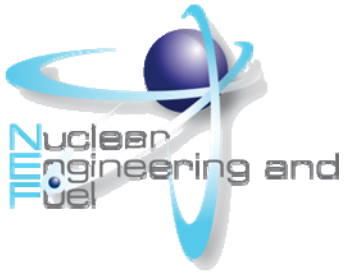
Surry Power Station
New Fuel Storage and Spent Fuel Pool Criticality Analysis
Proposed License Amendment Request

NRC Pre-Submittal Meeting

May 13, 2021



Agenda

- Current Surry SFP Configuration
- Proposed Changes
- Analysis Methods
- Conservatism
- Conclusion/Timeline
- Criticality Analysis Checklist

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Current Spent Fuel Pool Configuration

- One rack design, 2 regions
  - Maximum fuel enrichment: 4.3 wt. % U-235
  - Racks have a large cell pitch (14 inch pitch)
  - No neutron absorber material
  - Region 1
    - 4-out-of-4 pattern with burnup credit
    - Susceptible to cask drop accident
  - Region 2
    - 4-out-of-4 pattern with no burnup credit

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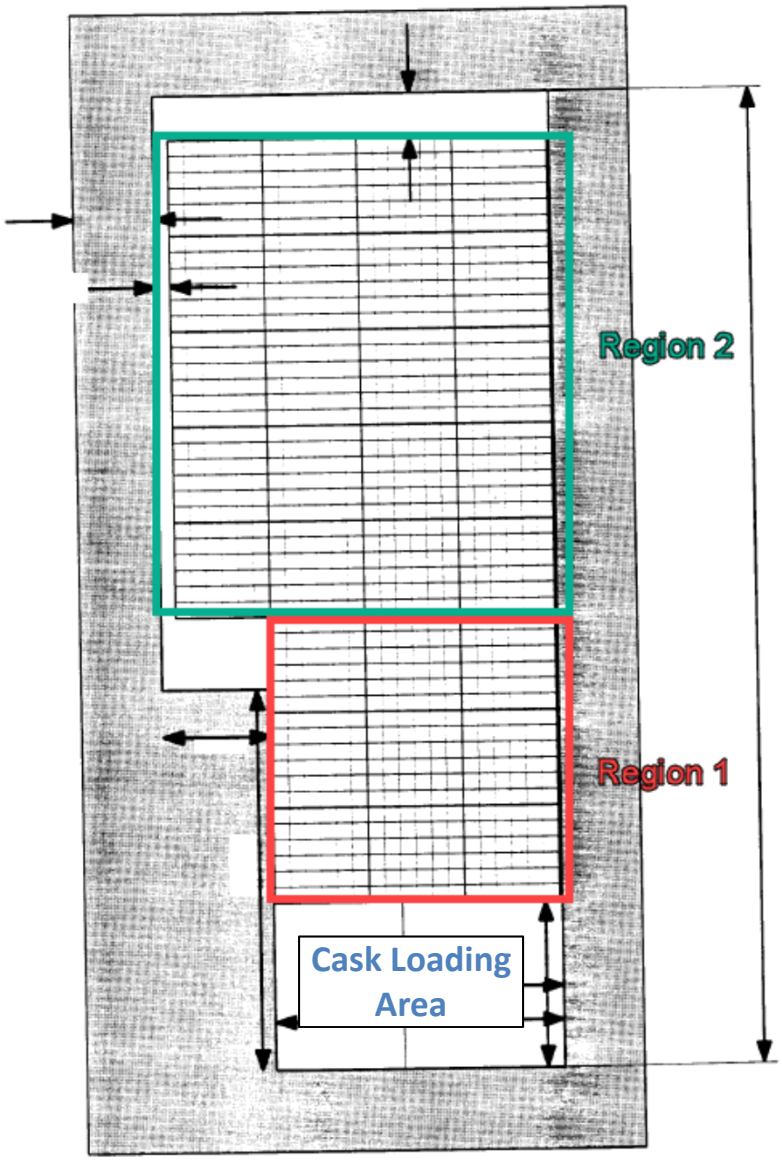
Current Spent Fuel Pool Configuration



Current Spent Fuel Pool Configuration

- SFP boron concentration $\geq$ 2300 ppm
  - Technical Specification limit
  - Boron credited only for accident conditions
    (No dilution accident analysis. $k_{eff} \leq 0.95$ with unborated water)

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Proposed SFP Changes and Goals

- Increase maximum enrichment to 5.00wt%
- Update analysis
  - Includes items identified in Reg Guide 1.240 (NEI 12-16)
  - Brings analysis and codes in-house
- Add soluble boron credit for normal and accident conditions
  - $k_{eff} \leq 1.00$ when flooded with unborated water
  - Introduces boron dilution analysis
  - Maintains SFP Tech Spec minimum soluble boron (2300 ppm)
- Add gadolinium burnable absorber into the Licensing Basis
  - Added to code benchmarking analysis and explicitly modeled in depletion
- Increase identified analysis margin
  - NRC and Dominion Energy margin partitioned

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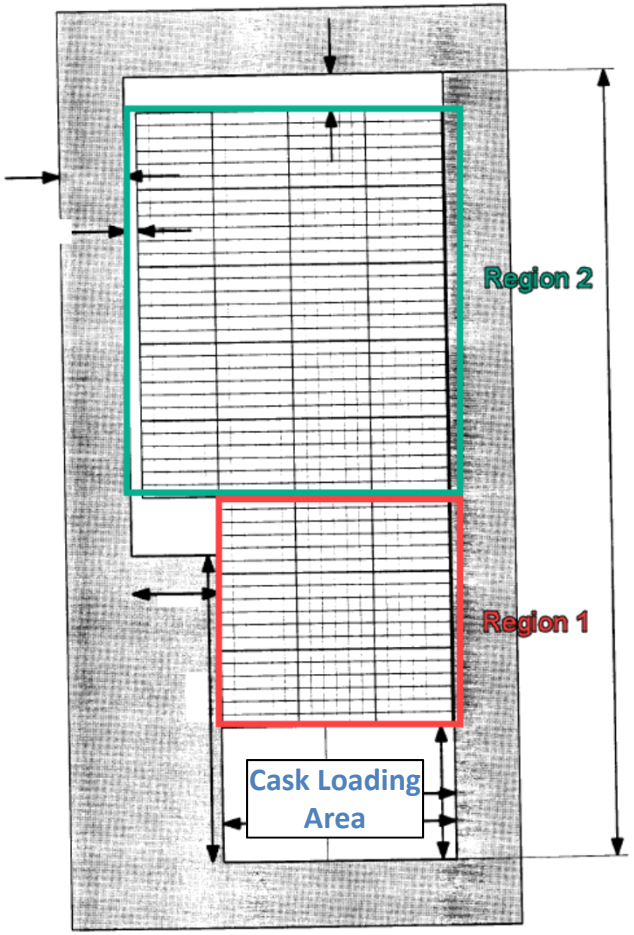
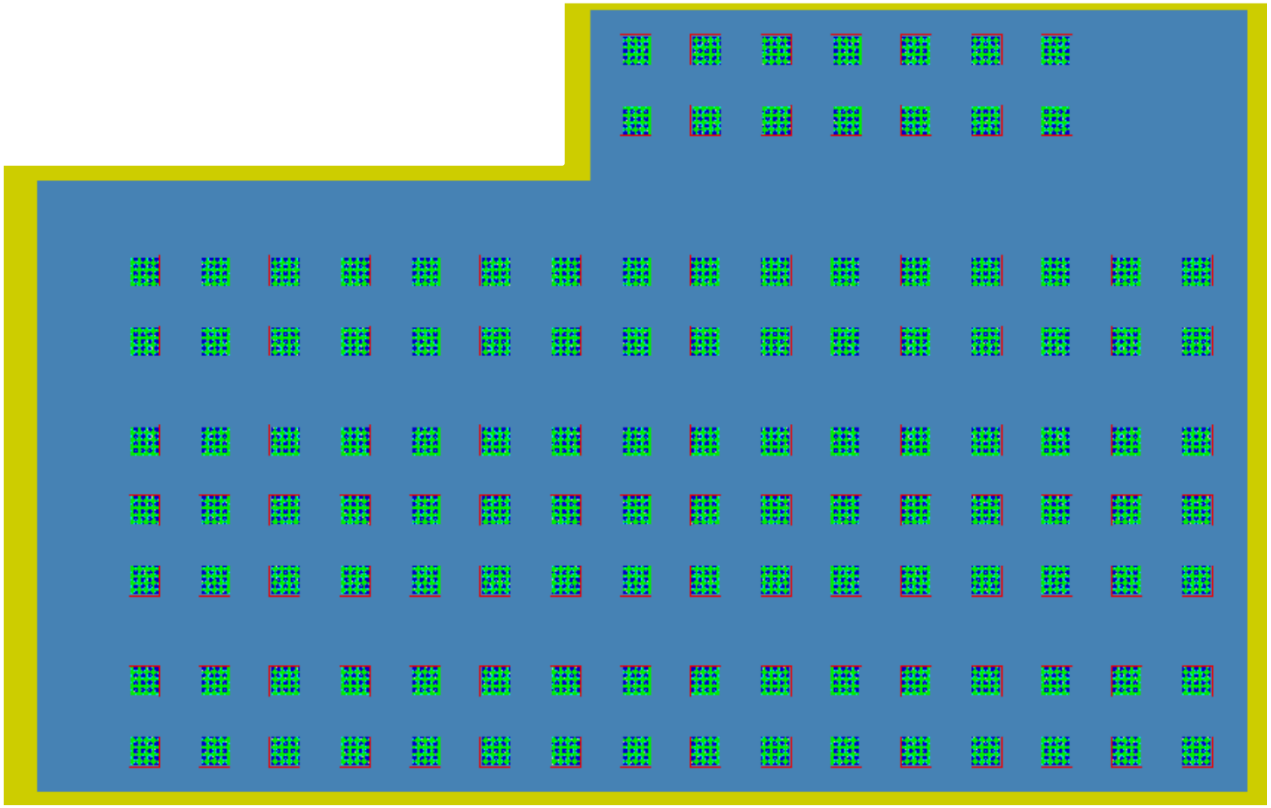
Proposed SFP Changes and Goals



- Maintain the 2 region configuration
  - Region 1: 4 out of 4 with updated burnup curve
  - Region 2: 4 out of 4 without burnup curve

Current New Fuel Storage Area Configuration

- Maximum fuel enrichment: 4.3 wt. % U-235
- No empty cells required or burnable absorber credited



Proposed New Fuel Storage Area Changes and Goals

- Two storage configuration options
  - All cells used when all fuel is enriched to ≤4.35wt%
  - Required empty cells when any fuel is enriched to >4.35wt% (3-out-of-4 storage geometry)
- Update analysis
  - Includes items identified in Reg Guide 1.240 (NEI 12-16)
  - Same computer codes as SFP analysis
- Increase identified analysis margin
  - NRC and Dominion Energy margin partitioned

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Proposed New Fuel Storage Area Changes and Goals

- 3 out of 4 Configuration ("X" locations are required to be empty)

Analysis Methods

- SCALE 6.2.3 with ENDF/B-VII 238 group cross section data
  - KENO-V.a criticality calculation
  - TRITON / T5-depl (KENO-V.a) fuel depletion
  - ORIGAMI fuel decay
  - New code benchmarking analyses
    - NUREG/CR-6698 used for criticality code analysis
    - EPRI Benchmark and Utilization Reports used for depletion code analysis
- Consistent with RG 1.240 (NEI 12-16)

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Analysis Methods

- Boron dilution analysis
  - Supports incorporation of soluble boron credit
  - Identifies water sources, flow rates and volumes
  - Calculates dilution times
  - Discusses means of detection and mitigation
  - Starting and ending soluble boron conservatively bounded by criticality analysis boron
    - Boron required for normal storage ≥ 350 ppm
    - Technical Specification boron ≥ 2300 ppm

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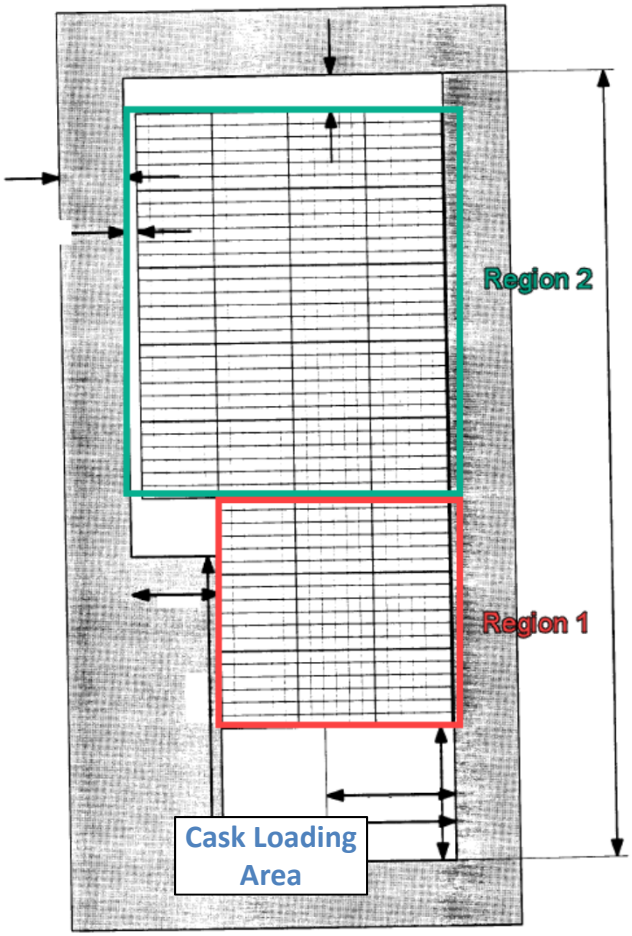
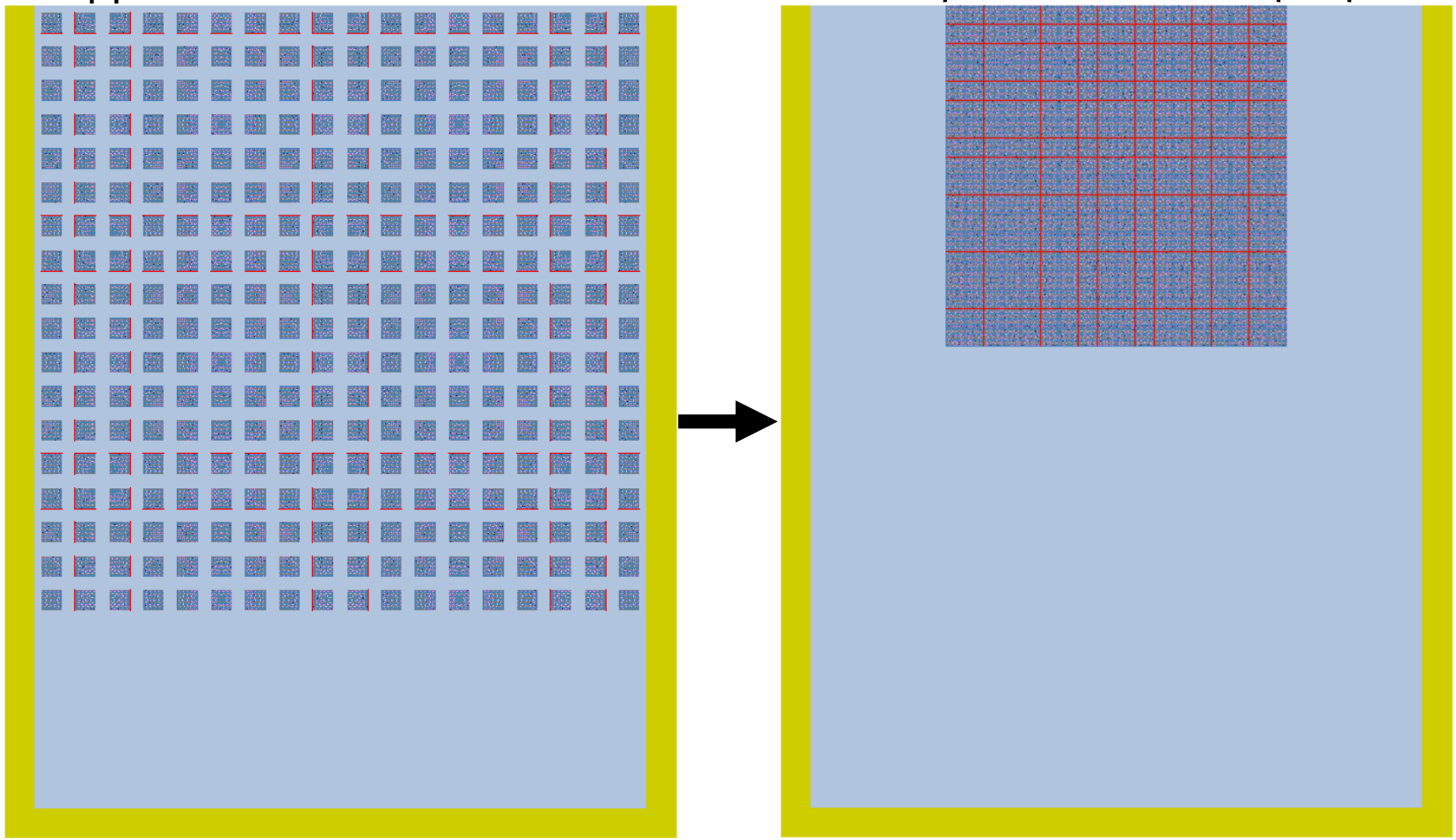
Cask Drop Accident

- Cask Drop Accident
  - No wall between the cask loading area and fuel racks
  - Assumes cask is dropped and tips over.
  - Mechanical analysis shows two rows of 6x6 rack modules will be damaged.
  - The current Analysis of Record:
    - CSA conservatively assumes 3 rows of rack modules are damaged
    - CSA assumes racks are deformed to optimum pitch
  - New CSA additionally assumes fuel pins are deformed to optimum pitch



Cask Drop Accident

Dropped cask deforms racks and assemblies to optimum rack and pin pitch



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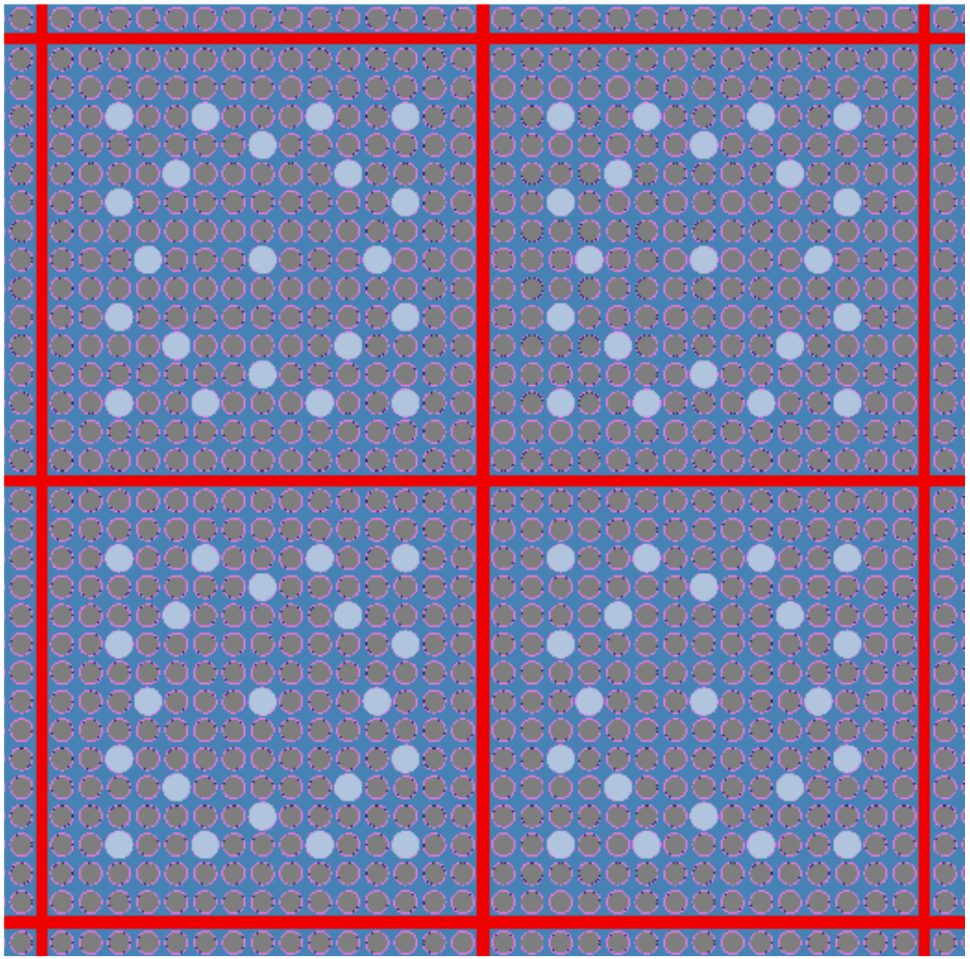

Misload Accidents

- Single and multiple misload accidents are NOT analyzed because they are bounded
  - Region 2 allows storage of fresh assemblies with the maximum allowed enrichment in every cell.
    - There cannot be a Region 2 misload since no credit is taken for burnup, fuel storage geometry, reduced enrichment, etc.
  - A Region 1 misload would be equivalent to Region 2.
    - The only difference between the two regions is that Region 1 (i) is susceptible to the cask drop accident and (ii) credits burnup
    - The cask drop accident and the misload accident are independent events
    - A misload of fresh fuel would be equivalent to Region 2

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Conservatism

- Conservative modeling (e.g. no axial blanket credit, no decay credit)
- NRC administrative margin of 0.01 ΔK reserved to account for minor methodology issues and uncertainties
- Identify Dominion retained margin to allow for future fuel changes and/or methodology issues

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Conclusion / Timeline

- Surry SFP and new fuel rack criticality analysis License Amendment Request
  - Increase maximum allowable enrichment
  - Include gadolinium into our Licensing Basis
  - Add soluble boron credit
  - Update methods with RG 1.240
  - Bring computer codes and method in house
  - Increase identified margin

- Major milestones:
  - Submit LAR to NRC Q3 2021
  - Receive SER Q4 2022
  - Implement new TS Q1 2023

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Criticality Analysis Checklist

- See attached completed checklist
- Includes placeholders for analysis Scope, Methods, and Details
- Some items not included or not applicable
  - Justification or explanation provided

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