulic-Cement Concrete*

Unit Weight of the fresh concrete will be determined using ASTM C 138-01 *Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete.*

Air content of the fresh concrete will be determined using ASTM C 231-04 *Standard Test Method for Air Content of Freshly Mixed Concrete by Pressure Method.*

Cylinders will be cast using *ASTM C 192-06 Standard Test Method for Making and Curing Concrete Test Specimens in the Laboratory.* A minimum of eleven 6" x 12" cylinders will be cast for each mix. Plastic, single use molds will be used.

The first five days of cylinder curing will be performed using ASTM C 684-99 *Standard Method for*

Making, Accelerated Curing, and Testing Concrete Compression Test Specimens, Method C.

The remaining cylinder curing will be performed following *ASTM C 192-06 Standard Test Method for Making and Curing Concrete Test Specimens in the Laboratory.*

Compressive strength testing will be performed using ASTM C 39-05$^{\varepsilon 1}$ *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.* For each mix, two specimens will be tested at and age of 5 days and two specimens at an age of 28 days.

Modulus of Elasticity testing will be performed using ASTM C 469-02$^{\varepsilon 1}$ *Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression.* For each mix, two specimens will be tested at and age of 5 days and two specimens at an age of 28 days.

Thermal Diffusivity testing will be performed on one cylinder from each batch at an age of 28 days following CRD-C-36-73 *Handbook of Concrete and Cement Method of Test for Thermal Diffusivity of Concrete.*

A report will be generated that details the results of the final two mixes within 2 weeks after completion of Phase II testing.

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Document: Phase 1 Test Report **Revision 0**

The signature below of the Lead Reviewer records that:
- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☐ **Design Verification Review** ☐ **Engineering Review** ☒ **Owner's Review**
- ☐ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

☐ **Special Engineering Review** ______________________

☐ YES ☐ N/A **Other Records are attached.**

John Holliday [signature]	Civil	08/10/09
Lead Reviewer (print/sign)	**Discipline**	**Date**

Item No.	Deficiency	Resolution
1.	NONE	
2.		
3.		

FORM EGR-NGGC-0003-2-10
This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

EGR-NGGC-0003	Rev. 10	

S&ME, INC. KNOXVILLE BRANCH

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PHASE I TEST REPORT
INGREDIENT MATERIAL TESTING

FOR
CRYSTAL RIVER UNIT 3 STEAM GENERATOR REPLACEMENT PROJECT
S&ME PROJECT NUMBER 1439-08-208

Prepared for:
Mr. John Holliday
PROGRESS ENERGY FLORIDA, INC.

15760 West Powerline Street
Crystal River, Florida 34428-6708

September 16, 2008

PREPARED BY: ____________________

REVIEWED BY: ____________________

QA BY: ____________________

APPROVED BY: ____________________

All work contained in this report was conducted in accordance with the requirements of the referenced procurement documents and the S&ME, Inc., Knoxville Branch Quality Assurance Manual, Volume I, Revision 4, dated December 5, 2003.

S&ME, INC. / 1413 Topside Road / Louisville, TN 37777 / p 865.970.0003 f 865.970.2312 / www.smeinc.com

SCOPE

S&ME, Inc. (S&ME) and our subcontractor CTLGroup (CTL) have completed the Phase I Ingredient Materials Testing for the Crystal River Unit 3 Steam Generator Replacement Project. The ingredient material testing was performed as outlined in Contract 3738121, Laboratory Testing Requirements for Concrete Proportioning Revision 3, and the Phase I Test Plan Rev. 0 dated July 3, 2008.

RECEIPT INSPECTION

Materials received for testing were inspected and documented in accordance with S&ME Quality Assurance Procedure (QAP) 10.1, "Quality Inspection". The following table provides information on the items received.

Material	Quantity	Date Received	Inpspection Report	S&ME Sample I.D.
Natural Sand (Lilesville)	3.00 tons	6-16-08	QA-INSP-08-032	08-032-001
No. 67 Stone (Norcross)	6.57 tons	6-18-08	QA-INSP-08-033	08-033-001
Class F Fly ash (ProAsh-Sep. Tech.)	2, 55-gal. drums	6-19-08	QA-INSP-08-034	08-034-001
No. 67 Stone (Maryville)	7.42 tons	6-24-08	QA-INSP-08-037	08-037-001
Manufactured Sand (Maryville)	3.25 tons	6-24-08	QA-INSP-08-038	08-038-001
Rheomac SF 100 Silica Fume	8, 25-pound bags	6-26-08	QA-INSP-08-039	08-039-001
Type I/II Portland Cement (Holly Hill)	6, 55-gal. drums	6-30-08	QA-INSP-08-040	08-040-001
Eucon WR 91 Admixture	2, 5-gal buckets	7-01-08	QA-INSP-08-041	08-041-001
Plastol 100 HRWR Admixture	2, 5-gal buckets	7-01-08	QA-INSP-08-041	08-041-002
Type I Low Alkaline Cement	8, 55-gal drums	7-01-08	QA-INSP-08-042	08-042-001

TEST RESULTS

Certified Materials Test Reports (CMTRs) are included for each material. All tests performed to date meet the specified project requirements with the exception of the Manufactured Sand (Maryville) which did not meet the requirements specified in ASTM C 33-03 for gradation and fineness modulus.

PROPOSED PROPORTIONS

The proposed (paper) mix proportions that can be used as a beginning for Phase II mixes is provided below. Option A will be an aggressive approach to obtain the best estimated creep and shrinkage performance while attempting to maintain other specification requirements. Option B will be a simplified approach that will use fewer ingredients and should be more "user-friendly" regarding the fresh properties and ease of production. In both mixtures, we are also considering autogenous shrinkage potential and hydration heat evolution, even though it was not a directive and these properties will not be tested. We believe they are important factors that should be considered when developing concrete mixtures for critical applications.

Target Proportions:	Option A	Option B
Total Cementitious Content	600 lb/yd^3	700 lb/yd^3
Supplementary Cementitious Materials	10-20% fly ash 2-4% silica fume	0-20% fly ash
water/cementitious ratio (maximum allowable by spec)	0.35	0.35
Admixtures	Plastol 100 HRWR	Euclid WR 91

Initial aggregate proportions were estimated based on optimization techniques. The optimization strategy considers particle packing (which should reduce creep) and flowability of the fresh concrete mixture. Based on the optimization, Vulcan crushed granite from Norcross, GA and the natural sand from B.V. Hedrick would make the most desirable two-aggregate blend at a ratio of 60/40 coarse to fine. The final two mixes proposed at the end of Phase II testing will likely vary from the above, based on the results of the initial Phase II Trial Mixture Testing.

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	Type I Low Alkaline Portland Cement
Project:	*Crystal River*	*Source:*	*Holcim – Artesia, Mississippi*
S&ME Project No.:	1439-08-208	Quantity:	Eight 55-gallon drums
Contract/P.O. No.:	373812	Date Received :	July 1, 2008
		S&ME Log No.:	08-042-001

Chemical Property	Test Designation	Results	Requirement (ASTM C 150-07)
			Type I
Silicon Dioxide (SiO_2)	ASTM C 114-06$^{\varepsilon1}$	18.7 %	---
Aluminum Oxide (Al_2O_3)		6.1 %	---
Ferric Oxide (Fe_2O_3)		2.7 %	---
Calcium Oxide (CaO)		64.7 %	---
Magnesium Oxide (MgO)		0.9 %	6.0 % max
Tricalcium aluminate (C_3A)		12 %	---
Sulfur Trioxide (SO_3) When C_3A is more than 8%		3.0 %	3.5 % max
Potassium Oxide (K_2O)		0.42 %	---
Loss On Ignition		2.1 %	3.0 % max
Insoluble Residue		0.43%	0.75 % max
Equivalent Alkalies (Na_2O + $0.658K_2O$)		0.48 %	0.60 % max

Physical Property	Test Designation	Results	Requirement (ASTM C 150-07)
			Type I
Air Content of Mortar	ASTM C 185-02	6.9 %	12 % maximum
Fineness, specific surface Air permeability test	ASTM C 204-05	404.4 m^2/kg	260 m^2/kg min (any one sample)
Autoclave Expansion	ASTM C 151-05	- 0.01%	0.80 % max
Compressive Strength: 3 days 7 days 28 days	ASTM C 109-05	4,120 psi 5,220 psi 5,620 psi	1,740 psi min 2,760 psi min 4,060 psi min
Vicat Initial Time of setting (Method A)	ASTM C 191-04b	78 minutes	not less than 45 minutes not more than 375 minutes
Early Stiffening of Hydraulic Cement Percent Final Penetration	ASTM C 451-05	79%	50% minimum
Gillmore Time of setting: Initial Final	ASTM C 266-04	105 minutes 265 minutes	not less than 60 minutes not more than 600 minutes
Normal Consistency	ASTM C 187-04	25.85 %	Not Applicable
Density	ASTM C 188-95 Reapproved 2003	3.10	Not Applicable

Note 1 The density value was based on an average of three tests.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: [signature] Date: SEP 16 2008

Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 *Phone: 865-970-0003 Fax: 865-970-2312*

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	Type I/II Portland Cement
Project:	Crystal River	Source:	Holcim – Holly Hill, South Carolina
S&ME Project No.:	1439-08-208	Quantity:	Six 55-gallon drums
Contract/P.O. No.:	373812	Date Received :	June 30, 2008
		S&ME Log No.:	08-040-001

Chemical Property	Test Designation	Results	Requirement (ASTM C 150-07)
			Type I
Silicon Dioxide (SiO_2)	ASTM C 114-06$^{\varepsilon 1}$	18.9 %	---
Aluminum Oxide (Al_2O_3)		5.2 %	---
Ferric Oxide (Fe_2O_3)		4.1 %	---
Calcium Oxide (CaO)		64.3 %	---
Magnesium Oxide (MgO)		1.4 %	6.0 % max
Tricalcium aluminate (C_3A)		7 %	---
Sulfur Trioxide (SO_3) When C_3A is 8% or less		3.2 %	3.0 % max
Potassium Oxide (K_2O)		0.53 %	---
Loss On Ignition		1.4 %	3.0 % max
Insoluble Residue		0.20%	0.75 % max
Equivalent Alkalies ($Na_2O + 0.658K_2O$)		0.48 %	0.60 % max

Physical Property	Test Designation	Results	Requirement (ASTM C 150-07)
			Type I
Air Content of Mortar	ASTM C 185-02	6.6 %	12 % maximum
Fineness, specific surface Air permeability test	ASTM C 204-05	432.7 m^2/kg	260 m^2/kg min (any one sample)
Autoclave Expansion	ASTM C 151-05	- 0.02%	0.80 % max
Compressive Strength: 3 days 7 days 28 days	ASTM C 109-05	4,580 psi 4,970 psi 5,750 psi	1,740 psi min 2,760 psi min 4,060 psi min
Vicat Initial Time of setting (Method A)	ASTM C 191-04b	84 minutes	not less than 45 minutes not more than 375 minutes
Early Stiffening of Hydraulic Cement Percent Final Penetration	ASTM C 451-05	73%	50% minimum
Gillmore Time of setting: Initial Final	ASTM C 266-04	120 minutes 210 minutes	not less than 60 minutes not more than 600 minutes
Normal Consistency	ASTM C 187-04	25.38 %	Not Applicable
Density	ASTM C 188-95 Reapproved 2003	3.14	Not Applicable
Expansion of Hydraulic Cement Mortar Bars Stored in Water	ASTM C 1038-04	0.00 %	0.020% max at 14 days

Note 1 The Sulfur Trioxide (SO_3) percentage exceeded the specified amounts in ASTM C 150-07 for a Type I Portland Cement. Progress Energy requested that an ASTM C 1038 test be performed on the material.

Note 2 The density value was based on an average of three tests.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: [signature] Date: SEP 16 2008

Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 *Phone: 865-970-0003 Fax: 865-970-2312*

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	Class F Fly Ash
Project:	Crystal River	Source:	Pro-Ash, Separation Technologies
S&ME Project No.:	1439-08-208	Quantity:	Two 55-gallon drums
Contract/P.O. No.:	373812	Date Received :	June 19, 2008
		S&ME Log No.:	08-034-001

Chemical Property	Test Designation	Results	Requirement (ASTM C 618-05)
			Class F
Silicon Dioxide (SiO_2) plus Aluminum Oxide (Al_2O_3) plus Iron Oxide ((Fe_2O_3)	ASTM C 311-05	86.7 %	70% min
Sulfur Trioxide (SO_3)	ASTM C 311-05	1.0 %	5.0% max
Moisture Content	ASTM C 311-05	0.2 %	3.0% max
Loss On Ignition	ASTM C 311-05	2.3 %	6.0% max

Physical Property	Test Designation	Results	Requirement (ASTM C 618-05)
			Class F
Percent retained on No. 325 sieve	ASTM C 311-05	17.9 %	34% max
Strength Activity Index 7 days 28 days	ASTM C 311-05	94 % (7-days) 91 % (28-days)	75% min (percent of control) Only one age compliance required
Water Requirement	ASTM C 311-05	97 %	105 % max (percent of control)
Autoclave expansion or contraction	ASTM C 311-05	0.00 %	0.8% max
Density	ASTM C 311-05	2.40	Not Applicable
Multiple Factor	ASTM C 311-05	41 %	255 % max
Effectiveness in Controlling Alkali-Silica Reaction (15% replacement by weight)	ASTM C 311-05	38 %	100% max at 14-days

Note 1 The density value was based on an average of three tests.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: [signature] Date: SEP 16 2008

Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 Phone: 865-970-0003 Fax: 865-970-2312

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	Rheomac SF100 Silica Fume
Project:	Crystal River	Source:	Globe Metallurgical, Inc.
S&ME Project No.:	1439-08-208	Quantity:	Eight 25-pound bags
Contract/P.O. No.:	373812	Date Received :	June 26, 2008
		S&ME Log No.:	08-039-001

Chemical Property	Test Designation	Results	Requirement (ASTM C 1240-05)
Silicon Dioxide (SiO_2)	ASTM C 1240-05	95.8 %	85.0% min
Moisture Content		0.58 %	3.0% max
Loss On Ignition		1.7 %	6.0% max

Physical Property	Test Designation	Results	Requirement (ASTM C 1240-05)
Percent Retained on the 325 sieve	ASTM C 1240-05	0.4%	10% max
Accelerated Pozzolanic Strength Activity Index 7 days	ASTM C 1240-05	119%	105% min percent of control (7 days)
Specific Surface	ASTM C 1240-05	22 m^2/g	15 m^2/g min
Density	ASTM C 1240-05	2.21	Not Applicable

Note 1 The density value was based on an average of three tests.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: [signature] Date: SEP 1 6 2008

Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 Phone: 865-970-0003 Fax: 865-970-2312

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	No. 67 Stone
Project:	Crystal River	Source:	Vulcan Materials – Maryville, TN
S&ME Project No.:	1439-08-208	Quantity:	7.42 tons
Contract/P.O. No.:	373812	Date Received :	June 24, 2008
		S&ME Log No.:	08-037-001

ASTM C 117-04 and ASTM C 136-06		
Sieve Size	Percent Passing (%)	ASTM C 33-03 No. 67 Stone Specification (%)
1"	100	100
3/4"	91	90 – 100
1/2"	44	---
3/8"	27	20 – 55
No. 4	3	0 – 10
No. 8	2	0 – 5

Physical Property	Test Designation	Results	Requirement (ASTM C 33-03)
Clay Lumps and Friable Particles	ASTM C 142-97 Reapproved 2004	0.1 %	3.0 % maximum
Material Finer than the No. 200 Sieve	ASTM C 117-04	1.4 %	1.0 % maximum
Lightweight Particles in Aggregate (Coal and Lignite)	ASTM C 123-04	0.0 %	1.0 % maximum
Los Angeles Abrasion Grading B	ASTM C 131-06	17 %	50 % maximum
Bulk Density of Aggregate Voids in Aggregate by Rodding	ASTM C 29-97 Reapproved 2003	101 pcf 42 %	Not Applicable
Bulk Specific Gravity Bulk Specific Gravity (SSD) Apparent Specific Gravity Absorption	ASTM C 127-04	2.79 2.80 2.82 0.4 %	Not Applicable

Note 1 The test properties are compared to specifications for an ASTM C 33-03 Class Designation 2N aggregate.

Note 2 The percent passing the No. 200 sieve may be increased under either of the following conditions: (1) is permitted to be increased to 1.5 if the material is essentially free of clay or shale; or (2) if the source of the fine aggregate to be used in the concrete is known to contain less than the specified maximum amount passing the No. 200 sieve the percentage limit (L) on the amount in the coarse aggregate is permitted to be increased to L=1 + [(P)/(100-P)](T-A), where P = percentage of sand in the concrete as a percent of total aggregate, T = the Table 1 limit for the amount permitted in the fine aggregate, and A = the actual amount in the fine aggregate.

Note 3 The specific gravity and absorption values were based on an average of three tests.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: [signature] Date: SEP 16 2008

Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 *Phone: 865-970-0003 Fax: 865-970-2312*

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	No. 67 Stone
Project:	Crystal River	Source:	Vulcan Materials – Norcross, GA
S&ME Project No.:	1439-08-208	Quantity:	6.57 tons
Contract/P.O. No.:	373812	Date Received :	June 18, 2008
		S&ME Log No.:	08-033-001

ASTM C 117-04 and ASTM C 136-06		
Sieve Size	Percent Passing (%)	ASTM C 33-03 No. 67 Stone Specification (%)
1"	100	100
3/4"	97	90 – 100
1/2"	64	---
3/8"	39	20 – 55
No. 4	7	0 – 10
No. 8	3	0 – 5

Physical Property	Test Designation	Results	Requirement (ASTM C 33-03)
Clay Lumps and Friable Particles	ASTM C 142-97 Reapproved 2004	0.0 %	3.0 % maximum
Material Finer than the No. 200 Sieve	ASTM C 117-04	0.9 %	1.0 % maximum
Lightweight Particles in Aggregate (Coal and Lignite)	ASTM C 123-04	0.0 %	1.0 % maximum
Los Angeles Abrasion Grading B	ASTM C 131-06	46 %	50 % maximum
Bulk Density of Aggregate Voids in Aggregate by Rodding	ASTM C 29-97 Reapproved 2003	103 pcf 39 %	Not Applicable
Bulk Specific Gravity Bulk Specific Gravity (SSD) Apparent Specific Gravity Absorption	ASTM C 127-04	2.71 2.73 2.77 0.7 %	Not Applicable

Note 1 The test properties are compared to specifications for an ASTM C 33-03 Class Designation 2N aggregate.
Note 2 The specific gravity and absorption values were based on an average of three tests.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: ______________________ Date: SEP 1 6 2008
Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 Phone: 865-970-0003 Fax: 865-970-2312

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	Natural Sand
Project:	Crystal River	Source:	B.V. Headrick, LLC – Lilesville, NC
S&ME Project No.:	1439-08-208	Quantity:	3 tons
Contract/P.O. No.:	373812	Date Received :	June 16, 2008
		S&ME Log No.:	08-032-001

ASTM C117-04 and ASTM C136-06		
Sieve Size	Percent Passing (%)	ASTM C 33-03 Concrete Sand Specification (%)
3/8"	100	100
No. 4	100	95 – 100
No. 8	93	80 – 100
No. 16	75	50 – 85
No. 30	44	25 – 60
No. 50	14	5 – 30
No. 100	3	0 – 10

Physical Property	Test Designation	Results	Requirement (ASTM C 33-03)
Fineness Modulus	ASTM C 136-06	2.71	Not less than 2.3 nor more than 3.1
Clay Lumps and Friable Particles	ASTM C 142-97 Reapproved 2004	0.4 %	3.0 % maximum
Material Finer than the No. 200 Sieve	ASTM C 117-04	1.4 %	3.0% maximum - Concrete subject to abrasion 5.0% maximum - All other concrete
Lightweight Particles in Aggregate (Coal and Lignite)	ASTM C 123-04	0.0 %	0.5 % maximum - when surface appearance of concrete is of importance 1.0 % maximum - for all other concrete
Sodium Sulfate Soundness	ASTM C 88-05	1 %	10 % maximum
Organic Impurities in Fine Aggregate	ASTM C 40-04	Organic Plate 2	Organic Plate No. 3 or less
Bulk Density of Aggregate Voids in Aggregate by Rodding	ASTM C 29-97 Reapproved 2003	100 pcf 38 %	Not Applicable
Bulk Specific Gravity Bulk Specific Gravity (SSD) Apparent Specific Gravity Absorption	ASTM C 128-07	2.62 2.63 2.66 0.6 %	Not Applicable

Note 1 The specific gravity and absorption values were based on an average of three tests.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: [signature] Date: SEP 16 2008
Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 *Phone: 865-970-0003 Fax: 865-970-2312*

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	Manufactured Sand
Project:	Crystal River	Source:	Vulcan Materials – Maryville, TN
S&ME Project No.:	1439-08-208	Quantity:	3.25 tons
Contract/P.O. No.:	373812	Date Received :	June 24, 2008
		S&ME Log No.:	08-038-001

ASTM C 117-04 and ASTM C 136-06		
Sieve Size	Percent Passing (%)	ASTM C 33-03 Concrete Sand Specification (%)
3/8"	100	100
No. 4	100	95 – 100
No. 8	92	80 – 100
No. 16	46	50 – 85
No. 30	22	25 – 60
No. 50	10	5 – 30
No. 100	5	0 – 10

Physical Property	Test Designation	Results	Requirement (ASTM C 33-03)
Fineness Modulus	ASTM C 136-06	3.25	Not less than 2.3 nor more than 3.1
Clay Lumps and Friable Particles	ASTM C 142-97 Reapproved 2004	0.2 %	3.0 % maximum
Material Finer than the No. 200 Sieve	ASTM C 117-04	3.2 %	3.0% maximum - Concrete subject to abrasion 5.0% maximum - All other concrete
Lightweight Particles in Aggregate (Coal and Lignite)	ASTM C 123-04	0.0 %	0.5 % maximum - when surface appearance of concrete is of importance 1.0 % maximum - for all other concrete
Sodium Sulfate Soundness	ASTM C 88-05	1 %	10 % maximum
Organic Impurities in Fine Aggregate	ASTM C 40-04	Organic Plate 1	Organic Plate No. 3 or less
Bulk Density of Aggregate Voids in Aggregate by Rodding	ASTM C 29-97 Reapproved 2003	110 pcf 36 %	Not Applicable
Bulk Specific Gravity Bulk Specific Gravity (SSD) Apparent Specific Gravity Absorption	ASTM C 128-07	2.76 2.78 2.82 0.9 %	Not Applicable

Note 1 The percent passing the No. 16 sieve does not meet the ASTM C 33-03 requirements.
Note 2 The percent passing the No. 30 sieve does not meet the ASTM C 33-03 requirements.
Note 3 The fineness modulus result exceeds the ASTM C 33-03 limit.
Note 4 The specific gravity and absorption values were based on an average of three tests.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: ______________________ Date: SEP 1 6 2008
Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 Phone: 865-970-0003 Fax: 865-970-2312

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	Eucon WR 91 Admixture
Project:	Crystal River	Source:	Euclid Chemical, Auburndale, FL
S&ME Project No.:	1439-08-208	Quantity:	Two buckets
Contract/P.O. No.:	373812	Date Received :	July 1, 2008
		S&ME Log No.:	08-041-001

Chemical Property	Test Designation	Results	Requirement (Laboratory Testing Requirements For Concrete Proportioning, Rev. 3)
Chloride Content	ASTM C 114-06	0.050 %	.1 % by volume

Note 1 Chloride was determined by a potentiometric titration according to ASTM C 114-06 Section 19, with the following exceptions to Section 19.5.1: 2 g of liquid admixture was used instead of a 5 g of sample, 50 mL of water was used instead of 75 mL, 3 mL of dilute nitric acid was used instead of 25 mL and the text "breaking up any lumps with a glass rod. If the smell of hydrogen sulfide is strongly evident at this point, add 3 mL of hydrogen peroxide (30% solution)" was ignored as it only pertains to cementitious materials.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: [signature] Date: SEP 16 2008

Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 Phone: 865-970-0003 Fax: 865-970-2312

S&ME

Certified Materials Test Report

Client:	Progress Energy	Material:	PLASTOL 100 Admixture
Project:	Crystal River	Source:	Euclid Chemical, Auburndale, FL
S&ME Project No.:	1439-08-208	Quantity:	Two buckets
Contract/P.O. No.:	373812	Date Received :	July 1, 2008
		S&ME Log No.:	08-041-002

Chemical Property	Test Designation	Results	Requirement (Laboratory Testing Requirements For Concrete Proportioning, Rev. 3)
Chloride Content	ASTM C 114-06	0.003%	1 % by volume

Note 1 Chloride was determined by a potentiometric titration according to ASTM C 114-06 Section 19, with the following exceptions to Section 19.5.1: 2 g of liquid admixture was used instead of a 5 g of sample, 50 mL of water was used instead of 75 mL, 3 mL of dilute nitric acid was used instead of 25 mL and the text "breaking up any lumps with a glass rod. If the smell of hydrogen sulfide is strongly evident at this point, add 3 mL of hydrogen peroxide (30% solution)" was ignored as it only pertains to cementitious materials.

I certify the above results of tests and/or analyses to be correct as contained in the records of S&ME, Inc.

Signed: ________________ Date: SEP 16 2008

Quality Assurance Supervisor

1413 Topside Road Louisville, Tennessee 37777 *Phone: 865-970-0003 Fax: 865-970-2312*

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Document: Phase 1 Test Plan **Revision 0**

The signature below of the Lead Reviewer records that:
- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☐ **Design Verification Review** ☐ **Engineering Review** ☒ **Owner's Review**
- ☐ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

☐ **Special Engineering Review**____________________

☐ YES ☐ N/A **Other Records are attached.**

John Holliday [signature]	Civil	08/10/09
Lead Reviewer (print/sign)	**Discipline**	**Date**

Item No.	Deficiency	Resolution
1.	NONE	
2.		
3.		

FORM EGR-NGGC-0003-2-10
This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

S&ME

S&ME, INC. KNOXVILLE BRANCH

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PHASE I TEST PLAN
INGREDIENT MATERIAL TESTING

FOR
CRYSTAL RIVER UNIT 3 STEAM GENERATOR REPLACEMENT PROJECT
PROJECT NUMBER 1439-08-208

Prepared for:
Mr. John Holliday
PROGRESS ENERGY FLORIDA, INC.

15760 West Powerline Street
Crystal River, Florida 34428-6708

Revision 0
July 3, 2008

PREPARED BY: ____________________

REVIEWED BY: ____________________

QA BY: ____________________

APPROVED BY: ____________________

S&ME, INC. / 1413 Topside Road / Louisville, TN 37777 / p 865.970.0003 f 865.970.2312 / www.smeinc.com

This testing plan was developed based upon the S&ME Proposal 3908110R1, and e-mail and telephone correspondence with Progress Energy and Sargent & Lundy and the applicable requirements of *Laboratory Testing Requirements For Concrete Proportioning for Crystal River 3 Steam Generator Replacement Restoration of the Containment Opening Revision 3 section 3.8.2.1 items a and b.* Items c through f of section 3.8.2.1 are applicable to the creep testing which will be performed in Phase III. The purpose of the testing plan is to provide our understanding of the testing to be performed, so that any questions or concerns can be addressed prior to the start of the testing program.

The testing program will be conducted under S&ME's Quality Assurance Program Manual Dated December 4, 2003, and using subcontractors that are on our Approved Suppliers List (ASL).

The ingredient materials have been shipped to S&ME's laboratory facility located at 1413 Topside Road, Louisville, Tennessee 37777. The aggregates arrived in loose bulk form in transport trucks with dump beds; the cement arrived in 55-gallon drums; the flyash arrived in 55-gallon drums; the silica fume arrived in individual bags as packaged by the manufacturer; and the admixtures arrived in plastic pails as packaged by the manufacturer.

The following materials have been received for testing:

Cement
- Holcim Type I – Artesia, Mississippi Plant
- Holcim Type I – Holly Hill, South Carolina Plant

Coarse Aggregate
- Vulcan Materials No. 67 stone, Maryville, Tennessee Quarry
- Vulcan Materials No. 67 stone, Norcross, Georgia Quarry

Sand
- Vulcan Materials manufactured sand, Maryville, Tennessee Quarry
- B.V. Hedrick Gravel & Sand natural sand, Lilesville, NC Quarry

Fly ash
- ProAsh Separation Technologies Class F Flyash

Silica Fume
- Norchem's Silica Fume marketed by MasterBuilders/Global Metallurgical

Liquid Admixtures
- UCON WR 91 water reducing admixture, Euclid Chemical Company
- Plastol 100 high range water reducing admixture, Euclid Chemical Company

The materials were received in accordance with S&ME's documented Quality Assurance Program by our Quality Assurance staff and given S&ME sample identification numbers. Portions of the samples will be sent to CTLGroup (Skokie, Illinois) for testing. QA and engineering personnel will package the sub-samples for shipment to CTLGroup.

QA and engineering personnel at CTLGroup will follow standard procedures for receiving materials and tracking samples as described in the CTLGroup Quality Control Manual.

Coarse Aggregate – Tests on the coarse aggregate will be those as outlined in ASTM C 33-03 *Standard Specification for Concrete Aggregates* tables 2 and 3, and additional physical tests to be used for mix proportioning calculations such as specific gravity, absorption, and dry rodded unit weight. As determined by Sargent & Lundy, the coarse aggregate will be considered a class 2N. Alkali reactivity testing, freeze-thaw testing, and soundness testing (sodium or magnesium sulfate) are not included as part of the scope. The testing will include:

- ASTM C 136-06 *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate*
- ASTM C 142-97 *Standard Test Method for Clay Lumps and Friable Particles in Aggregates*
- ASTM C 117-04 *Standard Test Method for Material Finer than No. 200 Sieve in Mineral Aggregate by Washing*
- ASTM C 123-04 *Standard Test Method for Lightweight Particles in Aggregate*
    - Sample will only be tested for coal and lignite; chert is not required for class 2N aggregate.
- ASTM C 131-06 *Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine*
    - Grading B will be used for testing
- ASTM C 29-97 *Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate*
- ASTM C 127-04 *Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate*

Fine Aggregate – Tests on the fine aggregate will be those with defined requirement limits outlined in ASTM C 33-03 *Standard Specification for Concrete Aggregates*, and additional tests to aid in mix proportioning calculations such as specific gravity, absorption, and dry rodded unit weight. Alkali reactivity testing and freeze-thaw testing are not included as part of the scope. The testing will include:

- ASTM C 136-06 *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates*
- ASTM C 142-97 *Standard Test Method for Clay Lumps and Friable Particles in Aggregates*
- ASTM C 117-04 *Standard Test Method for Material Finer than Mo. 200 Sieve in Mineral Aggregate bys Washing*
- ASTM C 123-04 *Standard Test Method for Lightweight Particles in Aggregate*
    - Sample will only be tested for coal and lignite
    - Chert content is not required for fine aggregate.
- ASTM C 88-05 *Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate*
    - For this testing program, sodium sulfate will be used.
- ASTM C 40-04 *Standard Test Method for Organic Impurities in Fine Aggregate for Concrete*

- ASTM C 87-05 *Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar*
  - This test will only be performed if requested, if the aggregate fails ASTM C 40.

- ASTM C 29-97 *Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate*

- ASTM C 128-07 *Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate*

Cement-The cement will be tested by the test methods outlined in ASTM C 150-07 *Standard Specification for Portland Cement* tables 1, 2, 3, and 4 for a Type I cement. The tests will be as follows:

Table1-Standard Composition Requirements

- ASTM C 114-06$^{\epsilon 1}$-*Standard test Methods for Chemical Analysis of Hydraulic Cement* (Oxide analysis will be by X-ray fluorescence qualified under Section 3.3.2 of ASTM C 114). The test results will include:

  - Silicon Dioxide (SiO_2)
  - Aluminum Oxide (Al_2O_3)
  - Ferric Oxide (Fe_2O_3)
  - Calcium oxide (CaO)
  - Magnesium Oxide (MgO)
  - Sulfur Trioxide (SO_3)
  - Sodium Oxide (Na_2O)
  - Potassium Oxide (K_2O)
  - Loss on Ignition
  - Insoluble Residue

Table 2-Optional Composition Requirements

- The only optional property in Table 2 required for a Type I cement is Equivalent Alkalies ($Na_2O + 0.658K_2O$). This result will be calculated from the Table 1 results.

Table 3-Standard Physical Requirements

- ASTM C 185-02 *Standard Test Method for Air Content of Hydraulic Cement Mortar*

- ASTM C 204-05 *Standard Test Method for Fineness of Hydraulic Cement by Air Permeability Apparatus*
  - ASTM C150-07 allows for either this test, or the turbidimeter test (ASTM C 115) to be performed.
  - The turbidimeter test will not be performed as part of this scope.

- ASTM C 151- 05 *Standard Test Method for Autoclave Expansion of Hydraulic Cement*

- ASTM C 109-05 *Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or [50-mm] Cube Specimens)*
  - Tests will be performed on 3 and 7 day specimens.

- ASTM C 191-04b *Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle*
  - Final set is not required and will not be determined as part of this scope

Table 4-Optional Physical Requirements

- ASTM C 451-05 *Standard Test Method for Early Stiffening of Hydraulic Cement (Paste Method)*
- ASTM C 109-05 *Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or [50-mm] Cube Specimens).*
  - Tests will be performed on 28 day specimens
- ASTM C 266-04 *Standard Test Method for Time of Setting of Hydraulic –Cement Paste by Gillmore Needles*

Flyash-Flyash testing will be performed to verify the standard physical requirements listed in Tables 1 and 2 of ASTM C 618-05 *Standard Specification for Coal Flyash and Raw or Calcined Natural Pozzolan for use in Concrete*. In addition the supplementary optional requirements of multiple factor and effectiveness in controlling alkali-silica reaction will be performed. The test methods to be used for the flyash testing will be as described in Requirements ASTM C 311-05 *Standard Test Methods for Sampling and Testing Flyash or Natural Pozzolans for Use in Portland-Cement Concrete.*

Table 1-Chemical Requirements

- Silicon Dioxide (SiO_2) plus Aluminum oxide (Al_2O_3) plus iron oxide (Fe_2O_3)
- Sulfur Trioxide (SO_3)
- Moisture Content
- Loss on Ignition

Table 2-Physical Requirements

- Fineness (325 sieve)
- Strength Activity Index
  - 7 day and 28 day specimens will be cast.
  - The requirement in ASTM C 150 need only be met at one of the two ages.
- Water Requirement
- A density (specific gravity) will be performed for purposes of mix calculations. Uniformity requirements will not be applicable since we are not dealing with multiple shipments.

Table 3-Supplementary Optional Physical Requirements

- Multiple Factor will be calculated from the results of Table 1 and 2 testing.
- Effectiveness in Controlling Alkali-Silica Reaction will be performed. This test will be conducted with a fly ash content of 15% replacement by weight of cement unless otherwise directed by Progress Energy. CTLGroup will provide control cement with alkali content as equivalent Na_2O between 0.50 and 0.60 %. The job cement with the highest alkali content of the two submitted for this evaluation will be used as for this test.
- No other Supplementary Optional Physical tests are to be performed as part of this scope.

Liquid Admixtures – Liquid Admixtures will be tested for chloride content. Chloride (Cl) content is determined and reported as weight percentage of the sample following treatment of the admixture for potentially interfering species. Chloride is determined by a potentiometric titration according to ASTM C114 Section 19, with the following exceptions to Section 19.5.1: We will use 2 g of liquid admixture instead of 5 g of sample, 50 mL of water instead of 75 mL, 3 mL of dilute nitric acid instead of 25 mL and we will ignore the text "breaking up any lumps with a glass rod. If the smell of hydrogen sulfide is strongly evident at this point, add 3 mL of hydrogen peroxide (30% solution)" as it only pertains to cementitious materials.

Silica Fume-Silica fume testing will consist of performing the tests outlined in Tables 1 and 2 of ASTM C 1240-05 with the addition of density (specific gravity) using *Standard Specification for Silica Fume Used in Cementitious Mixtures.* Test for the specific parameters listed below will be conducted in accordance with the relevant test standards specified in ASTM C 1240.

- SiO_2
- Moisture Content
- Loss on Ignition
- Percent Retained on the 325 sieve
- Accelerated Pozzolanic Strength Activity Index
- Specific Surface
- Density (specific gravity)

Progress Energy **CR3 FSAR CHANGE REQUEST** CP-216, Enclosure 3

FSAR Change Number: **FSAR 2008-0017**

Initiating Activity (e.g., AR Number, EC Number, LAR Number, Procedure Revision, etc., which initiates this FSAR Change):

EC 63016

List and Attach any Documentation Supporting the Change (e.g., 10CFR50.59 Screen/Evaluation, etc.):

EC 63016 AR 282349

FSAR Section(s) Impacted (e.g., Section 9.3.6.a, Table 5-9, Figure 8-12, etc.):

5.2, 5.2.1.2, 5.2.2.1, 5.2.2.1.1.1, 5.2.2.1.1.2, 5.2.2.1.1.3, 5.2.2.2. 5.2.2.2.3 (New Section), 5.2.2.2.4 (New Section), 5.2.2.3.2, 5.2.2.3.3, 5.2.2.4.4, 5.2.4.1.1, 5.2.5.2.1.1.g, 5.2.5.2.1.1.h.6

NOCS review identified commitment impact.	(If YES, CP-252 & REG-NGGC-0110 complied with)	☐ YES	☒ NO
This change is associated with an ITS change.	(If YES, provide LAR # ______)	☐ YES	☒ NO
This change is associated with an ITS Bases change.	(If YES, provide ITSB # ______)	☐ YES	☒ NO
This change includes deleted FSAR information not being replaced by new information.		☐ YES	☒ NO

Is the Initiating Activity a Delayed Implementation?	Is this an Editorial change?
☐ NO — Initiating Activity is complete and not tied to any pending plant change.	☒ NO — 10CFR50.59 Screen Number: AR 282349
☒ YES — 12/20/2009 (RF16) (**expected** date of completion)	☐ YES — Licensing & Regulatory Programs Concurrence Initials:
Initiating Activity signed-off by Operations: ______ DATE	

John Holliday — *John Holliday* (signature) — 09 / 11 / 08

Preparer (Name) (Signature) Date Signed

TCO Review and Approval

Dan Jopling — *Dan Jopling* (signature) — 9 / 11 / 08

(Name) (Signature) Date Signed

Supervisor SGR Project

Title

Config Mgmt Review and Implementation

Config Mgmt Concurrence: FSAR Change Request Package Is Complete and Meets Requirements of 10CFR50.59.

(Name) (Signature) Date Signed ___ / ___ / ___

FSAR Change(s) Incorporated into Native FSAR file, and printout(s) attached: ☐ Initials ______ Date ______

Final Config Mgmt Approval: FSAR printouts approved for uploading to Living FSAR Revision ______

(Name) (Signature) Date Signed ___ / ___ / ___

5.2 *REACTOR BUILDING*

The reactor building is a concrete structure with a cylindrical wall, a flat foundation mat, and a shallow dome roof. The foundation slab is reinforced with conventional mild-steel reinforcing. The cylinder wall is prestressed with a post-tensioning system in the vertical and horizontal directions. The dome roof is prestressed utilizing a three-way post-tensioning system. The inside surface of the reactor building is lined with a carbon steel liner to ensure a high degree of leak tightness during operating and accident conditions. Nominal liner plate thickness is 3/8 inch for the cylinder and dome and 1/4 inch for the base.

The foundation mat is bearing on competent bearing material and is 12-½ feet thick with a 2 feet thick concrete slab above the bottom liner plate. The cylinder portion has an inside diameter of 130 feet, wall thickness of 3 feet 6 inches, and a height of 157 feet from the top of the foundation mat to the spring line. The shallow dome roof has a large radius of 110 feet, a transition radius of 20 feet 6 inches, and a thickness of 3 feet. The reactor building is shown in Figure 5-2, penetration details in Figure 5-3, and personnel and equipment access opening details in Figure 5-4.

The reactor building has been designed to contain radioactive material which might be released from the core following a Loss-of-Coolant Accident (LOCA). The prestressed concrete shell ensures that the structure has an elastic response to all loads and that the structure strains within such limits so that the integrity of the liner is not prejudiced. The liner has been anchored to the concrete so as to ensure composite action with the concrete shell.

The design and construction of the reactor building has been given a thorough re-evaluation subsequent to the discovery on April 14, 1976, of a delaminated condition in the dome. The upper part (approximately 12 inches thick) of the 3 feet design concrete thickness separated from the lower part of the dome structure parallel to the membrane over an approximate diameter of 105 inches. Extensive analytical and field investigations were conducted to establish an acceptable repair program. This repair program included removal of the upper part of the dome, placement of non-prestressed reinforcing steel mats, installation of radial reinforcement, and placement of concrete to restore the dome to a thickness of 3 feet. Details of the delaminated condition of the dome, re-evaluations of the dome, and the dome repair program are described in the report: "Final Report - Reactor Building Dome Delamination", December 10, 1976.

In several instances, the design criteria and/or construction methods related to the repair program have superseded those contained in Chapter 5. In all such cases, the above referenced report is the preferenced authority applied to the dome repair.

In support of the steam generator replacement project (fall 2009) a temporary access opening was created in the post-tensioned, reinforced concrete wall and the interior steel liner plate at azimuth 150 degrees. The concrete opening measured approximately 25'-0" wide x 27'-0" high, and the liner plate opening measured 23'-6" wide x 24'-9" high. The bottom of the concrete opening was located at elevation 183'0", and the bottom of the liner plate at elevation 184'-0". Creation and restoration of the access Opening required the removal and reinstallation of the concrete, rebar, tendons, tendon sheaths and liner plate within the boundaries of the Opening and detensioning and retensioning of selected vertical and horizontal tendons adjacent to the Opening. Additionally, a new reinforcing cage comprising of 2 layers of #11 rebars at 11" center to center spacing, in both the hoop and vertical directions was installed in the Opening.

5.2.1.2 Design Loads

The design loads for the reactor building have been determined based on operating and accident requirements, as specified below, in addition to the loads as required by applicable codes. *These design loads were maintained during the evaluation of the SGR access opening.*

Scaled plots of stress resultants, stress couples, shear, and deflections for the individual loads are shown in Figure 5-5 through Figure 5-9, and Figure 5-*12 for the original containment shell configuration (without the SGR opening).*

5.2.2.1 Concrete

Structural concrete work was performed in accordance with "Specifications for Structural Concrete for Buildings," ACI 301-66 (Ref 7). The prestressed concrete has a minimum compressive strength of 5,000 psi. The foundation mat also consists of 5,000 psi strength concrete.

Portland cement conforms to ASTM C 150 (Ref 8), Type II, modified for moderate heat of hydration. Concrete aggregates conform to ASTM C 33-67 (Ref 9), with minor modification to suit local conditions. The type and size of aggregate, slump, and additives were established to minimize shrinkage and creep. Neither calcium chloride nor any admixture containing calcium chloride or other chlorides, sulfide, or nitrates was used. Mixing water was tested to verify that it did not contain more than 100 ppm of each of the above chemical constituents.

Replacement Concrete for the Steam Generator Temporary Access Opening in the Containment Concrete Shell
A special high early strength concrete mix was developed, to enable tendon retensioning as soon as possible after concrete placement. The concrete has a specified 5 and 28 day minimum compressive strength of 6000 psi and 7000 psi respectively. Portland cement conformed to ASTM C150 Type 1. The type and size of aggregate, slump and additives were established to minimize shrinkage and creep.

5.2.2.1.1 Concrete Quality Control

The following Quality Control measures were followed for the structural concrete:

5.2.2.1.1.1 Preliminary Tests

a. The services of a testing laboratory were obtained prior to commencing concrete work. The testing laboratory made controlled mixes, using the proposed materials to consistencies satisfactory for the work, in order to determine the suitable mix proportions necessary to produce concrete conforming to the type and strength requirements specified. Aggregates were tested in accordance with the ASTM Specifications: C 29-69, C 40-66, C 127-59, C 128-59, C 136-63, and C 33-67 as modified for local conditions. The concrete compression tests conform to ASTM Specification C 39-64. *The applicable ASTM Specifications for the Steam Generator Project were: C 29-97, C 40-04, C 127-04, C 128-07, C 136-06, C 33-03 and C39-05.*
b. The proportions for the concrete were determined by Method 2 of Section 308 of ACI 301-66, and as herein specified. *Proportions for the concrete for the SGR temporary access opening were determined by using the absolute volume method described in ACI 211.1-91R-02*

5.2.2.1.1.2 Field Tests

During concrete operations, the testing laboratory had inspectors at the batch plant who certified the mix proportions of each batch delivered to the site and periodically sampled and tested the concrete ingredients. These inspectors ensured that a ticket was provided for each batch, documenting the time loaded, actual proportions of the mix, amount of concrete, concrete design strength, identification of transit mixer, and reading of revolution counter at first addition of water. The truck revolution counters, the cleanliness of trucks, and the handling and storage of aggregate were checked by the batch plant inspectors. A concrete batch plant was utilized which complied in all respects, including provisions for storage and precision of measurements, with ASTM C 94-68 (10) *(ASTM C 94-97 for the SGR Project).* The water and ice additions were modified as required by measurements of the moisture content of the aggregates and gradation changes.
The ready-mixed concrete was mixed and transported in accordance with ASTM C 94-68 *(ASTM C 94-97 for the SGR Project).* Records were maintained as to the time and reading of the revolution counter when concrete was discharged.
Other inspectors at the construction site inspected reinforcing and form placement, made slump tests, made test cylinders, checked air content, and recorded weather conditions. Except as noted hereinafter, test cylinders were molded, cured, capped, and tested in accordance with ACI 301-66 *66 (ACI 301-05 for the SGR project).* For the reactor building shell, a set of six cylinders were made for each 50 cubic yards or fraction thereof placed in any one day. Two cylinders were tested at 7 days, two cylinders at 28 days, and the remaining cylinders at 90 days. A slump test was conducted on each truck load in accordance with ACI and ASTM requirements.

Requirements for placing and consolidating concrete were as detailed in ACI 301-66 *(ASTM C 301-05 for the SGR Project).* Placing temperatures were limited per the requirements for 5,000 psi mass concrete.

In the event that concrete was poured during freezing weather or that a freeze was expected during the curing period, an additional cylinder was made for each set and was cured under the same conditions as the part of the structure which it represented. This cylinder was tested at 28 days.

Concrete for the SGR project was sampled and fresh concrete tests performed at the place of discharge from the concrete delivery trucks. As a minimum, concrete samples were taken from five randomly selected trucks. Sampling of fresh concrete conformed to ASTM C 172-04. Slump and air content testing was in accordance with ASTM C 143-05a and ASTM C231-04 and was performed on each sample of fresh concrete secured. A set of 10 standard 6" by 12" cylinder specimens was prepared and cured from each fresh concrete sample secured in accordance with ASTM C 31-06. Compression strength tests were performed in accordance with ASTM C 39-05 at 3, 5, 28, and 91 days. Four additional cylinder specimens were cast from two randomly selected samples and cured inside the containment adjacent to the opening as field cured cylinders. Strength testing was performed on these specimens for information purposes, two at 3 days and two at 5 days, in accordance with ASTM C 39-05.

5.2.2.1.1.3 Test Evaluation

The evaluation of test results was in accordance with Chapter 17 of ACI 301-66 *(ASTM 301-05 for SGR).* Sufficient tests were conducted to provide an evaluation of concrete strength.

5.2.2.1.1.4 Deficient Concrete

If concrete was found to be deficient because of failure to conform to the project specifications and/or design drawings, the Engineer was notified and requested to make an engineering evaluation. This evaluation was based upon all available data regarding the concrete placement in question (e.g., test reports, photographs, as-built sketches, site visitation by the Engineer S.D., etc.). Where concrete strength levels below project specifications were indicated from field test results of individual concrete pours, the evaluation of concrete acceptability was performed as provided by the ACI-318-71, Paragraph 4.3, code provisions.
If the Engineer determines that the concrete is acceptable as placed, the concrete is left in place.
A repair criteria will be issued and a work procedure will be developed based upon the criteria. The concrete will then be repaired using the repair procedure, and inspected according to the original and repair criteria.
If the Engineer determines that the concrete is not acceptable, a removal criteria is issued and a work procedure is developed based upon the criteria. The concrete is then removed doing as little damage to the surrounding concrete and embedments as possible. After removal of the deficient concrete, the area is thoroughly inspected by the Constructor, and the results of the inspection are evaluated by the Engineer. A replacement criteria is issued and a work procedure is developed based upon the criteria, if no existing procedure is applicable. The concrete is then replaced and inspected according to the original and replacement criteria.

5.2.2.2 Reinforcing Steel

The mild steel reinforcing for the reactor building provides capacity in bending and shear only and, therefore, was designed in accordance with ACI 318-63. In addition, mild steel reinforcement (0.15% of the wall section) was placed near the exposed surface of the concrete shell for crack control.
The mild steel reinforcing was deformed bar conforming to ASTM A 615-68 (Ref 12) Grade 40*, except that the replacement bars within the SGR opening placed near the exposed surface (#8s @ 12" c/c) will be ASTM A 615 Grade 60, mechanically (cold swaged) spliced to the existing #8 Grade 40 bars.* It is to be noted that Grade 40 reinforcing steel is the lowest strength material commonly used for construction. Furthermore, no reliance was placed on special high strength properties and, therefore, any interchange of higher strength material did not jeopardize the strength of the structure. *A new reinforcing cage comprised of two layers of #11 rebar (ASTM A615 Grade 60) on 11" center to centers in both the vertical and hoop directions was installed in the steam generator access opening. This new reinforcing cage was not spliced to any existing rebar.*

Splices at points of maximum tensile stress were avoided insofar as possible. Alternate Cadweld splices for concrete reinforcement were staggered, as far as possible, a minimum of 6 feet when the center-to-center spacing of bars was less than 12 inches. Arc welding was not used to splice concrete reinforcement *during initial construction.* Splices for bar sizes larger than #11 were made with Cadweld splices.

5.2.2.2.1 Reinforcing Steel Quality Control

The technical specifications for structural concrete included the following Quality Control measures for reinforcing steel:

a. Testing and inspection of reinforcing steel were performed at the mill to ASTM requirements. The certified mill test reports were provided for each heat of steel covering chemical composition and specification requirements in mechanical properties. Bars were branded in the deforming process to carry identification as to manufacturer, size, type, and yield strength.

b. User tests were performed on reinforcing steel by a testing laboratory to confirm compliance with physical requirements and verification of mill test results. The frequency of testing was two specimens taken from each heat of material. The tests determined yield, ultimate strength, and elongation.

c. Traceability of the reinforcing steel with regard to mill heat was provided at all stages of fabrication and delivery.

5.2.2.2.2 Cadweld Splice Quality Control

The technical specifications for structural concrete included the following Quality Control measures for Cadweld splices:

Prior to the production splicing of reinforcing bars, each operator or crew prepared and tested a joint for each bar size and position to be used in the production work. These qualification splices were tested to destruction and, in addition, were further examined to establish that each crew performed reproducible splices of acceptable quality. The acceptance criteria for Cadweld splices were as follows:......................................

5.2.2.2.3 Cold Swaged Splice Quality Control

All mechanical splices used for the restoration of the SGR temporary access opening were BarGrip XL – Nuclear / Type 2 Series cold-swaged steel coupling sleeves for #8 rebar, as manufactured by BarSplice Products, Inc, Dayton OH.

During installation of the mechanical splices continuous testing of the splices was required to ensure the consistency of the cold swaging operator and that the splice met the specified tensile requirements. Since the swaged couplings were quite close to the face of the concrete in the opening, it was not possible to cut out production splices and have a sufficient length of stub reinforcing remaining to remake these. Therefore, all testing was done on sister splices, which were made next to the production splices, under the same conditions and used for the tensile testing. The mix of sister splice reinforcing grade combinations (Grade 40 to Grade 40 and Grade 40 to Grade 60) was consistent with that of the production splices

Each sister splices was tensile tested (only) to destruction and was required to meet 125% of the specified yield strength and a sequential average of 9 splices had to meet at least 100% of the minimum specified ultimate tensile strength. The specified yield and ultimate tensile strength were based on a Grade 40 bar only, i.e., the lesser of the two grades governed.

5.2.2.2.4 Butt-Welded Rebar Splices for SGR

As an alternative to mechanical splicing of rebar in the SGR access opening, butt-welded rebar splices were allowed that met the fabrication and visual inspection requirements of AWS D1.4-2005 and the Corporate Welding Manual.

5.2.2.3 Post-Tensioning System

5.2.2.3.1 General

The post-tensioning system used on Crystal River Unit 3 was tested and supplied by the Prescon Corporation of Corpus Christi, Texas. Each tendon consisted of 163 7-mm. diameter low relaxation wires and developed a minimum ultimate tendon force of 2,333.5 kips. The end anchorage of each wire was a "BBRV" buttonhead type. The details of the tendon system are shown in Figure 5-24 and Figure 5-25.

5.2.2.3.2 Wire

The low relaxation wire conformed to the applicable portions of ASTM A 421-65 (Ref 13), type BA with a minimum ultimate tensile stress of 240,000 psi. The low relaxation wire was produced by the Somerset Wire Co., Ltd. process which is patented in the United States by the relevant numbers 3,068,353 and 3,196,052. The method of manufacture increases the resistance to creep under tension of the wire. The method subjects plain carbon steel wire having a carbon content within the range of 0.35% to 0.9% to a cold drawing operation. During the drawing operation, the wire is under a tension to facilitate the drawing operation. After the wire emerges from the drawing, and is still subjected to a tension, it is exposed to a tempering temperature within the range 220°C to 500°C. The tension and temperature that the wire is subjected to is controlled to impart a maximum elongation to the wire of approximately 5%. This process increases the creep resistance of the wire. Relaxation test data available to date is shown in Table 5-1 and Figure 5-26. Present data extrapolated to 40 years indicates that the maximum relaxation is less than 2%, as is shown in Figure 5-26. The design is based on a relaxation of 4%.

The wire for the new replacement tendons within the SGR access opening conformed to the applicable portions of ASTM A 421-98a, type BA with the added requirement that the wires ultimate tensile stress was equal to or greater than 240,000 psi. It was manufactured by the Kiswire Company, Busan, Korea.

5.2.2.3.3 Anchorage Component Materials

The dimensions, acceptance criteria, and materials of the post-tensioning system components are as follows:

Component	Size	fu (ksi) min.	fu (ksi) min.	NDTT (max)	Location	Material
Bearing Plate	24" x 24" x 3"	50	90	-15 °F	Mat only All Others	ASTM A 533 Grade B Class 2 Modified Armco VNT (Proposed ASTM A 633-E) single normalized.
Shims	7" ID x 13.5" OD	50	90	-15 °F	All	Modified Armco VNT (Proposed ASTM A 633-E) or like material, 3" plate single normalized, 4" plate double normalized. *NOTE 1*
Stressing	10.5" dia. x 6"	60	100	-15 °F	All	Quenched or End Washer tempered alloy steel forging, chemistry of ASTM A 514 type E - double quenched and tempered. *NOTE 2*

Chemical composition for modified Armco VNT:

Carbon	0.25 % maximum
Manganese	1.30% to 1.65%
Vanadium	0.12% to 0.17%
Silicon	0.15% to 0.30%

Nitrogen	0.01% to 0.02%
Phosphorus	0.035% maximum
Sulfur	0.04% maximum

NOTE 1: Alternative shim material may be Armor Plate HY-80, Type 1 (MIL-S-16216). PEERE 987 Revision 0 documented the review and approval of this material for use.

NOTE 2: Alternative material for the stressing washers may be ASTM A514 Grade Q. Review documented in EC 63016.

5.2.2.4.1 Codes

The reactor building liner and penetrations conformed in all respects to the applicable Sections of ASA N 6.2-1965 (Ref 17). The personnel access locks, the portion of the equipment access door extending beyond the reinforced concrete shell, and the internal primary pressure boundary of all penetrations conformed to the requirements of the ASME Boiler and Pressure Vessel Code Section III Class B. The selection of materials considered a lowest service metal temperature of 120°F within containment and +25°F outside containment.

The principal load carrying components of ferritic materials for the reactor building liner, penetrations, and locks were selected and tested to conform to the impact requirements of ASME-ASTM SA-300 Class 1 and ASME Section III Class B which had a minimum impact test temperature of 0°F. (See Note 1 on Page 5-33.)

5.2.2.4.4 Quality Control and Nondestructive Testing

Butt-welded joints in the main liner shell and in the dome were examined by the following methods:

a. 100% visual inspection
b. 20% liquid penetrant examination
c. 100% vacuum box testing or leak testing
d. 2% spot radiograph examination

Butt-welded joints in the personnel access locks and in the penetrations and the reinforcement around the openings were examined by full radiography and other methods called for by ASME Section III Class B and were also vacuum box tested or leak tested.

Non radiographable joint details covered by the ASME Section III Class B requirements and the polar crane support welds were 100% examined by visual and either liquid penetrant or magnetic particle methods.

All other joint details in the liner, sumps, anchors, etc., which were nonradiographable were examined by the following methods:

a. 100% visual inspection
b. 20% liquid penetrant or magnetic particle examination
c. 100% vacuum box or leak testing

Full radiography was in accordance with Paragraph N-1350 of ASME, Section III. The procedures and acceptance criteria conformed to Paragraph UW-51 of ASME, Section VIII.

Spot radiography was in accordance with approved procedures and governed by the acceptance criteria of Paragraph UW-52 of ASME, Section VIII and porosity charts of Appendix IV of ASME, Section III with the following conditions:

a. Two percent of the welds covered by spot radiography were examined, excluding repairs.
b. The 2% was approximately 2% of welds of each welder.
c. The frequency was 12 inches in every 50 feet of welding.

Liquid penetrant examination methods and acceptance criteria were in accordance with Appendix VIII of ASME, Section VIII.

Magnetic particle examination methods and acceptance criteria were in accordance with Appendix VI of ASME, Section VIII.

Quality Control and Nondestructive Testing for SGR

After the liner plate was welded back to its original configuration, the following Non-Destructive Examinations (NDE) were performed in accordance with the applicable sections of ASME Section VIII and ASME Section XI Subsections IWA and IWE on the liner plate butt welds around the perimeter of the Opening:

- *100% visual examination*
- *100% vacuum box leak testing*
- *100% Magnetic Testing (Double sided welds received Magnetic Particle Examinations on both sides of the liner shell. Welds with backing bar received Magnetic Particle Examinations after the first and final layers.*

100% magnetic particle examination was used as an alternative to the original Owner examination requirements of 2% spot radiography and 20% liquid penetrant per the reconciliation evaluation contained in ECED 70586.

Liquid penetrant examination methods and acceptance criteria were in accordance with Appendix VIII of ASME, Section VIII.
Magnetic particle examination methods and acceptance criteria were in accordance with Appendix VI of ASME, Section VIII.

5.2.4.1 Reactor Building Concrete Shell

5.2.4.1.1 Static Solution

The static load stresses and deflections that are in a thin, elastic shell of revolution, are calculated by an exact numerical solution of the general bending theory of shells. This analysis employs the differential equations derived by E. Reissner (Ref 23). These equations are generally accepted as the standard ones for the analysis of thin shells of revolution. The equations given by E. Reissner are based on the linear theory of elasticity, and they take into account the bending as well as the membrane action of the shell.

The method of solution is the multi-segment method of direct integration, which is capable of calculating the exact solution of an arbitrary thin, elastic shell of revolution when subjected to any given edge, surface, and temperature loads. This method of analysis was published (Ref 26) and has found wide application by many engineers concerned with the analysis of thin shells of revolution.

The actual calculation of the stresses produced in the shell and foundation was carried out by means of a computer program written by Professor A. Kalnins of Lehigh University, Bethlehem, Pennsylvania. This computer program makes use of the exact equations given by E. Reissner, and solves them by means of the multi-segment method mentioned above. The program can solve up to four layers in a shell and these layers can have different elastic and thermal properties and can vary in thickness in the meridional direction. Applied loads can vary in meridional and circumferential directions. The program does not include the cracked state of the concrete nor the influence of the prestressing tendon holes. Most portions of the shell are uncracked or within the allowable compression or tension stresses for all loading conditions. Cracking will occur at discontinuity points. To balance this condition non-prestressed reinforcement has been provided.

The physical properties of the steel liner and the concrete shell, the geometry of the structure, and the breakdown of the shell into various parts, together with shell type, number of segments, and shell layers per part as used in Kalnin's Program are shown in Figure 5-19.

Figure 5-20 shows the applied loads for a typical loading case that were used as input for Kalnin's Program. The loads shown are those due to dead load, equipment load, prestressing loads, 1.15 times the basic pressure load, and the load attributed to the subgrade.

The analysis of the reactor building for operating condition includes an evaluation of thermal transients for initial start-up, start-up during cold weather, protracted shutdown, and seasonal variations during operating condition. This static analysis method has been evaluated by H. Kraus (Ref 25).

The method of analysis for thermal loading of the shell at the penetrations and all pipe reactions and moments is as suggested by A. K. Maghdi and A. C. Eringen (Ref 26), and by G. N. Savin (Ref 27). Stress concentration factors used to analyze membrane stresses around the penetration are based upon these references.

With the exception of the openings for the equipment hatch and personnel access lock, the next largest opening is the purge line sleeve which has a diameter of 48 inches. The diameter to wall thickness ratio is about 1:1.4. This opening and other smaller openings are described in Section 5.2.5.2.3.

Large openings in the reactor building:

1 - Equipment Hatch, 22 feet, 4 inches inside diameter
1 - Personnel Lock, 10 feet inside diameter

The equipment access and personnel access openings are designed for the loads and load combinations as specified in Section 5.2.3.2.1. The analysis of discontinuity stresses resulting from these large openings was performed by the finite-element method. A complete description of the analysis and design as applied to the equipment opening is described in (Ref 28).

Static Solution for Steam generator replacement project – creation and restoration of temporary access opening.

The finite element computer program (GTSTRUDL) was used to create and analyze three dimensional models representing the containment shell, dome, basemat, and foundation soil springs for the fully restored configuration.

Similar to the original analysis, the models utilized thin shell elements that take into account bending and membrane action in the shell. Linear soil springs were also modeled similar to the original analysis to simulate the support provided by the rock foundation. Load application to the FEA models was performed in a similar manner to the original model, except for seismic OBE and SSE loads. This approach utilized element self-weight excitations in the horizontal and vertical directions to calculate the equivalent seismic forces using Zero Period Accelerations. The resulting structural response due to horizontal and vertical excitations was then combined using the absolute sum.

5.2.5.2 Design

5.2.5.2.1 Reactor Building Concrete Shell

The reactor building has been designed in accordance with ACI 318-63 to withstand the following load conditions:

a. During construction but prior to prestressing
b. During prestressing
c. Normal operating conditions
d. Test load conditions

The building has been checked for the factored loads and load combinations given in Section 5.2.3.2.1, and compared with the yield strength of the structure. The load capacity of the structure is defined for the design as the upper limit of an elastic behavior of the effective load carrying structural materials.
For steels (both tendon wires and mild steel reinforcement), this limit is considered to be the guaranteed minimum yield strength. For concrete, the yield strength is limited by the ultimate values of shear (as a measure of diagonal tension) and bond per ACI 318-63, and the 28 day ultimate compressive strength for flexure (f'_c). A further

....

In summary, the analysis described in the Appendix shows that the stress concentration in the dome and around the tendon conduits is acceptable, as the dome tendon conduit is made from Schedule 40 pipe, not lightweight tube. Aside from other functions, this relatively heavy conduit acts as additional reinforcement. Thus, the loss-of-gross section resulting from the presence of tendon conduit, does not yield unacceptable stress levels.

5.2.5.2.1.1 General Design Criteria for Post-Tensioning System

The tendons, including the anchorage zone, ...conditions was greater at a section than that required for "Ultimate Strength Design" under factored loads, the reinforcement required for "Working Stress Design" governed.
In addition to the load combination described in Section 5.2.3.2 where design is based upon an "Ultimate Strength Design" approach, the reactor building was also designed to accommodate construction and the controlling operating load combinations in accordance with ACI 318-63 "Working Strength Design" and "Prestressed Concrete."

a. Post-Tensioning Tendon Test Program

   Experimental data have been developed for the anchorage hardware and have been reported by The Prescon Corp (Ref 15). This report indicates that the end anchorages can satisfactorily resist:

   1. Loads equal to and greater than the guaranteed ultimate tendon strength (>100% GUTS).
   2. Dynamic loads.
   3. Normal (70% GUTS) tendon loads at temperatures 30°F lower than the service metal temperature.

   Dimensions, etc., of the anchorage components are as shown in Figure 5-24 and Figure 5-25.

b. Post-Tensioning Tendon Anchorage Zone Analysis and Design

   Examples of the analysis and design of the anchorage zones for the prestressed tendons are presented in Reference 19. The factors considered in the design of the anchorage zones were:

   1. Bearing stresses

2. Spalling stresses
3. Transverse tensile splitting stresses in vertical and horizontal direction
4. Transfer of unbalanced tendon forces

The reinforcement in the anchorage zone was designed for the most unfavorable condition to control possible cracks in the concrete.

A check of the design was performed utilizing the finite element method (Ref 19). The check design predicted cracking in localized areas during a winter LOCA. For this condition, areas of high tensile stress:

$$(>6\sqrt{f'_c})$$

have been defined and reinforcement capable of resisting them has been provided. The analysis did not include the tendon holes.

c. Tendon Friction and Efficiency TestsA series of tests have been conducted on curved tendons using the BBRV wire system to evaluate the efficiency of the tendon and the friction factors. These tests are as follows:

Location	[illegible]
Frick, Switzerland	121-7mm wires, 180° horizontal curvature
South Haven, Michigan	90-¼ inch wires - approx. 107° horizontal curvature
Middletown, Pennsylvania	90-¼ inch wires - approx. 30° horizontal and 50° vertical curvature

The combined results of the above give a coefficient of friction of 0.1217 and a wobble coefficient of 0.000343. The details of these tests were reported by H. Wahl and T. Brown (Ref 37). The coefficients used for design are 0.16 and 0.0003, respectively.

Three tests from the Frick series were also used to determine the ultimate strength efficiency of the curved tendon. These tests indicate that the tendons had no less than 95% efficiency. This efficiency is based upon 180° curvature and stressing from one end of the tendon. However, the design of the reactor building does not require that the ultimate strength of the tendon be reached. The load in the tendon will not be greater than 70% of the minimum guaranteed ultimate strength under any combination of loadings.

d. Tendon Redundancy

Section 5.2.5.2.1 states that the load capacity determined for tensile membrane stresses will be reduced by a capacity reduction factor "Φ" of 0.95 which will provide for the possibility that small variations in material strengths, workmanship, dimensions, and control may combine to result in under capacity. Considering the above "Φ" factor, it is possible to have a symmetrical failure of up to 5% of the tendons and meet the design criteria for the factored loads.

A study was performed to determine the effect of the total loss of three adjacent 163 wire tendons either vertically or circumferentially in the cylinder or in the dome. This study indicated that the loss of three adjacent tendons will not jeopardize the capability of the reactor building to withstand the design accident loading condition.

e. Prestress Losses

In accordance with ACI 318-63, the design makes allowance for the following prestress losses:

1. Seating and anchorage
2. Elastic shortening of concrete
3. Creep of concrete
4. Shrinkage of concrete

5. Relaxation of steel stress
6. Frictional loss due to intended or unintended curvature in the tendons

The above losses have been predicted within safe limits. The environment of the prestress system and concrete is not appreciably different in this case from that found in numerous bridge and building applications.

f. Prestressing Arrangement

The configuration of the tendons in the dome (see Figure 5-2) is based on a three-way tendon system consisting of three groups of tendons oriented at 120° with respect to each other. A large concrete ring girder is provided at the intersection of the dome and wall. The cylindrical wall is prestressed with a system of vertical and horizontal tendons. The horizontal system consists of a series of rings. Each ring is made up of three tendons, each subtending an angle of 120°. Six buttresses are used as anchorages with the tendons staggered so that adjacent rings do not have tendons anchored at the same buttress. Each hoop and dome tendon is stressed from both ends so as to reduce the friction losses. The vertical system consists of vertical tendons anchored in the foundation mat and ring girder. For typical tendon arrangement, see Figure 5-2 and Figure 5-4.

g. Prestressing Sequence

The dome and wall tendons were installed and tensioned in a prescribed sequence so as to minimize stress concentration in the shell. The stressing operation for the vertical tendons started at four positions approximately equally spaced along the circumference of the cylinder and proceeded in a prescribed sequence.

The hoop tendons were stressed in sets of three tendons comprising a complete 360° band at six positions and proceeded in a prescribed sequence.

The stress-strain curves for the production lots used were reviewed by the Engineer along with the final gauge reading and elongation for each stressed tendon. The loss of prestress force due to failure of wires or buttonheads was maintained at 2% or less, as stipulated by the Engineer.

Force and strain measurements were made by measurement of elongation of the prestressing steel after taking up initial slack and comparing it with the force indicated by the jack-dynamometer or pressure gauge. The gauge indicated the pressure in the jack within plus or minus 2%. Force-jack pressure gauge or dynamometer combinations were calibrated against known precise standards just before application of prestressing forces and calibrations were so certified prior to use. Pressure gauges and jacks so calibrated were always used together. During stressing, records were made of elongations as well as pressures obtained. Dynamometers or force-jack gauge combinations were checked against elongation of tendons. Any discrepancy exceeding ±5% of that predicted by calculations (using average load elongation curve) was documented and reviewed. All elongations were corrected to within ±10% of predicted.

As a result of the steam generator replacement outage a new pre-stressing sequence was developed for the tendons affected in and around the temporary access opening. This retensioning sequence started with the tendons furthest from the opening and progressed towards the opening, thereby ensuring the maximum distribution of prestress to the concrete within the opening. All of the affected tendons were retensioned to 70% of GUTS (+4%, -0%).

h. Tendon Surveillance

An in-service tendon surveillance program has been established which meets the requirements of the ASME boiler and Pressure Vessel Code, Section XI.. Some pertinent aspects of the program are as follows:

1. Twenty-one tendons were selected for each of the first three surveillance periods for inspection, consisting of ten hoop tendons, six vertical tendons, and five dome tendons. Unless experience shows that there are significant problems with prestressing members in the containment building, eleven tendons shall be selected for each subsequent surveillance period for inspection, consisting of five hoop tendons, three vertical tendons, and three dome tendons.

2. Lift-off tests for some surveillance tendons shall include essentially complete detensioning.
3. Each surveillance period a previously stressed tendon wire shall be removed from one dome tendon, one vertical tendon, and one hoop tendon and tensile, and elongation tests performed.
4. For the surveillance tendons selected each surveillance period an inspection shall be conducted of the anchorage assembly hardware, anchorage concrete, and conduit grease filler.
5. The surveillance was performed 1, 3, and 5 years after the initial containment structural integrity test and is performed every 5 years thereafter. A report of each inspection will be recorded and significant deterioration or abnormal behavior reported to the Commission.
6. *The surveillance for the affected tendons in and around the temporary SGR access opening and for the remaining population is as follows:*

- *2010 - 1year repair/replacement scope; 4% sample of both the vertical and hoop tendons affected by the repair. However, only the Vertical Tendons are accessible during plant operation, the Horizontal Tendons will be deferred to 2011, Refuel 17.*
- *2011 -1 year repair/replacement of the deferred scope (inaccessible Horizontal Tendons), plus 4% sample of both the vertical and hoop tendons affected by the repair, plus the normal 2% sample drawn from the population that excludes previously examined tendons and those affected by the SGR.*
- *2017 - 4% sample of both the vertical and hoop tendons affected by the repair, plus the normal 2% sample drawn from the population that excludes previously examined tendons and those affected by the SGR*

From:
CHRIS.A.SWARD@sargentlundy.com
To:
Holliday, John;
cc:
domingocarreira@sbcglobal.net;
Subject:
Concrete
Date:
Friday, September 05, 2008 3:01:37 PM
Attachments:
CR3 Answers to Question, Aug. 2008.doc

John, Domingo's answers to the outstanding questions are attached. He and I also discussed formwork removal. We will be able to set a time period in the spec after we have completed mix proportioning and testing. He expects that it will be 24 hours or less in that we only need around 500 psi. Early removal however, means a longer period for application of curing methods. Domingo would also like to begin some dialogue on the placement and consolidation methods. CTL may be leaning toward a high slump (6" or so) concrete if the desire is to pump the concrete. If we go with a lower slump we may need to use buckets or conveyors.

Chris Sward Project Manager Sargent & Lundy 312-269-7426

Summary of S&L Position on Seven Topics Discussed with Mr. John Holliday

1. Testing for Poisson's ratio of concrete

Answer to the question: Why we are not testing for Poisson's ratio?

Testing to determine the concrete Poisson's ratio in accordance to ASTM C469 "Standard Method for Static Modulus of Elasticity and Poisson's ratio of Concrete in Compression," does not require extra test specimens, just the use of an extensometer to measure the transverse strain of the test specimens in addition to the compressometer used for the determination of the elastic modulus.

The Poisson's ratio is used in the computer programs for structural analysis to account for the effect of transversal deformations. The Poisson's ratio in concrete varies within a narrow range such as 0.17 to 0.20. Therefore, the effect of this variation in the results of the structural analysis if any is negligible.

The value of the Poisson's ratio used during the structural analysis of the replacement concrete was the same used in the plant FSAA. That is $\upsilon = 0.20$ which is adequate for the analysis performed.

Poisson's ratio is not a parameter tested for quality control during production and placement of concrete, and it not required to be tested in any structural design code or specification whether it is a structure built of reinforced concrete, prestressed concrete, or steel.

Conclusion: For these reasons, Poisson's ratio was not included in the testing program for the concrete mixture design program, and will not be included in the testing required for the concrete quality control during construction.

2. Recommendations to prevent mold in the aggregate stock piles

Answer to the question asking for recommendations to prevent mold in the aggregate stock piles.

Mold and plants will grow at aggregate stock piles if moisture, temperature and stagnant air are present. Organic impurities in aggregate from mold and plant growing may interfere with the chemical reactions of the cement hydration. The organic matter found in aggregate consists usually of product of decay of vegetable matter including mold.

The fine aggregate is more prone to the development of mold and to have organic matter than the coarse aggregate, because of its higher water and moisture receptivity compared with those of the coarse aggregate.

Prevention is the recommended solution to this possible contamination. Since there is very little control over the temperature of the aggregates in the stock piles, we shall concentrate on reducing the moisture content and the stagnant air in the stock piles of aggregates. Usually this is not a problem for short-term stockpiling as done in concrete ready mixed plants. The possibility of contamination increases with time of stock piling, and the warm and humid weather in Florida is a cause for concern.

It is recommended that:

First, the aggregates shall be initially stored and continuously keep stored in a dry condition. That is, it is very important that aggregated will be dry at all times, except at the time of their use in concrete. The surface on which they are stock piled must be dry at all the times, and the stock piles protected from rain.

Second, the rain and moisture protection provided to the stock piles should allow the air to circulate around the stock piles, to reduce the possibility of mold and vegetation development.

Third, periodically move the piles to prevent accumulation of moisture and stagnant air inside the plies, and to visually check for mold and vegetation development. In addition to periodical visual inspections, it is recommended to test aggregate samples in accordance to ASTM C 40, "Standard Test Method for Organic Impurities in Fine Aggregates for Concrete,"

Fourth, if organic impurities are found in the aggregates, samples of the presumed contaminated sand shall be tested in mortar specimens in accordance to ASTM C 87 "Standard Test Method for Effect of Organic Impurities in Fine Aggregates on Strength of Mortar,"

Washing the aggregates is an effective method to remove organic impurities and may be considered as a solution if the problem develops beyond the control with the solutions proposed. Some chemicals like hydrogen peroxide may be used to eliminate organic material contamination during washing of the aggregates if so required but additional search and testing is required.

Conclusion: Stockpiles of aggregates shall be dry and ventilated to prevent mold and vegetation grows. Periodical inspection to detect mold and vegetation development is strongly recommended with testing to verify organic contamination if any. Washing of aggregates and the use of chemical may be required if mold an organic contamination develops

3. Applicability of ACI 209R-92 (97) report to nuclear containments structures

Answer to the question about the applicability of ACI 209R-92(97) report to the concrete replacement in CR3 containment based on its disclaimer in Section 1.1.

Article 1.1 in ACI 209R-92(97) states “Special structures, such as nuclear reactor vessels and containments, bridges or shells of record spans, or large ocean structures, may require further considerations which are not within the scope of this report.”

ACI 209R-92(97) is a five chapter report on the prediction of creep, shrinkage and temperature effects in concrete structures.

At the time the original report was published (written in the 1970's and approved by ACI TAC for publication in 1982), two of the three principal authors of the report were involved in the design of nuclear containments, and other members of the Subcommittee II were involved in the design of long span bridges.

The scopes of Chapters 1, 2 and 5 of this report were general, but the scopes of Chapters 3 and 4 were mainly oriented to common reinforced concrete building structures, and to simple span prestressed members used in bridges up to medium spans. It was the opinion of the writers to caution report users of the limitations of this report.

In the case of the CR3 concrete replacement, Chapter 2 of ACI 209R-92(97) was the only portion of this report used as a guide to estimate the creep coefficient and concrete shrinkage strain for the calculations of the stresses and strains in the new replacement concrete after post-tensioning forces were reapplied. The main goal of the analytical studies was to find concrete creep and shrinkage strains that assure the restoration of an acceptable level of prestressing in the wall, and to provide the specific target values required for the concrete mixture design and testing program.

Since an extensive test program is being implemented on the concrete constituent materials as well on the creep and shrinkage of the concrete mixtures to be used in CR3, to applicability of ACI 209R-92(97) is not an issue at all, because this testing program will remove most of the limitations of the prediction models in Chapter 2 of ACI 209R-92(97).

ACI Committee 209, decided to restructure the new revisions to ACI 209R-92(97) as independent reports to avoid conflict of applicability and to facilitate future revisions.

In 2005 ACI Committee 209 published the Report ACI 209.1R-05 “Guide to factors Affecting Shrinkage and Creep of Hardened Concrete in Engineering,” 12pp., which is a new and more complete version of Chapter One in the ACI 209R-92(97) report. This new report is in the process of revision for a new edition.

In 2008 ACI Committee 209 published the Report ACI 209.2R-08 “Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete,” 44 pp.

This report is a new and more complete version of Chapter Two in the ACI 209R-92(97). In Section 1.1 of this report it is stated "For structures where shrinkage and creep are deemed critical, material testing should be undertaken and long-term behavior extrapolated from resulting data. This is precisely was it is being done with the CR3 concrete in the ongoing testing program.

Since, ACI 209.2R-08 is now available and tests are performed to determine the creep and shrinkage strain of the concrete that will be used as well as other properties, it is better to refer to it, instead of the reference to ACI 209R-92(97) that was the only document available from ACI at the time the CR3 analysis was performed in year 2007.

Conclusion: The implementation of the ongoing tests program to determine the concrete creep and shrinkage strains in the concrete to be used in CR3 conforms to the new ACI 209.2R-08 and removes any potential questioning about the applicability of ACI 209R-92(97) to CR3 project. It is recommended to reference ACI 209.2R-08 report instead of the previous reference to ACI 209R-92(97).

4. Concrete Placement Temperature of 50 °F

Answer to the question about the applicability of the maximum concrete temperature of 50 °F when compared to the minimum temperature of 50 °F during cold weather concreting in ACI 306R-88.

Section 1.4.3 of ACI 306R-88 "Cold Weather Concreting" (reapproved 2002) states:

> "Where a specified concrete strength must be attained in a few days or weeks, protection at temperatures above 50°F (10°C) is required. See Chapters 5 and 6."

Cold weather definition in Section 1.1 of ACI 306R-88(02).

> "Cold weather is defined as a period when, for more than 3 consecutive days, the following conditions exist: 1) the average daily air temperature is less than 40°F (5°C), and 2) the air temperature is not greater than 50°F (10°C) for more than one-half of any 24-hr period."

Each one of the following eight observations per se will explain the non-applicability of the minimum 50°F recommendation in ACI 306-88(02) to CR3 project. All together reinforce each other on the non-applicability to CR3 project.

- This definition of cold weather in ACI 306-88(02) hardly applies to Florida even in deep winter.
- The interior temperature of the containment will be all the times at a temperature higher than 50°F, even if the replacement work is done during

the months of January or February. Therefore, more than one half of the new concrete surfaces will be exposed at a temperature higher than 50°F as soon as it is placed, even if the outside air temperature is below 50°F.

- The outside surface of the formwork can be insulated if necessary in the extreme case the cold weather definition applies to the location of CR3 or as a precaution measure if concrete is placed in winter. Further more, the use of insulation initially applied on the formwork is desirable to take advantage of the autogenously curing provided by the cement heat of hydration. During curing, following curing and at the removal of formwork in cold weather, prevent the maximum temperature decrease at the surface of the concrete in a 24 hr period exceeding 30°F, (ACI 301-05, Section 5.3.6.5).

- ACI 306-88R (02) is a committee report with recommendations of good construction practices, but it is not written as specification or code requirements with the purpose of being enforced.

- ACI 318-08 Code and ACI 301-05 Specifications are documents to be enforced legally by the jurisdiction where the work is performed. They do not have this limit of 50°F minimum temperature in their cold weather requirements.

- Concrete mixtures for CR3 are designed and tested at a mixing maximum temperature of 50°F to reduce the concrete creep and shrinkage, while developing the desired specified strengths. Test results from the ongoing test program are the best way to assure a desired performance. If the goals for the desired creep and shrinkage maximum strains are reached at a higher temperature, the specified 50°F may be raised based on the test results.

- Concrete samples will be secured during concrete placement for testing. Based on their test results, the performance of the concrete will be evaluated with respect to: a) the specification requirements, b) the laboratory tests results, and c) the parameters and properties of the concrete used in the structural analysis of the containment concrete replacement.

- The cooler the concrete temperature during mixing, the better the quality of the hardened concrete if proper curing environment is provided. Controlling the minimum temperature of the concrete curing environment in Florida will be a not to difficult task to enforce in winter. However, controlling the maximum temperature will be more difficult in summer.

- **Conclusion:** The maximum specified concrete temperature of 50°F as delivered is not of concern when compared to the minimum temperature of 50°F during cold weather concreting in ACI 306R-88. Controlling the minimum curing environment of the concrete in Florida will be a not to difficult task to enforce in winter. However, controlling the maximum temperature will be more difficult in summer.

5. Location where concrete temperature requirement of 50 °F will be tested and enforced

Answer to the question: Where the maximum temperature limit of 50°F will be tested and enforced.

Representative samples of fresh concrete are secured at the project site in accordance to ASTM C 172 "Standard Practice for Sampling Freshly Mixed Concrete" which is the sampling standard referred in ASTM C 94 "Standard Specification for Ready-Mixed Concrete," in ACI 318-08 Code and ACI 301-05 Specifications.

Samples of concrete taken at place of delivery are used for the fresh concrete tests and for preparation of the compression test cylinders. One of the fresh concrete tests is the determination of its temperature as delivered.

The concern is the possible difficulty of not meeting the maximum requirement of 50°F at point of delivery if concrete is placed in summer and if the delivery time from the ready-mixed plant is delayed for more than 30 minutes.

Since the mixing plant is close to the project site and the total volume of concrete to be placed is approximately 90 yd^3, time coordination to avoid delays of more than 30 minutes from batch plant to the site should not be a problem.

Not meeting the maximum 50°F may result in a loss of slump which can be compensated at batch plant by the chemical admixtures used and / or additional vibration during concrete consolidation. Nevertheless, for the approximately 90 yd^3 to be placed in one day, delays should be avoided as part of the QC/QA program.

On the other hand, taking representative concrete temperature readings at the batch plant is not an easy task, unless the mixing drum or the trucks are instrumented. However, meeting the temperature requirement is needed at the location of placement to control the workability and other properties of the concrete, not at the batch plant.

Conclusion: Concrete temperature reading shall be taken on samples at point of delivery, not at batch plant. Delays in the delivery of concrete to the site should be avoided as part of the QC/QA program.

6. Forms Continually Wet During Hot Weather Curing of Concrete

Answer to the question: ACI 305R-99 "Hot Weather Concreting" and S & L specification requirement to keep the forms continually wet during the curing period in hot weather. How does this apply or what other requirements do we need to stipulate if they use metal formwork?

ACI 305R-99 states "Section 4.4.4 of "*Curing of concrete in forms*—Forms should be covered and kept continuously moist during the early curing period. Formed concrete requires early access to ample external curing water for strength development. This is particularly important when using high-strength concrete having a w/cm less than approximately 0.40 (ACI 363R). The forms should be loosened as soon as this can be done without damage to the concrete, and provisions made for curing water to run down inside them. Cracking may occur when the concrete cools rapidly from a high peak temperature and is restrained from contracting. In more massive members, and if the internal temperature rise cannot be controlled by available means, the concrete should be given thermal protection so that it will cool gradually at a rate that will not cause the concrete to crack."

This recommendation is very good for hot weather concreting and shall be enforced. However, the following observations shall be considered:

- Hot weather conditions as defined in Section 1.2.1 of ACI 305R-99 were mainly defined for hot weather in semi-desert places like Arizona and Nevada for example, where any combination of the following conditions tends to impair the quality of the freshly mixed or hardened concrete by accelerating the rate of moisture loss and the rate of cement hydration. That is:

  High ambient temperature;
  High concrete temperature;
  Low relative humidity;
  Wind speed; and
  Solar radiation.

These conditions may not apply in Florida even in summer, since:

- The ambient temperature in summer seldom exceeds 95°F compared to the common temperatures above 100°F in semi-desert places.
- The concrete temperature as placed will not exceed 50°F. This is another advantage of low initial concrete temperature.
- The relative humidity in Florida is very high in summer compared with the 30% and lower in the semi-desert places.
- High wind speeds in Florida are related to hurricanes and summer thunderstorms which are extremely wet rather than dry.

- Solar radiation in Florida is attenuated by the high relative humidity in summer, as well by the clouds absent in semi-desert places.

The use of metal formwork is more critical in hot weather concreting than the wood formwork, because of the lesser insolating thermal properties of the metal compared to those of the wood. Therefore, this is another reason to enforce the ACI 305R-99 Section 4.4.4 recommendations.

Providing protection from solar radiation is easy and highly desired. However, the wetting of the formwork is usually avoided as messy, especially if other work is performed in the vicinity of the wetted formwork. In the case of CR3 if the formwork is outside and the water can be drained easily, this wetting should not be a problem.

ACI 305R-99 is a committee report with recommendations of good construction practices, but it is not written as specification or code requirements with the purpose of being enforced. Section 4.4.4 language need to be revised to be incorporated the recommendations as requirements in specification language, and adapted to the climatic conditions in Florida if concrete will be placed in summer.

Conclusion: Specification requirement to keep the forms continually wet during the curing period in hot weather is very good for hot weather concreting and shall be enforced. Providing protection from solar radiation is easy and highly desired.

7. Use of ASTM C150 Type I Cement vs. Type III Cement

Answer to the question: Why ASTM C150 Type I cement was specified and used instead of Type III cement, if high early compressive strength is required in the CR3 concrete replacement?

ASTM C150 "Standard Specification for Portland Cement" defines the eight types of cements, (I, IA, II, IIA, III, IIIA, IV and V) based on minimum and maximum physical and chemical requirements.

Type IV production was discontinued decades ago, and Types IA, IIA and IIIA are not produced since it is easier, more economic and more reliable to introduce air in a concrete mixture using air entraining admixtures rather than using these types of cement.

Type V cement and Type II cement conforming to the Optional Chemical and Optional Physical requirements are produced in a limited number of plants in the USA and Canada, were local conditions require their use.

At present, most of the cement plants produce only one cement that meet simultaneously the ASTM C150 requirements for Types I, Type II (No optional Requirements) and Type III.

The two cements for the CR3 concrete were selected based on their test results, with emphasis on a compressive strength of 3900 psi at 3 days. This strength compares well with the required minimum strength at 3 days of 3480 psi in ASTM C150 for Type III cement, and with the minimum required strength of 1740 psi at 3 days for Type I cement. The cement for CR3 is a Type I cement performing as good or better than a Type III cement, at the price of a Type I cement.

During the cement procurement phase of this project, the required minimum 3 days strength was reduced from 4000 psi to 3900 psi because of the cement availability and the assurance to meet the compressive strength required. Tests performed on the two cements selected exceed procurement requirements.

Conclusion: Results from tests performed on the two cements selected for the CR3 project exceed procurement requirements and Type III cement requirements in ASTM C150.