Presentation to the Early Site Permit Subcommittee of the Advisory Committee on Reactor Safeguards

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Safety Review of the North Anna Early Site Permit Application

Presented by
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Purpose

- Brief the Subcommittee on the North Anna early site permit (ESP) application and the status of the NRC staff's safety review of that application
- Support the Subcommittee's review of the application and subsequent interim Committee letter to the Commission
- Answer the Subcommittee's questions

Agenda

• Background	5 min
• Milestones	5 min
• North Anna ESP Application	10 min
• Plant Parameter Envelope Concept	10 min
• Draft Safety Evaluation Report (DSER)	10 min
• DSER Issues	10 min
• Future-Oriented Items	40 min
• DSER Conclusions	5 min
• Presentation Conclusions	5 min
• Discussion / Subcommittee questions	

Background and Regulatory Framework

- Subpart A to 10 CFR Part 52 governs ESPs
- Subpart B to 10 CFR Part 100 contains applicable siting evaluation factors
- 10 CFR 52.23 requires ACRS to report to Commission on portions of application that pertain to safety (i.e., Site Safety Analysis Report)
- Purpose of ESP process is to resolve issues related to siting at early stage
- North Anna is first of three ESP applications the NRC staff is currently reviewing - others follow at two-month intervals

Completed Milestones

- Dominion Nuclear North Anna, LLC (hereafter Dominion) submitted ESP application 9/25/03
- Staff docketed application 10/23/03
- Staff issued draft environmental impact statement 12/10/04
- Staff issued draft safety evaluation report (DSER) 12/20/04

Future Milestones

- ACRS interim letter to the Commission assumed 03/18/05
- Staff provides final SER (FSER) to ACRS late May 2005 (prior to final division director and Office of the General Counsel concurrence)
- Staff issues FSER 06/16/05
- ACRS letter to the Commission assumed 07/25/05
- Staff incorporates ACRS letter and issues FSER as NUREG 08/29/05
- Mandatory hearings begin fall 2005
- Commission decision assumed mid 2006

North Anna ESP Application

- Submitted for a site wholly within the existing North Anna Power Station (NAPS) site, adjacent to existing North Anna units 1 and 2 and partially overlaying site of canceled units 3 and 4 (partially constructed in early 1980s; most structures subsequently removed)
- NAPS is owned by Virginia Power and Old Dominion Electric Cooperative and controlled by Virginia Power
- ESP applicant, Dominion, is a wholly-owned subsidiary of Dominion Resources, Inc. (as is Virginia Power)
- Dominion seeks authorization for limited work in accordance with 10 CFR 52.17(c) and 10 CFR 50.10(e)(1)

North Anna ESP Application

- Dominion requests site be approved for location of two "units" of up to 4300 MWt
- Each unit may be one large reactor or multiple smaller reactors
- Dominion has chosen not to submit a specific design but instead has submitted a plant parameter envelope (PPE) based on a number of current and future reactor designs

ACR700	ESBWR
AP1000	ABWR
GT-MHR	IRIS
PBMR	

PPE CONCEPT

- Staff's review of PPE values in ESP applications limited to whether they are reasonable
- Applicant retains flexibility to choose a design at combined license (COL) or construction permit stage rather than at ESP
- ESP would not approve siting of any particular design
- Staff plans to include, in any ESP that might be issued for the site, PPE values used in ESP compliance demonstrations [e.g., source term, atmospheric dispersion factors (X/Q)]
- COL applicant will need to show that design falls within the PPE values specified in the permit or will need to show regulations have been met

North Anna ESP Application

- Unit 3 to use once-through cooling
- Unit 4 to use "dry" closed-loop (radiative) cooling to atmosphere to eliminate/minimize lake temperature increase and water demand on lake
- Underground ultimate heat sink (UHS) if design selected requires a UHS
- Dominion considering use of intake and discharge structure of canceled units 3 and 4
- Dominion seeks 20-year ESP term

DSER

- First ESP DSER
- Benefited from resolution of a number of generic issues prior to application submittal
- Review guidance is RS-002, "Processing Applications for Early Site Permits," which updates the site-related sections of NUREG-0800 and addresses ESPs
- Despite "up front" issue resolution reflected in guidance, some additional "generic" issues arose during application review and needed to be resolved during DSER development

Safety Review Areas and Lead Staff Reviewers

- Meteorology: Brad Harvey
- Hydrology: Goutam Bagchi (contract support from Pacific Northwest Laboratory) (PNL)
- Site Hazards: Kaz Campe (contract support from PNL)
- Geology/seismology: Cliff Munson (support from U.S. Geologic Survey)
- Demography/Geography: Jay Lee
- Emergency Planning: Bruce Musico (consultation with Federal Emergency Management Agency)
- Quality Assurance: Paul Prescott
- Physical Security: Al Tardiff
- Radiological Consequence Analysis: Jay Lee

Issues - Emergency Planning

- Dominion has elected to seek acceptance of "major features" of emergency plans as provided in 10 CFR 52.17(c)(ii)
- Concept is not defined in detail in regulations
- NRC/FEMA have issued draft guidance document, Supplement 2 to NUREG-0654
- Generic industry concern with degree of finality associated with major features
- Staff can grant finality as to the overall description but will need to address implementation details at COL

Issues - Seismic

- Dominion proposed new "performance-based" approach for determining safe shutdown earthquake (SSE)
  - Not entirely consistent with NRC-approved method in RG 1.165
  - ASCE Standard 43-05 describes this approach
  - Risk-based approach that targets performance goal
    - $1x10^{-5}$ annual probability of unacceptable performance of Category 1 systems, structures, and components
    - Target seismic risk based on core damage frequencies for existing nuclear power plants

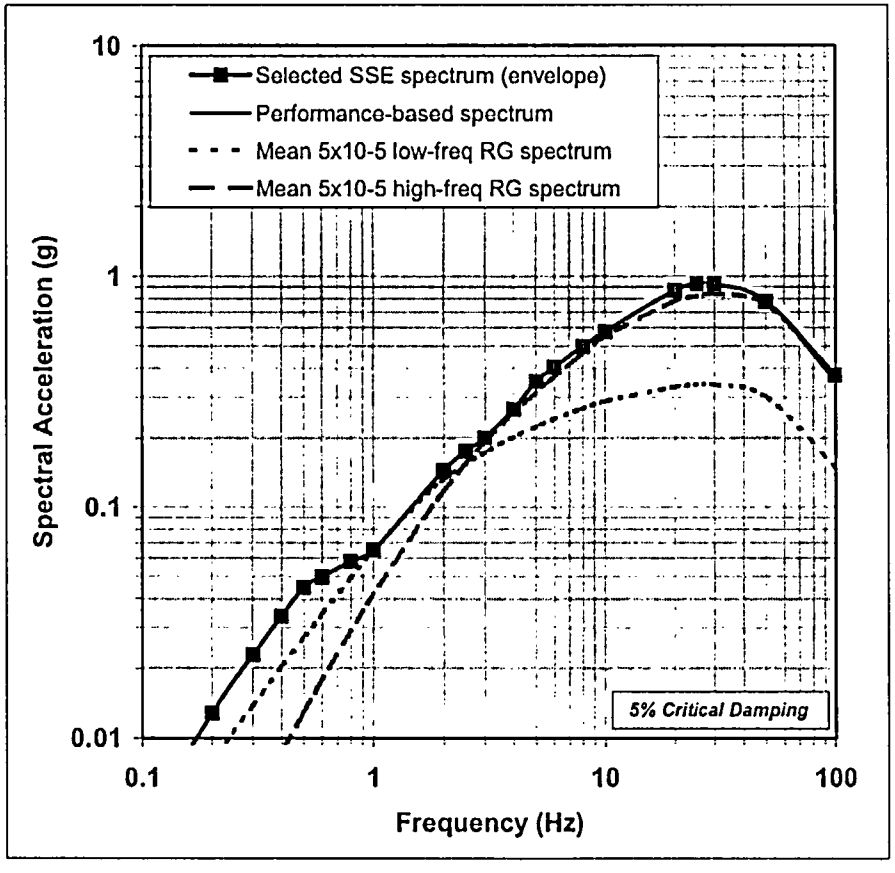
Issues - Seismic

- Because staff had not reviewed or approved the performance-based approach, staff advised Dominion that time required for review of this method would likely result in delay in issuance of staff's review products for the ESP application
- Applicant ultimately elected to use RG 1.165 method with justification for use of reference probability $5x10^{-5}$ per year

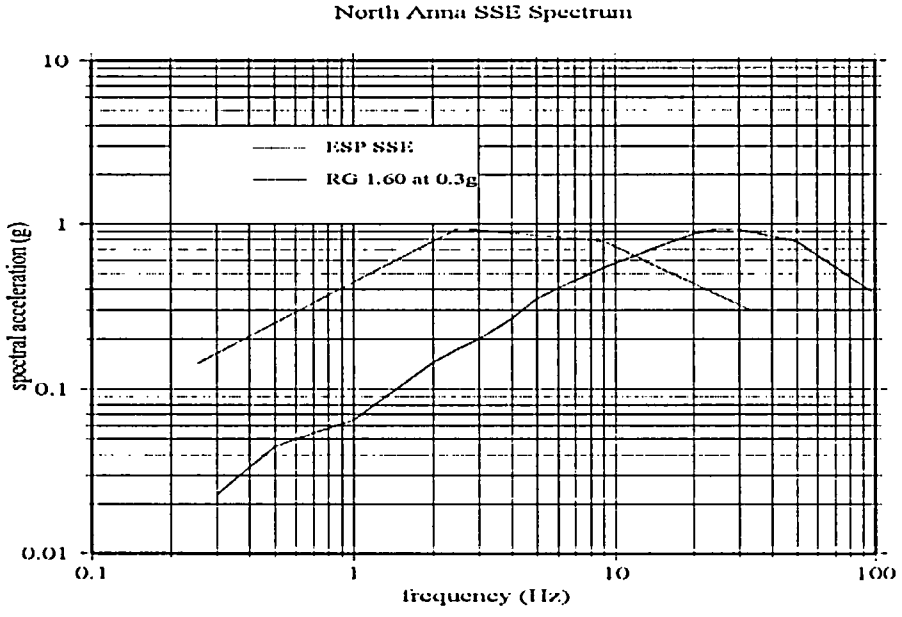
Issues - Seismic

- Because North Anna is a rock site, site SSE exceeds design SSE at high frequencies for designs certified to date
- COL applicant would need to resolve disparity if one exists (dependent on design selected)
- See SSE vs. RG 1.60 diagram

North Anna SSE



SSE vs RG 1.60


North Anna SSE Spectrum
ESP SSE
RG 1.60 at 0.3g
spectral acceleration (g)
10
1
0.1
0.01
0.1
1
10
100
frequency (Hz)

Issues - Site Characteristics vs Design Inputs

- 10 CFR 100.21(d) states:
  - The physical characteristics of the site, including meteorology, geology, seismology, and hydrology must be evaluated and site parameters established.
- General Design Criterion 2, while largely not required at ESP, states:
  - The design bases for these structures, systems, and components shall reflect: (1) Appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated…

Issues - Site Characteristics vs Design Inputs

- Issue is what is needed and/or appropriate at ESP
  - Staff has given Dominion credit for appropriate consideration of most severe natural phenomena including margin
  - Dominion concerned that ESP should not specify design bases, but rather may specify site characteristics that would serve as minimum site-related design inputs at COL

Issues - Design/Site Interface

- Several examples involving interface between site (intended to be subject of ESP) and design (intended to be subject of design certification and/or COL)
  - Potential interferences between new and existing plants
  - Potential underground UHS in presence of water table near surface
  - Potential for frazil and anchor ice
- These individual items will be discussed in later slides

Future-Oriented Items in DSER

- Open items – Staff needs additional information prior to developing FSER
- Confirmatory item – Staff needs to verify applicant's planned actions as stated in its responses to requests for additional information
- COL action items – Site-related items that are more appropriately addressed at COL stage
- Permit conditions – Conditions the staff proposes be imposed on holder of the ESP should one be issued

Open Items

- 2.1-1, Control of exclusion area
  - Applicant must have control over exclusion area or irrevocable right to obtain control
  - Legal issue being addressed in Office of General Counsel
- 2.3-1, Basic wind speed (fastest mile)
  - Dominion used 100-year return fastest mile value from industry standard
  - Observed data point exceeds 100-year return from standard
  - Dominion has chosen to provide 100-year return 3-second gust in lieu of fastest mile

Open Items

- 2.3-2, Snowpack weight vs snow load
  - Regulatory Guide 1.70 states weight of 100-year snowpack and 48-hour probable max winter precipitation (PMWP) should be used to provide weight of snow and ice on safety-related structures
  - Staff branch technical position provides clarification:
    - Normal winter precipitation load should be weight of 100-year snowpack
    - Extreme winter precipitation load should be weight of 100-year snowpack plus 48-hour PMWP
  - Dominion plans to provide 100-year snowpack, 48-hour maximum snowfall, and 48-hour winter PMP
  - COL applicant will determine how to combine these characteristics for comparison with design for extreme environmental load category unless otherwise justified

Open Items

- 2.3-3, Site characteristic to assess potential for freezing in UHS
  - Dominion plans to submit accumulated degree-days below freezing
  - Issues remain regarding choice of weather station and methodology for calculating
- 2.3-4, Impact of dry cooling on atmospheric temperature
  - Dominion plans to provide qualitative or semi-quantitative assessment
  - Approach recognizes system not designed
- 2.4-1, Coordinate reference system
  - Dominion plans to submit reference system and units of measure

Open Items

- 2.4-2, Minimize distance to existing systems, structures, and components (SSCs)
  - Existing NAPS Units 3 and 4 discharge tunnel likely within 1 foot of Units 1 and 2 service water piping
  - What will happen if COL applicant finds it cannot use existing structure?
  - Dominion states:
    - Not feasible or necessary to specify vertical separation distance
    - Only one of many examples of possible interferences that can and will be addressed at construction stage
    - 10 CFR 50.59 review of changes provides protection for operating plant

Open Items

- 2.4-3, Impacts of low-flow conditions
  - Dominion plans to propose minimum lake level same as for NAPS units
- 2.4-4, Ice jam formation and breakup
  - Dominion plans to show impact bounded by already-analyzed impact of breach of upstream dams
- 2.4-5, Minimum intake water temperature
  - No clear quantitative site characteristic regarding frazil ice
  - Dominion plans to note in application that frazil ice conditions could occur at the site
  - COL applicant would need to describe engineered measures to handle frazil ice

Open Items

- 2.4-6, Stability of underground UHS against ground water pressure head
  - Water table near surface, could lift empty or partially full UHS
  - Absent construction details, would have site characteristic for groundwater elevation
- 2.4-7, Correlate ground water level measurements taken in support of the ESP application with data from long-term piezometers
  - Dominion states they do not correlate well (different purposes and locations)
  - Need to show post-drought data not anomalous
  - Dominion plans to take additional data
  - Dominion will need to assess impact of lack of correlation

Open Items

- 2.4-8, Conservative hydraulic conductivity
  - Dominion plans to provide more conservative method
- 2.4-9, Upward hydraulic gradients
  - Dominion plans to show such gradient is small fraction of horizontal flow and bound its impact
- 2.4-10, Variation in hydraulic gradient
  - Dominion plans to provide additional seasonal data
- 2.4-11, Onsite measurement of adsorption and retention coefficients
  - Dominion plans to use onsite measurements of soil conditions and a lookup table from the Environmental Protection Agency to determine coefficients

Open Items

- 2.5-1, Criteria for ground motion model weighting in the model clusters for the EPRI 2003 ground motion evaluation
  - Dominion has responded to this item
  - Staff has questions regarding evaluation
    - Heavy weighting in one cluster for three ground motion models
    - Seismic attenuation parameter for three models in one cluster
    - Criteria for overall weighting for clusters not clearly explained

Open Items

- 2.5-2, Incorporate site-specific geologic properties and their uncertainties into the determination of safe-shutdown earthquake (SSE)
  - Dominion plans to determine SSE at hypothetical rock outcrop consistent with NRC guidance and determine transfer function
  - Dominion has provided method to staff, and staff has no questions on it

Open Items

- 13.3-1, Offsite laboratories
- 13.3-2, Orange County emergency notification program
- 13.3-4, Reliance on DOE for plume tracking
- 13.3-5, Various additional details on offsite emergency response measures
- 13.3-7, Guidance and authority for exceeding exposure limits
- 13.3-8, Capabilities of hospital and emergency services
- 13.3-9, Qualification for directors of emergency response
- 13.3-10, Cross-references to NUREG-0654 Supplement 2 and review of Orange County emergency response program

Applicant has provided information to address the above open items, and staff has no additional questions on them

Open Items

- 13.3-3, Adequacy of technical support center, emergency operations facility, and operational support center
  - Applicant does not plan to provide details on these subjects and plans to withdraw request for the associated major feature
- 13.3-6, Additional information on evacuation time estimate (ETE)
  - Applicant referenced existing NAPS ETE
  - Staff has a number of questions on details of the plan
  - Dominion is reviewing document against staff questions

COL Action Items

- Identify/highlight work needed at COL
- Similar to established concept in design certifications
- Regulatory standing under discussion (unlike design certification, not written into a rule)
- Not all-inclusive
- Applicant believes some are unnecessary when already required by regulations
- Specific items in backup slides
- Based on staff's evaluation of open item responses, some of these items may be changed or deleted in FSER

Proposed Permit Conditions

- Should an ESP be issued for the site, NRC staff believes the ESP holder needs to be constrained by these conditions
- Based on staff's evaluation of open item responses, some of these items may be changed or deleted in FSER
- May also reclassify some of these as COL action items
- Dominion plans to identify technical concerns with some of these items

Permit Conditions

- 2.1-1, Obtain authority to restore site before undertaking limited work activities
- 2.4-1, Maintain minimum separation distance from NAPS SSCs
  - This item likely to be revised based on Dominion's response to open item 2.4-2
- 2.4-2, Maximum water budget
  - Dominion believes minimum lake level is adequate limit

Proposed Permit Conditions

- 2.4-3, Design slopes based on drainage without need for engineered drainage systems that can be blocked
- 2.4-4, Locate safety-related facilities above maximum water level from local intense precipitation
- 2.4-5, Minimum free-surface elevation of UHS
  - This item may be revised based on applicant's response to open item 2.4-6
- 2.4-6, Minimum UHS storage capability
- 2.4-7, Design UHS capacity to address potential for freezing

Proposed Permit Conditions

- 2.4-8, No reliance on Lake Anna for safety-related water supply
- 2.4-9, Locate ingress/egress opening for safety-related SSCs above 271 ft MSL
- 2.4-10, Provide erosion protection for slopes at intake
- 2.4-11, No compromise of flood control measures for existing NAPS units during construction of new units
- 2.4-12, Locate new units where ground water level does not exceed 270 ft MSL
  - Dominion believes appropriate condition is distance above water table

Proposed Permit Conditions

- 2.5-1, Replace fractured/weathered rock at foundations
- 2.5-2, Perform additional borings to identify weathered or fractured rock at foundations
- 2.5-3, Do not use saprolite as engineered fill
- 2.5-4, Perform geologic mapping of future excavations for safety-related facilities
- 2.5-5, Improve Zone II saprolitic soils if locating safety-related structures on them

DSER Conclusions

- DSER defers general regulatory conclusion regarding site suitability to FSER after open items addressed
- Some conclusions from individual sections without open items
  - Applicant has provided appropriate quality assurance measures equivalent to those in 10 CFR Part 50 Appendix B
  - Site characteristics are such that adequate security plans and measures can be developed

DSER Conclusions

- Additional conclusions from individual sections without open items
  - Population center distance, as defined in 10 CFR100.3, is at least one and one-third times the distance from the reactor to the outer boundary of the low population zone and compliant with 10 CFR 100.21(b) and (h)
  - Applicant has established appropriate atmospheric dispersion characteristics to support radiological calculations
  - Based on PPE and site characteristics, site meets radiological dose consequence criteria in 10 CFR 50.34(a)(1)

DSER Conclusions

- Additional conclusion from individual section without open items
  - Potential hazards associated with nearby transportation routes, industrial and military facilities pose no undue risk to facility that might be constructed on the site

Presentation Conclusions

- Staff has issued first-of-a-kind DSER for North Anna ESP application
- Most open item responses expected by March 3, 2005
- Because of first-of-a-kind nature of this action, staff is working through some issues identified during the review
- Looking forward to seeing interim ACRS letter and to briefing the Subcommittee and the full Committee this summer on final results of staff's review of this application
- Staff is identifying lessons learned for possible inputs to future rulemakings and revisions to guidance

Backup Slides

COL Action Items

- 2.1-1, Specific unit locations
- 2.1-2, Agency control of water bodies within exclusion area
- 2.2-1, Hazards of nearby industrial area
  - Currently undeveloped
  - Zoning could permit hazardous operations in future
- 2.2-2, Design-specific interactions between NAPS and new facility
  - Depends on layout and design of new units

COL Action Items

- 2.3-1, Dispersion of radionuclides to control room
- 2.3-2, Release point characteristics and receptor locations for routine release dose computations
- 2.4-1, Restriction on operations posed by low-water conditions
- 2.5-1, Additional soil borings
- 2.5-2, Compare plot plans with subsurface profile and material properties
- 2.5-3, Submit excavation and backfill plans

COL Action Items

- 2.5-4, Evaluate groundwater impact on foundation stability and dewatering plans
- 2.5-5, Perform soil column amplification/attenuation analyses
- 2.5-6, Analyze stability of safety-related structures
- 2.5-7, Provide design-related structural criteria
- 2.5-8, Provide plans for ground improvement
- 2.5-9, Verify average shear-wave velocity of materials underlying containment

COL Action Items

- 2.5-10, Provide more detailed slope stability analysis
- 2.5-11, Provide plans for safety-related slopes
- 13.6-1, Provide designs for protected area barriers