NOG-L Progress Update on Seismic and Wind Evaluation (URI 70-27/2012-006-01)

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Agenda

- Background
- Actions Taken
- Actions Planned
- Conclusion

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Background

NRC onsite inspection - February 27 through March 1, 2012

- The NRC Utilized Temporary Instruction, (TI) 2600/015 "Evaluation Strategies for the Prevention and /or Mitigation of Emergencies at Fuel Facilities"

- "*The inspectors determined that procedures and strategies credited by B&W NOG-L for responding to natural phenomena events were adequate to mitigate potential consequences.*"

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Background

"The inspectors were not able to verify earthquake and wind design specifications for existing buildings … which were constructed prior to International Building Codes adoption."

NRC issued URI 70-27/2012-006-01

" further evaluate whether the licensee is in compliance with the requirements of 10 CFR 70.62 (c) and the performance requirements of 10 CFR 70.61 regarding accident sequences that are a result of natural phenomena events."

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Actions Taken

- Entered URI in Preventative/Corrective Action System
- Determined Likelihood of Criticality Initiated by a Seismic Event
- Determined Probability of a Tornado Strike
- Reviewed and Analyzed Building Construction and Code Requirements
- Modeled Facility Response to Seismic and Wind Events

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Likelihood of Seismically Initiated Criticality

- Evaluation to Demonstrate Compliance with 10 CFR 70.62 (c), (iv), 10 CFR 70.61
- The NRC provides guidance relative to natural phenomena in NUREG-1520 Revision 1.
  - NUREG-1520 “Appendix D discusses acceptable ways for the ISA to address natural phenomena”
  - NUREG-1520, Appendix D “for natural phenomena, deterministically defined events… can also be applied to 10 CFR Part 70 facilities as ‘highly unlikely’ events. The actual probability (or likelihood) of such events may be difficult to define quantitatively and varies from site to site.”

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Likelihood of Seismically Initiated Criticality

- Utilized the following tools to determine likelihood
  - the U.S. Geological Services (USGS) data and tools,
  - guidance from NUREG-1520 endorsed methodology outlined in DOE-STD-1020 for existing facilities,
  - and the Chapter 3 ISA methodology to perform the additional site specific seismic evaluations for the NOG-L.

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Likelihood of Seismically Initiated Criticality

- USGS Tool For Assessing Likelihood of Earthquake
  - USGS 2009 Earthquake Probability Mapping (https://geohazard.usgs.gov.eqprob/2009/)
  - Conservatively used **minimum** intensity to cause damage using Modified Mercalli Scale (https://earthquake.usgs.gov/learn/topics/mag_vs_int.php)
    - MM VII - Damage negligible in buildings of good design and construction: slight to moderate in well built ordinary structures

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Likelihood of Seismically Initiated Criticality

- USGS Tool For Assessing Likelihood of Earthquake
  - Used comparative scale between intensity and magnitude
    - Minimum intensity MM VII equates to 5.0 - 5.9 on Richter Scale (https://earthquake.usgs.gov/learn/topics/mag_vs_int.php)
    - Magnitude 5.0 is conservative input to model (i.e. greater likelihood of occurrence); also input 10,000 years and a 50 km radius of the Facility

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Likelihood of Seismically Initiated Criticality

- USGS Tool For Assessing Likelihood of Earthquake
  - Based on Site Specific Analysis, Likelihood = 1 in 10,000 years or less (i.e. highly unlikely) for NOG-L

Richter Magnitude	Likelihood in 10,000 years (midpoint)	Richter Magnitude	Likelihood in 10,000 years (midpoint)
5.0 – 5.1	0.93	5.5 – 5.6	0.69
5.1 – 5.2	0.89	5.6 – 5.7	0.66
5.2 - 5.3	0.87	5.7 – 5.8	0.59
5.3 – 5.4	0.83	5.8 – 5.9	0.55
5.4 – 5.5	0.76	5.9 – 6.0	0.48

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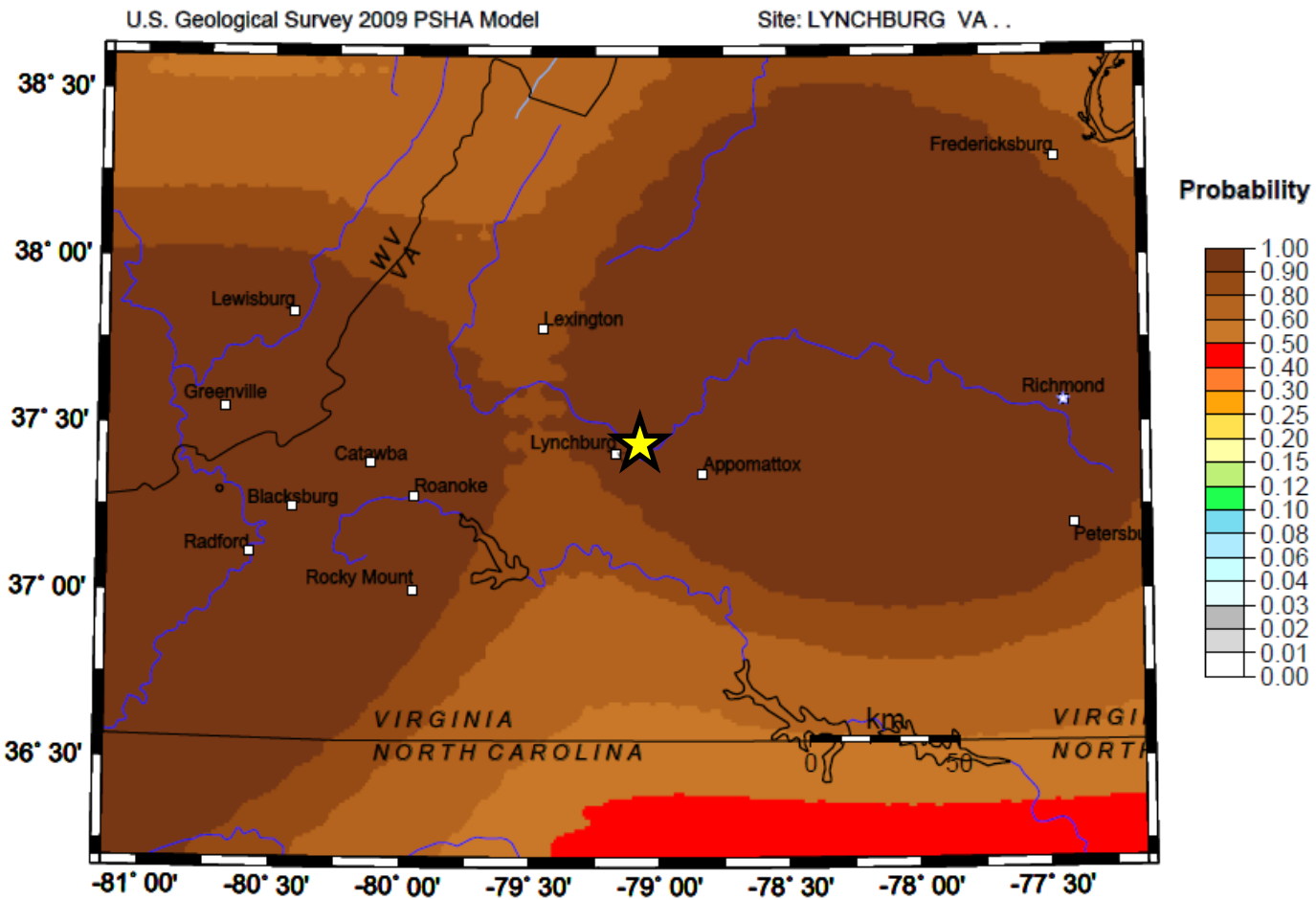
Likelihood of Seismically Initiated Criticality

Probability of earthquake with M > 5.0 within 10000 years & 50 km



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Likelihood of Seismically Initiated Criticality

- Utilized SNM-42, Chapter 3, ISA Likelihood and Consequence Analysis Methodology
  - The evaluation determined that the probability of an earthquake of sufficient magnitude to cause damage to internal or external structures is at least highly unlikely (1×10^{-4}/yr).
  - Likelihood of optimum spacing is 1 in 10 and the likelihood of optimum moderation is 1 in 10.

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Likelihood of Seismically Initiated Criticality

- Further, the probability of a criticality happening from such an event is incredible (1×10^{-6}/yr).

(1×10^{-4}/yr)	x	(1/10)	x	(1/10)	=	(1×10^{-6}/yr)
Seismic Event Initiator		Optimum Spacing		Optimum Moderation		Overall Likelihood

- Compliance with 10 CFR 70.62 (c) (iv) and 10 CFR 70.61 (d) demonstrated

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Probability of Tornado Strike

In the inspection report NRC noted that the method used by B&W NOG-L to evaluate the design basis for tornadoes, "*did not follow the guidance provided in NUREG/CR-4461 'Tornado Climatology of the Contiguous United States.'*"

- B&W NOG-L revised its evaluation of tornado wind speeds utilizing NUREG/CR-4461. The results did not affect the conclusion, but corrected a minor reference error (winds > 86 mph are 1×10^{-4}/yr, i.e. highly unlikely).

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Building Construction and Code Requirements

"The inspectors were not able to verify earthquake and wind design specifications for existing buildings …"

- Performed extensive effort to assemble all pertinent documentation and drawings on building design, year of construction and building code of record for buildings dating back to 1956.
- The compiled documentation clearly establishes the Licensing Basis for NOG-L.

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Modeling of Facility Response to Seismic and Wind Events

- To provide additional understanding of the effect of wind and seismic on existing structures built prior to 1973 (SBC)
  - Contracted Engineering Firm to perform structural analyses and modeling.

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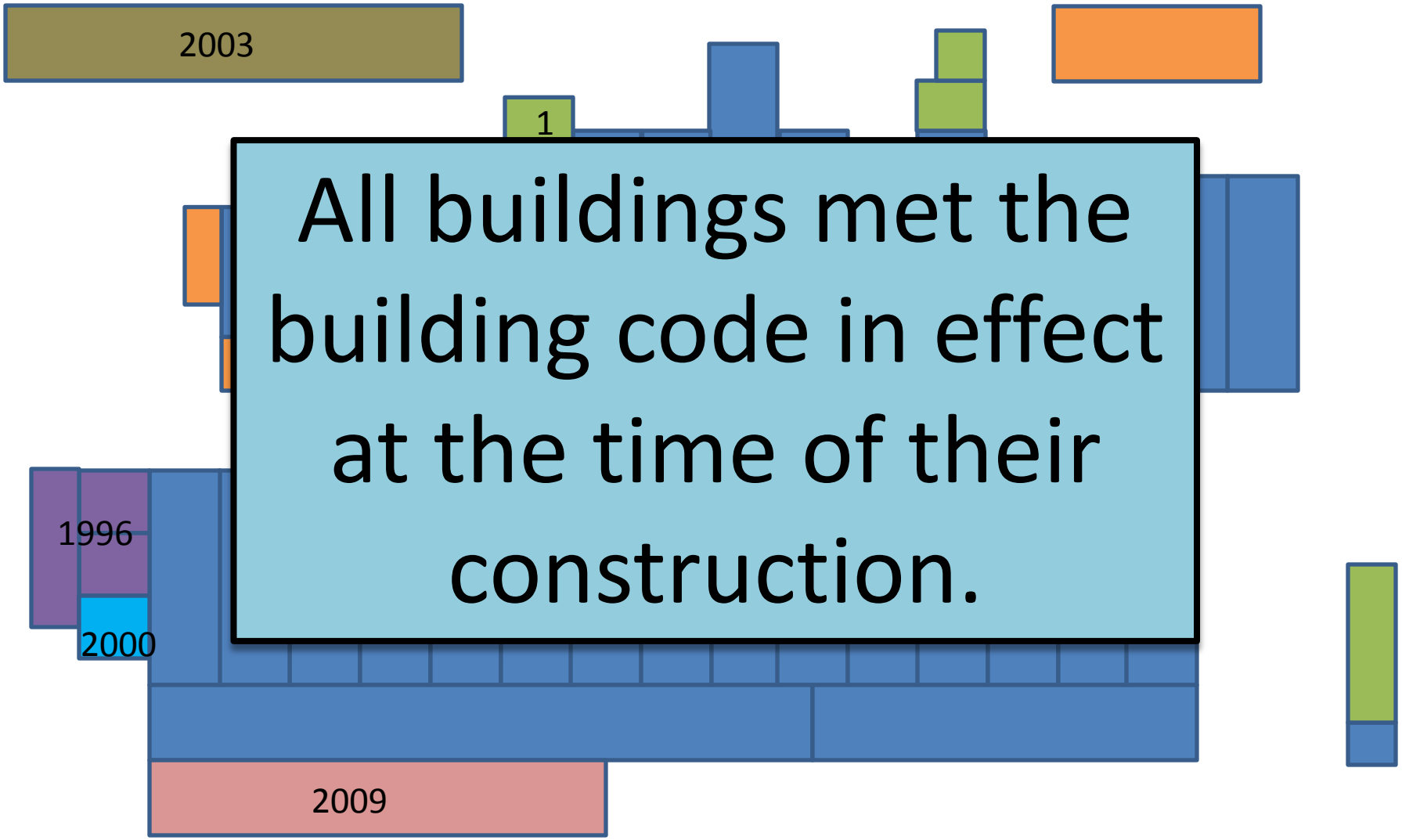
Building History (code in effect)



All buildings met the building code in effect at the time of their construction.

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Site Specific Building Code Comparisons

Year	Virginia Code	BOCA/IBC	Seismic S_A (% g)	Wind (psf)
Pre-1973	None	EOR used SBC	N/A	20
1973	VUSBC 1973	BOCA 1970	3.30	15
1982	VUSBC 1981	BOCA 1981	2.5	11
1991	VUSBC 1990	BOCA 1990	4.2	10.7
1997	VUSBC 1996	BOCA 1996	6.61	14.4
2003	VUSBC 2000	IBC 2000	6.6	14.8
2005	VUSBC 2003	IBC 2003	6.6	14.8
2011	VUSBC 2009	IBC 2009	8.3	14.8

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Modeling of Facility Response to Seismic and Wind Events

- To determine survivability (seismic and wind response) of the facilities when subjected to current code (IBC 2009), the Engineering firm modeled Main and “A” Bays constructed prior to 1973 (SBC).
  - Positive results –
    - Most Bays will survive an earthquake of the strength specified in IBC 2009 and allow safe evacuation of facility.
    - All Bays survive 90 mph wind specified in IBC 2009.

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Actions Planned

- B&W will review and document the licensing basis for the remaining facilities constructed prior to 1973 by 12/31/13.
- The ISA Summary will be updated with this information, as appropriate, and submitted to the NRC as required by 10 CFR 70 Subpart H. by 1/30/2014

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Conclusion

The actions taken and planned demonstrate compliance with 10CFR70.62 (c) and the performance requirements of 10 CFR 70.61 regarding accident sequences that are the result of natural phenomena events.

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