



NRC-011-R

Combined License Application Review Levy Nuclear Plant Units 1 and 2

**Safety Panel
July 28, 2016**

Panelists

- **Don Habib – Project Manager**
- **Gerry Stirewalt – Senior Geologist**
- **Vaughn Thomas – Structural Engineer**
- **Boyce Travis – Reactor Systems Engineer**

Safety Panel Topics

- **Geologic and geotechnical site characteristics**
- **Roller compacted concrete foundation design**
- **Condensate return design change**

Key Topic - Voids Created by Dissolution of Limestone in the Foundation Rock Unit

- Applicant identified potential for subsurface voids created by dissolution of limestone in the foundation unit (Avon Park Formation, >40 million years old) as the primary geologic hazard at the site.**

Field Data on Void Dimensions

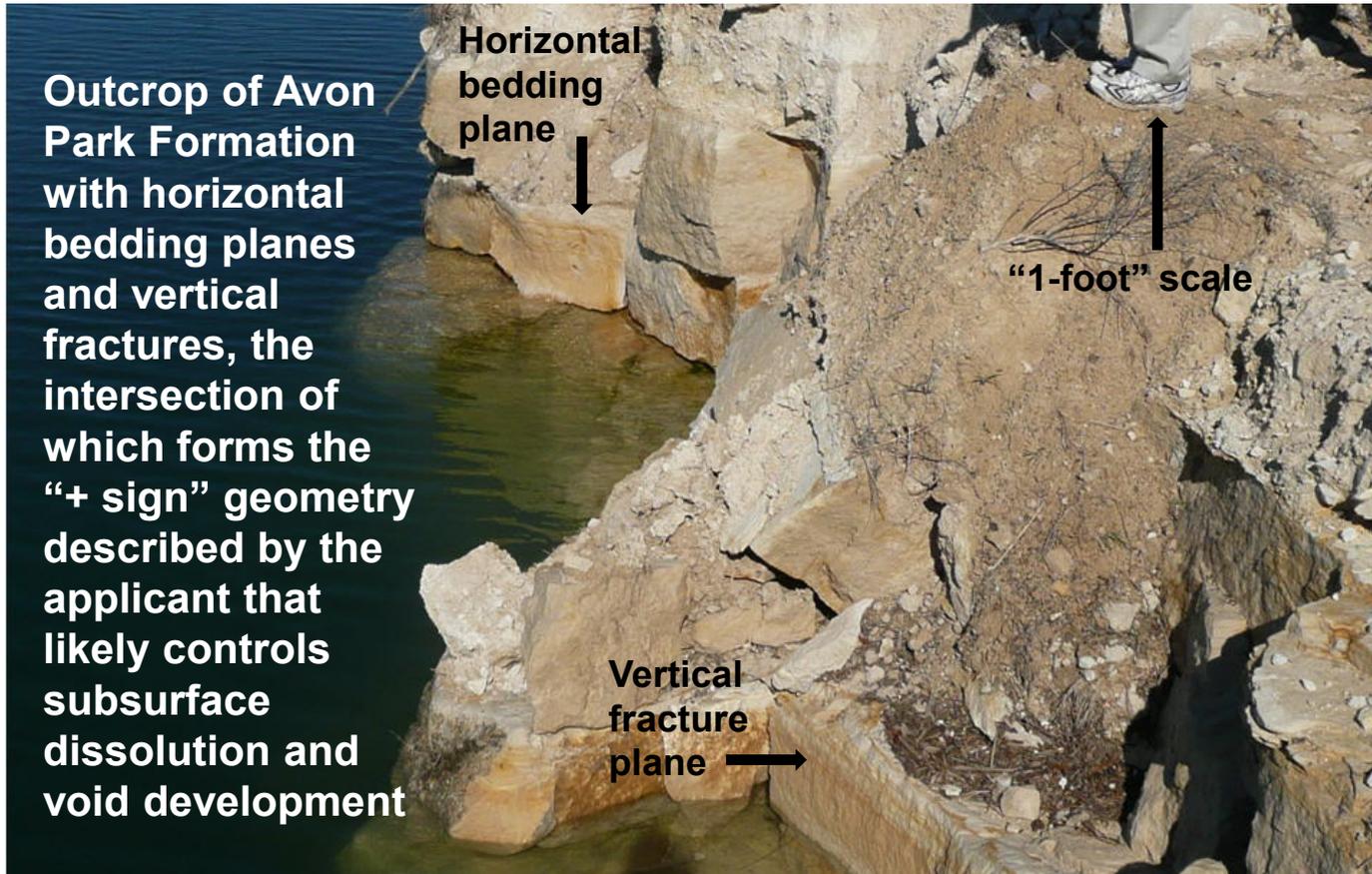
- **Applicant determined that dissolution voids in the Avon Park Formation were <1.5m (5ft) in vertical dimension [based on measured lengths of rod drops in boreholes] with a maximum horizontal dimension of 1.6m (5.3ft) [based on grout uptakes measured during grout testing].**

Staff Assessment of Potential for Dissolution Voids

- **Staff confirmed the applicant's characterization of voids by examination of sparse rock outcrops, borehole lithologic and geophysical logs, rock core, and grout uptake test data during site audits ... and review of select publications cited in the FSAR.**

Confirmatory Field Observations by Staff

Outcrop of Avon Park Formation with horizontal bedding planes and vertical fractures, the intersection of which forms the “+ sign” geometry described by the applicant that likely controls subsurface dissolution and void development



Examination of Avon Park Core Samples by Staff



Small disconnected dissolution voids.



Grouted fracture sealed against fluid flow during grout testing.

Staff Conclusions

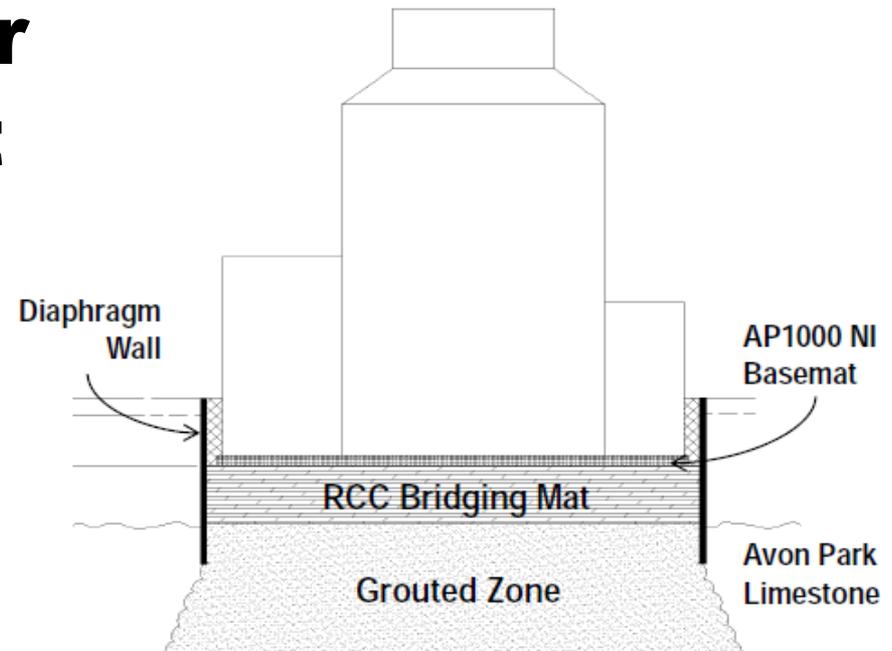
- **Field data support postulated maximum dimensions of dissolution voids in the Avon Park, and the interpretation that majority of voids are not more than 1ft in diameter.**
- **Subsurface voids will not detrimentally affect stability or suitability of the Avon Park.**

Staff Conclusions (Cont'd)

- **Grouting for groundwater control during construction (not safety-related and not credited in evaluation of safety) will likely reduce the size of, or seal, dissolution voids beneath safety-related structures and restrict flow of groundwater into foundation excavations.**

Roller Compacted Concrete (RCC) Foundation Design

- **6 foot thick AP1000 Nuclear Island Basemat**
- **35 foot thick RCC Bridging mat**
- **75 foot thick Grouted Zone**



RCC Foundation Design

- **The RCC design will follow standard industry guidance**
- **Nominal strength capacities are established during conceptual design phase using ACI 349-01, ACI 318-08 and USACE EM 1110-2-2006 guidance**

RCC Foundation Design

- **Finite Element Modeling of the RCC Bridging Mat was used to confirm capacities greater than expected design demands**
- **The applicant demonstrated that the stresses in the RCC bridging mat will remain within code allowable limits**

Construction of the RCC Foundation

- **The RCC construction will follow standard industry guidance**
- **The applicant provided a detail test plan describes the quality control and inspection to occur during construction**

Construction of the RCC Foundation

- **Post-COL RCC and bedding mix strength verification and constructability testing will be performed on a large test pad**
- **License Condition for post-COL RCC strength verification and construction testing**
- **ITAAC for RCC**

Condensate Return Design Change

- **In the event of a non-LOCA transient, AP1000 uses PRHR HX submerged in IRWST to cooldown**
- **For long term operation, water from IRWST boils to containment, and some is returned via gutters**

Condensate Return Design Change

- **Applicant determined analysis involving condensate return in certified design could not be met**
- **Proposed design change to improve guttering, add further routing to capture more water**

Condensate Return Design Change

- **Staff reviewed design change and new analysis against GDC 34**
- **Analysis accounts for increased condensate losses from testing**
- **Staff confirmatory analysis supports the results determined by applicant's analysis**

Condensate Return Design Change

- **Staff found the revised design meets requirements of GDC 34**
- **Containment peak pressure and Chapter 15 analyses not impacted**
- **Achieves 420 F in 36 hours**
- **Transition to open loop cooling via ADS maintained as backup**

Acronyms

- **ACI – American Concrete Institute**
- **ADS – Automatic Depressurization System**
- **FSAR – Final Safety Analysis Report**
- **GDC – General Design Criterion**
- **IRWST – In-containment Refueling Water Storage Tank**

Acronyms

- **ITAAC – Inspections, Tests, Analyses, and Acceptance Criteria**
- **LOCA – Loss of Coolant Accident**
- **PRHR HX – Passive Residual Heat Removal Heat Exchanger**
- **USACE EM – US Army Corps of Engineers Engineering Manual**