SOUTHERN COMPANY Westinghouse Shaw

Vogtle Units 3&4 Nuclear Island Basemat Design Increase to Specified Compressive Strength of Concrete

July 19, 2012

Meeting Agenda

- Background/Introduction
- Vogtle Basemat Design
- Proposed Licensing Approach
- Impacts of Change
- Conclusion

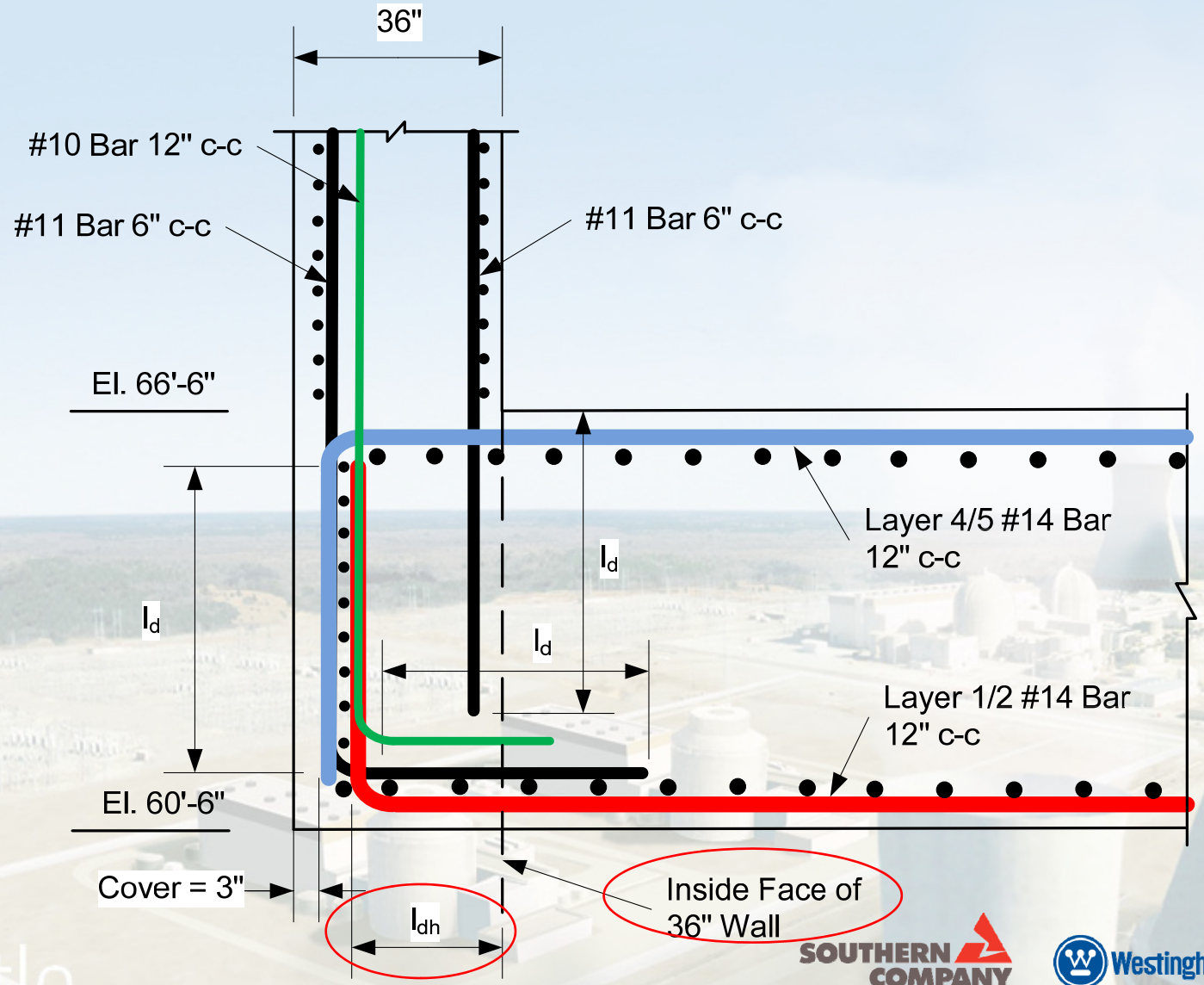
Background

- The basemat perimeter detail is illustrated in UFSAR Figure 3H.5-3
- The required standard hook development length of Layer 1 and 2 rebar is 32.1” for 4000 psi concrete
- The available Layer 1 and 2 standard hook development length is 29.5” due to rebar placement constraints caused by the MSE wall

Vogtle Basemat Design

- The required standard hook development length l_{dh} is specified in ACI 349-01 12.5.2
  - The two variables are the nominal rebar diameter and the specified compressive strength of concrete
  - Changing the specified compressive strength of concrete reduces the required development length for a given bar diameter
- The solution is to increase the specified concrete compressive strength of the basemat concrete from 4000 psi to 5000 psi
- The required l_{dh} for Layers 1 and 2 will then be developed within the inside face of the 36" wall

Vogtle Basemat Design



Calculation of Standard Hook Development Length

- Layer 1 and 2 consist of #14 rebar with a nominal bar diameter d_b = 1.693”
- The required standard hook development length l_{dh} is specified in ACI 349-01 12.5.2

  $l_{dh} = 1200d_b/(f'_c)^{½}$

  $l_{dh} = 1200(1.693”)/(5000)^{½} = 28.7”$

  $l_{dh(Required)} = 28.7” < l_{dh(Available)} = 29.5” \rightarrow$ OK
- Therefore, increasing the specified concrete compressive strength from 4000 psi to 5000 psi provides for an acceptable standard hook development length for Layers 1 and 2

Change Assessment

- Licensing
- Design
  - Seismic Analysis Considerations
  - Reinforcement Considerations
- Construction
  - Qualified mix

Licensing Basis Impacts

Changes to Licensing Basis

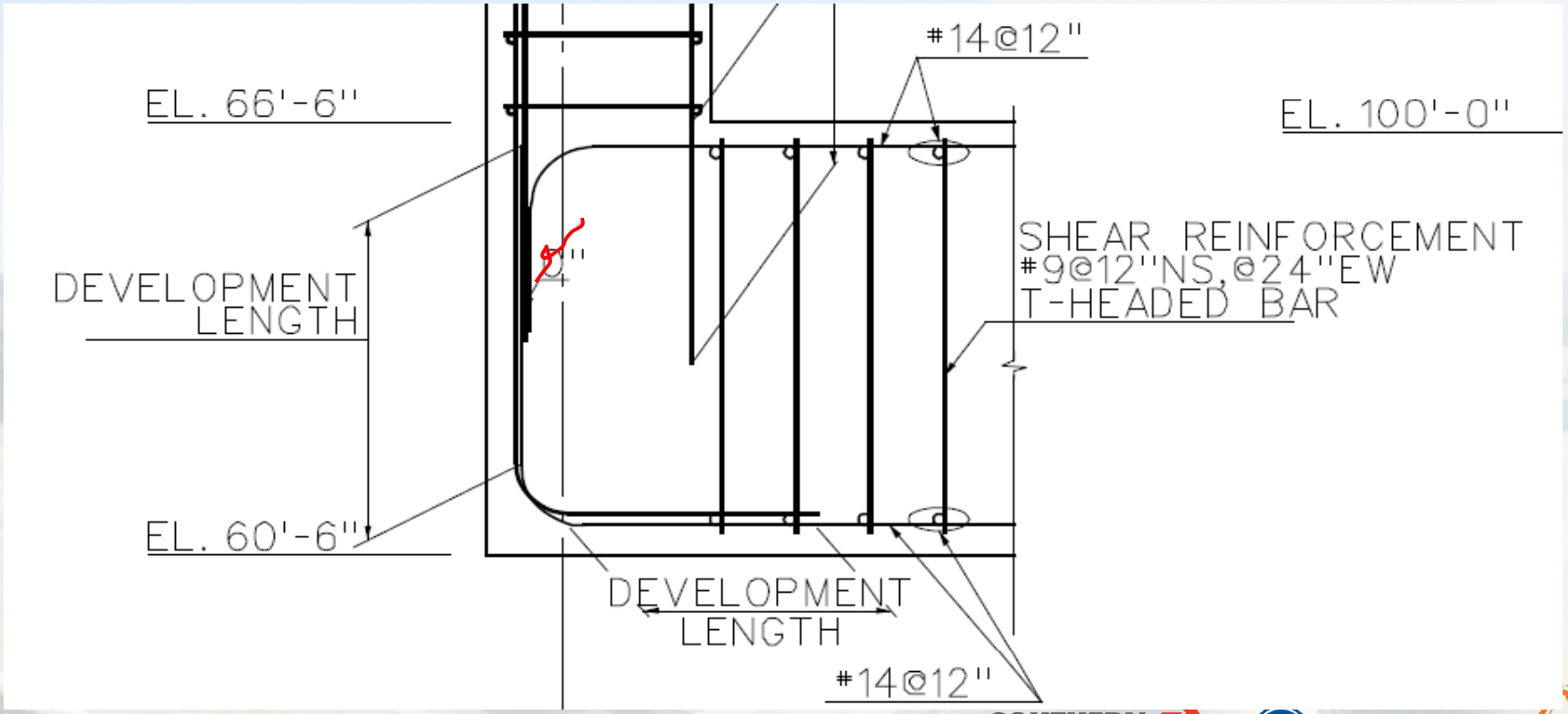
- FSAR 3.8.4.6.1.1 - Add 5000 psi concrete for basemat
- Preliminary FSAR Change

  3.8.4.6.1.1 Concrete

  – [*The compressive strength of concrete used in the seismic Category I structures and containment internal structures is f_c' = 4000 psi. For the nuclear island basemat the compressive strength of concrete is f_c' = 5000 psi. For the SC composite portion of the shield building structure including the connection region below the SC/RC interface and the shield building roof, the compressive strength of concrete is f_c' = 6000 psi.*]* The test age of concrete containing pozzolan is 56 days. The test age of concrete without pozzolan is the normal 28 days. Concrete is batched and placed according to Reference 6, Reference 7, and ACI-349.

Figure 3H.5-3

- With the use of 5000 psi concrete the reinforcement design is in conformance with Figure 3H.5-3



Changes to Licensing Basis

- No other design change to the basemat
- No change to longitudinal and shear reinforcement for basemat
- No change to analysis for bearing settlement sliding or overturning
- No change to mudmat, waterproofing, or backfill
- No change to seismic design spectra

No Change to Analysis Methods

- Basemat design is in compliance with ACI-349 including requirements for two way slabs
- No change to structural analysis method of basemat design
- No change to evaluation method for design spectra

Design Impact Considerations

Key Points for the Vogtle NI Basemat Design

- The current rebar configuration at Vogtle fully complies with ACI 349 two-way slab and Chapter 21 requirements using 5000 psi concrete for the basemat.
- The change from 4000 psi to 5000 psi concrete for the basemat has no effect on the Vogtle site specific spectra nor on the site specific soil pressures.
- The Vogtle basemat stresses are very similar for the 4000 psi and 5000 psi concrete basemat. The Vogtle basemat stresses are much less than the AP1000 basemat design stresses.

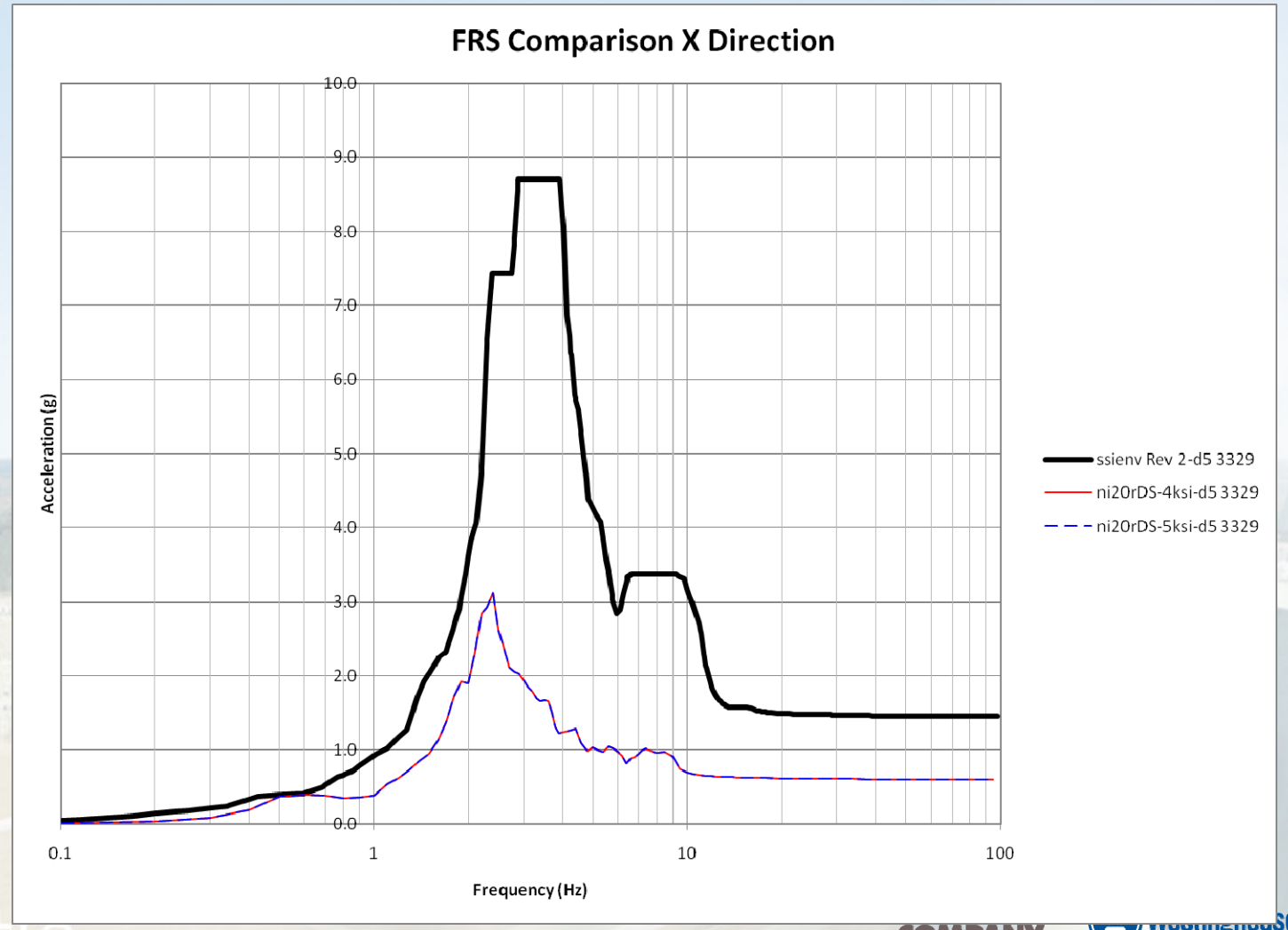
Basemat Design Methodology

- Basemat was designed using the ni05 ANSYS model by applying equivalent static accelerations based on the enveloping certified design soil conditions.
- The enveloping accelerations were used to conservatively represent the global seismic response that caused the basemat to uplift.
- An increase in concrete compressive strength results in an increase in moment and shear capacity of the basemat. No change in required minimum reinforcement.

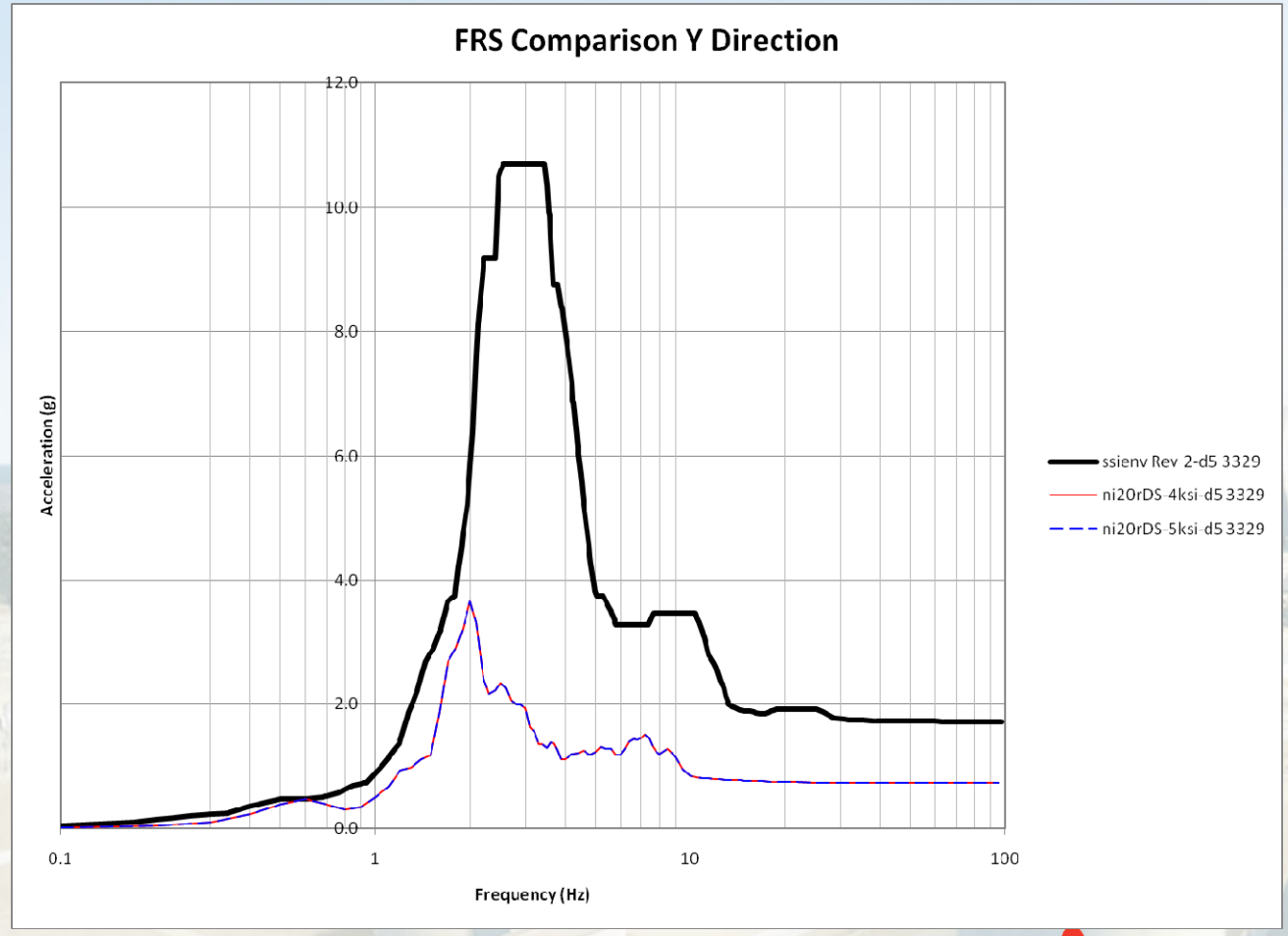
Sensitivity study of 5000 psi concrete basemat

- A sensitivity study was performed using both 4000 psi and 5000 psi concrete for the basemat in a soil-structure interaction analysis.
- The SASSI ni20 model was modified by changing the modulus of elasticity of the basemat shell elements to reflect the 5000 psi concrete, including Vogtle best estimate soil profile and seismic input.
- The Floor Response spectra for all six key locations was compared. There was no change in FRS. There was no change in the maximum accelerations.
- Since there are no instances where the generic maximum accelerations are exceeded, there is no effect on the generic analyses
- Since there is no change in the maximum accelerations, there is no effect on the seismic design margins.

Vogtle Site Specific Spectra at top of the Shield Building



Vogtle Site Specific Spectra at top of the Shield Building



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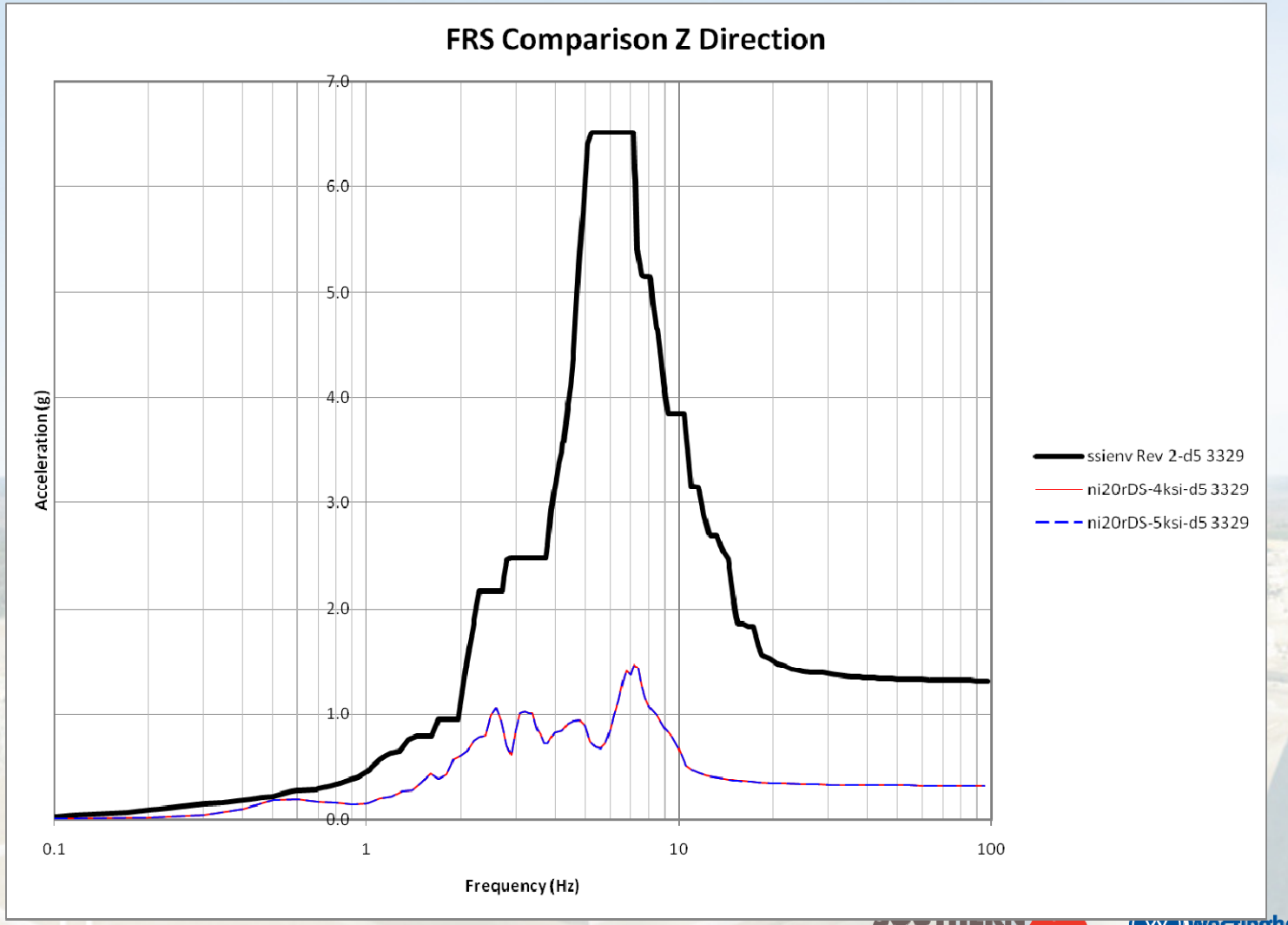
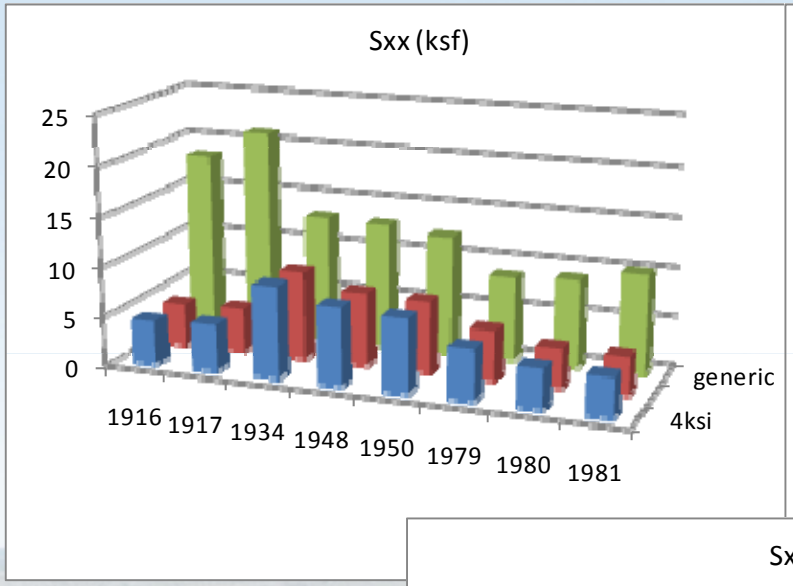
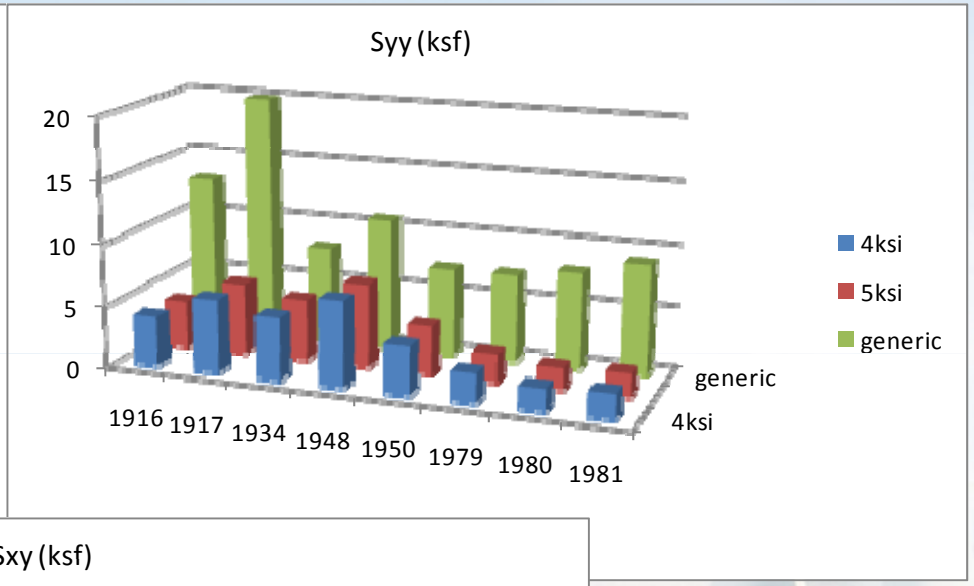
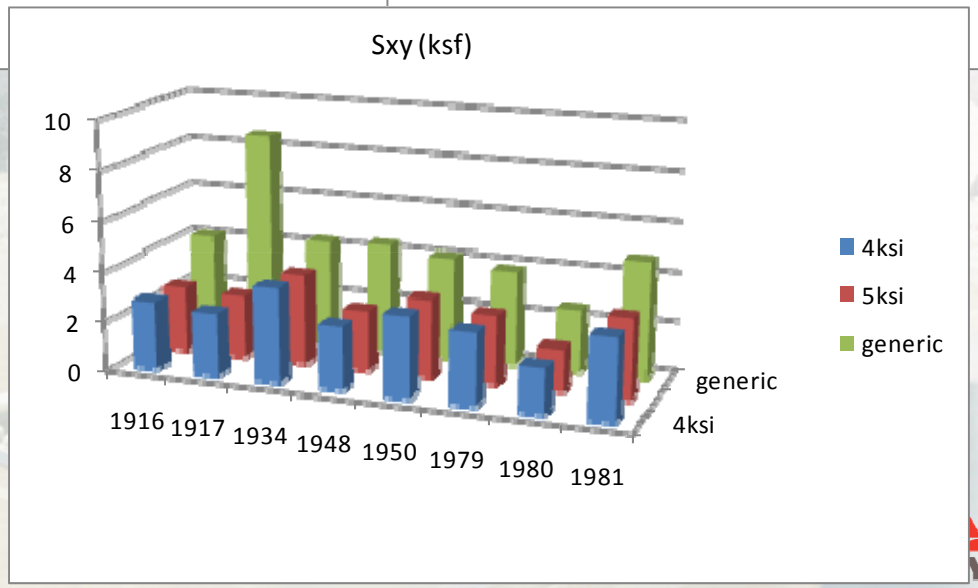


Comparison of SASSI basemat stresses







Similar Stresses for 4ksi and 5ksi basemat. Both are bounded by the generic envelope of all soil cases.

Design Summary

- The change to 5000 psi concrete
  - provides additional strength to the basemat
  - fully complies with ACI 349
  - has no effect on the Vogtle site specific spectra nor on the site specific soil pressures
  - provides very similar basemat stresses to the 4000 psi design and are bounded by the AP1000 basemat design stresses
  - has no effect on the basemat equivalent static analysis used for the basemat design.

Construction Considerations

Concrete Mix

- Concrete mix complies with the licensing basis requirements in the FSAR
- A 5000 psi mass concrete mix has been qualified and successfully field tested at Vogtle

Conclusion

- The change in the concrete strength for the basemat addresses ACI 349-01 code compliance.
- Next Steps and Schedule Request
  - Presubmittal Meeting Draft LAR – July 25th
  - Presubmittal Meeting – July 30th
  - Submittal – August 1st
  - PAR No Objection Letter – August 6th
  - Amendment approved – November