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December 23, 2009

Mr. Craig Miller
Progress Energy

Subject: **Report of Petrographic Observations
Crystal River Containment Wall
Steam Generator Replacement Project
Crystal River Nuclear Generating Facility, Florida
MACTEC Project 6468-09-2535**

Dear Mr. Miller

MACTEC Engineering and Consulting, Inc. (MACTEC) is pleased to present this report of our petrographic observations performed on a concrete chunk that was shipped to our laboratory under chain of custody. It is our understanding the chunk is from an area of the containment wall where a fracture was discovered running parallel to the surface at a depth of approximately 8 to 9 inches. We understand the submitted chunk contains the subject fractured surface and a portion of the concrete that was cast against a tendon duct.

The purpose of our work was to perform a petrographic analysis of the sample to observe the fractured surface and the surface that was cast against the tendon duct for depth of carbonation and other similarities or differences.

PETROGRAPHIC OBSERVATIONS

A Petrographic Analysis is a visual and microscopic analysis of cementitious materials performed by a qualified petrographer. Petrographic examinations are typically performed on polished sections or thin sections. Polished sections are generally cut sections that have been lapped (ground flat and smooth) and polished and are observed using reflected polarized light microscopes at magnifications of up to 80X. Thin sections are samples mounted to glass slides and ground to specific thicknesses (generally 20, 30, or 40 microns depending on the application) and observed using transmitted polarized light microscopes at magnifications of up to 600X.

A petrographic evaluation may be performed to identify and describe a specific item of interest such as the presence or extent of distress in concrete, or to provide a general characterization and measure of



**SUMMARY OF PETROGRAPHIC OBSERVATIONS
OF HARDENED CONCRETE – ASTM C-856-04**

PROJECT NAME	Crystal River Core Petrography Project
PROJECT NUMBER	6468-09-2535
DATE SAMPLED RECEIVED	12-2-09
SAMPLE I.D.	21378
SAMPLE SIZE AND DESCRIPTION AS RECEIVED	Chunk of Concrete identified as “small piece adjacent to sleeve”. The chunk has a section that appears to have been cast against a tendon duct and reportedly has a section of the subject fractured surface adjacent to the surface cast against the duct.
OBSERVATIONS BY	David Wilson

CHARACTERISTICS	OBSERVATIONS
COARSE AGGREGATE:	
Shape	Angular to sub rounded
Grading	Approximately ¾ maximum size
Distribution	Even. Approximately 50% of the aggregates appeared to be coarse aggregates with the remaining fraction being the fine aggregate.
Texture	Fine
Composition	Carbonate
Rock Types	Limestone, fossiliferous limestone
Alteration: - Degree - Products	Not observed
Coatings	Not observed
Rims	Not observed
Internal Cracking	Generally not observed except in the vicinity of the fractured surface.
Contamination	Not observed
FINE AGGREGATE:	
Shape	Generally sub-rounded to sub-angular
Grading	#4 and smaller



Distribution	Even
Texture	Fine
Composition	Siliceous
Rock Types	Quartz
Alteration: - Degree - Products	Not Observed
Coatings	Not Observed
Rims	Not Observed
Internal Cracking	A few internal fractures were observed
Contamination	Not observed

CHARACTERISTICS	OBSERVATIONS
CONCRETE:	
Air-Entrained or Not	Appeared to have some air entrainment. Total air content based on visual observations appeared to be 2 to 3%
Air Voids: - Shape - Size - Distribution	Mostly small and spherical. Some air void clustering was observed around a few coarse aggregate particles. The air void distribution was moderately uneven, some small areas lacked air entrainment. There was some limited mineral growth observed in some of the air voids. Calcium hydroxide was observed lining some air voids.
Bleeding	Not Observed
Segregation	Not Observed
Aggregate-Paste Bond	Coarse and fine aggregates appeared to have a good bond to the cement paste with few openings. Some aggregate particles had increased calcium hydroxide in the paste surrounding the perimeter of the particle.
Fractures	One long hairline crack was observed and is shown in the attached photograph #6. Some minor fractures were observed near the portion that was cast against the duct and the portion that contained the fractured surface.
Embedded Items - Shape	Not observed