eVinci™ Micro Reactor
Licensing Modernization Program Pilot

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Andrea Maioli

Fellow Engineer, Risk Analysis

Westinghouse Electric Company LLC

Acknowledgement & Disclaimer

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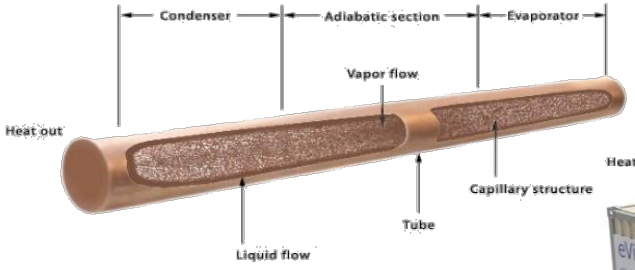
eVinci Micro Reactor Attributes

Heat Pipe Design



Reactor in CONEX Container

Attributes

- 1-2 MWe transportable energy generator
- Fully factory built, fueled and assembled in CONEX containers
- Passive heat pipe technology
- 40 year design life with 3+ years continuous power
- No operator action
- Capable of providing high temperature process heat
- Near zero emergency planning zone (EPZ)
- Greenfield decommissioning
- Small installation footprint

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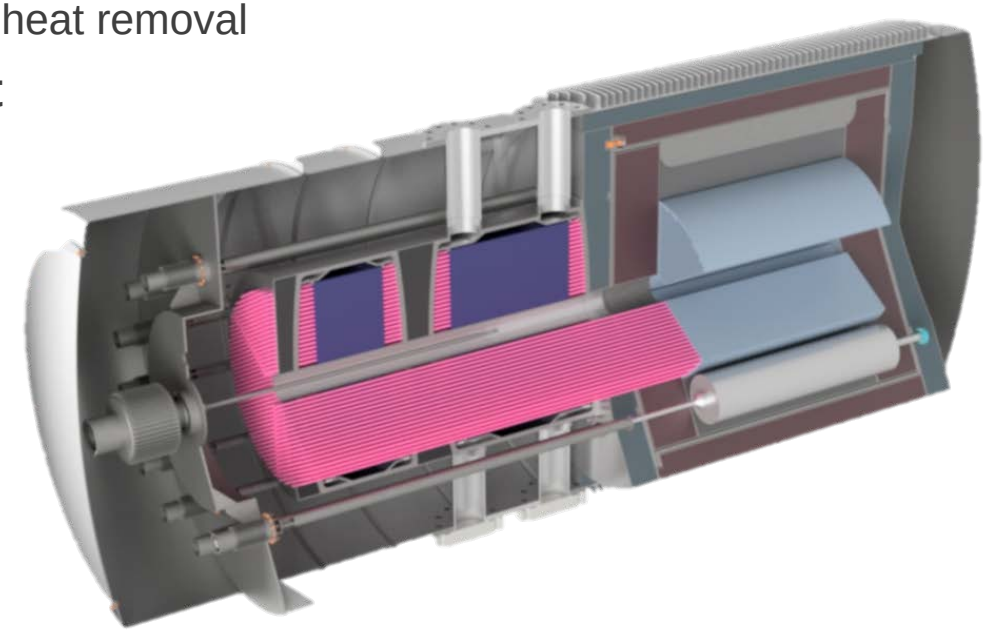
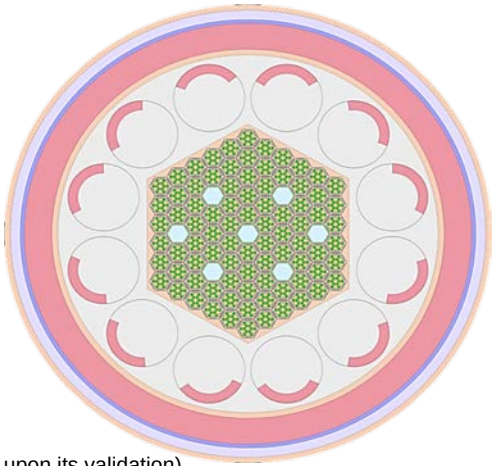
*** This record was final approved on 2/4/2020 10:21:33 PM. (This statement was added by the PRIME system upon its validation)

eVinci Micro Reactor Safety Functions

- **Reactivity Control**
  - Inherent feedback
  - Neutron absorption/reflection drum control and passive shutdown
  - Shutdown rod passive shutdown
- **Heat Removal**
  - Power conversion system for normal operation
  - Inherent self-regulation using heat pipes
  - Air passive heat removal
- **Containment**
  - Fuel
  - Core block
  - Canister





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eVinci Micro Reactor Probabilistic Risk Assessment

- First iteration of the PRA for internal events completed
  - Support to Licensing Modernization Program tabletop pilot activities
    - Justification for minimization of safety related classified components and I&C
  - Following ANS/ASME Non LWR PRA Standard as possible by design stage
  - Basic design evolution support
- PRA team involved with initial design requirements
  - More interactive role in LMP
- PRA team supported initial FMEA/fault schedule
  - Maintain appropriate balance in FMEA level of details (commensurate with design details level)
  - FMEA entries are directly linked with PRA elements (e.g., initiators, component failures, expected sequence behavior)
- Tracking of changing assumptions critical in PRA interaction
  - “As-being-designed” conditions
  - PRA assumptions database constantly reviewed/validated by design team

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eVinci Micro Reactor Probabilistic Risk Assessment

- Little expected relevance of internal events and internal hazards
  - Also, no internal fire/internal flood PRA expected
  - No human reliability analysis involved
- Success criteria mostly based on conservative assumptions associated with safety functions
  - Conservative Core Damage definition (will likely need to be more refined)
  - Isothermal core monolith may require localized core damage sequences
  - Single event tree due to design simplicity
  - Completely passive safety systems (no active actuation of any component)
  - Probabilistic success criteria being defined for future PRA iterations
- Minimal system analysis
  - Completely passive safety systems
    - Active systems captured mostly for initiating events frequency (IEFT analysis) and for ATWS considerations
  - High uncertainty associated with passive failure modes reliability data

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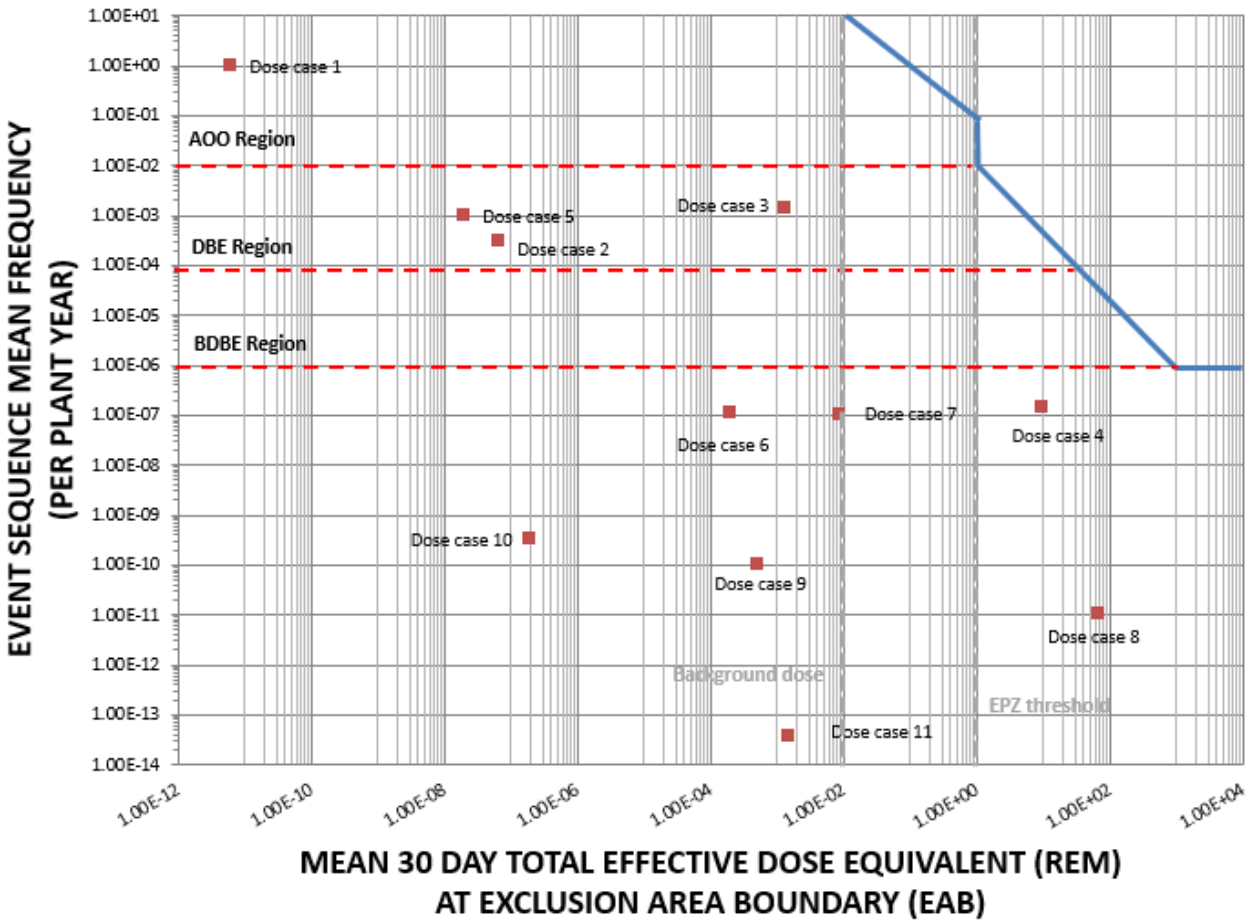
eVinci Micro Reactor Probabilistic Risk Assessment

- Success and core damage sequences retained in the analysis
- Dose estimates to the machine boundary estimated (<1m)
  - Peak temperature reached in success sequences drives different expected release cases



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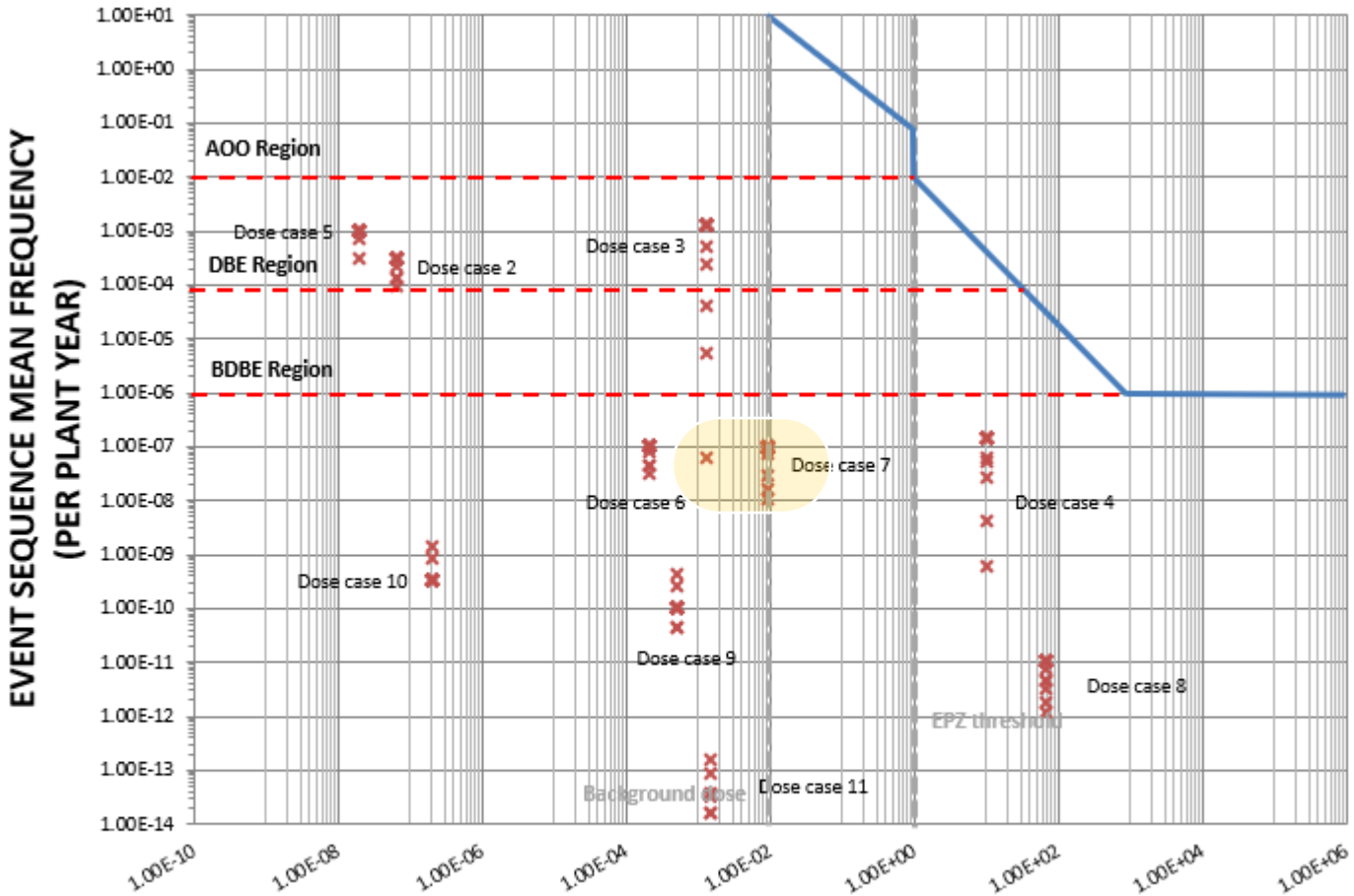
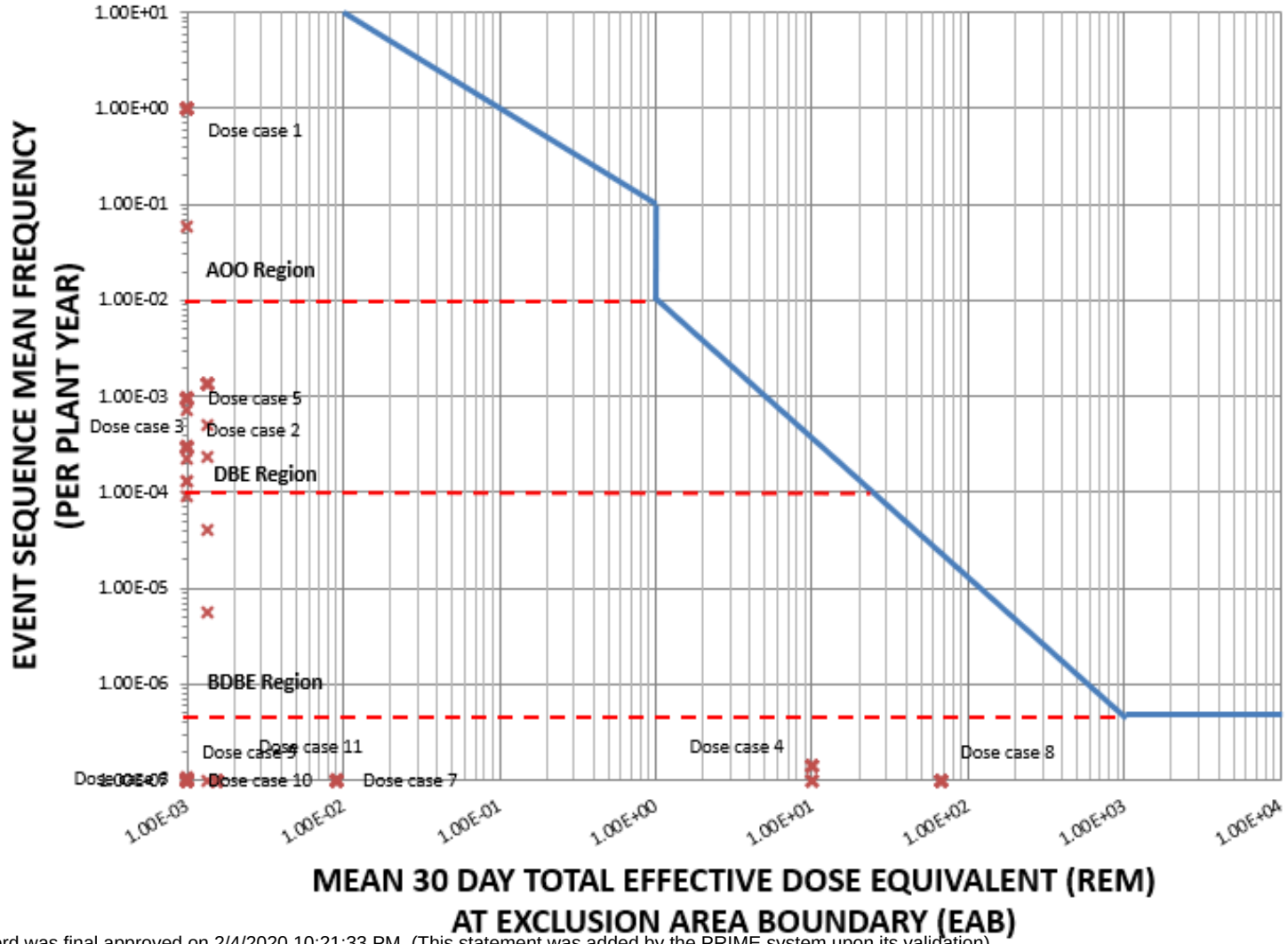
eVinci Micro Reactor Uncertainties

- Uncertainty in reliability data is significant, but epistemic uncertainties associated with design alternatives are dominating the current assessment



eVinci Micro Reactor DBE/BDBE Definition

- Minimal sequences in the region of interest for DBE and BDBE



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eVinci Micro Reactor Safety Classification

- Minimal set of Safety Class equipment identified by tracking how failure of individual systems makes sequences jumping across DBE/BDBE thresholds.

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eVinci Micro Reactor LMP Feedback and challenges

- LMP process feasibility has been tested for the initial phase of the design with good success and some feedback provided on the process
  - Emphasis may need to be added on epistemic uncertainties associated with design alternatives in the first iterations of the process
- Simplicity of eVinci micro reactor design possibly reduces the benefits of the methodology for DBE/BDBE and safety classification
- Challenges envisioned for external hazard assessment in absence of site information
  - Margin approach for seismic may be applicable but target HCLPF need to be increased and considerations on spectral shape may be needed to capture component specific classification
  - Margin approach does not exist for high winds and external flooding (admittedly with easier bounding fragility considerations)
- Site information is needed for a quantitative evaluation of external hazard that can feed the F/C diagram

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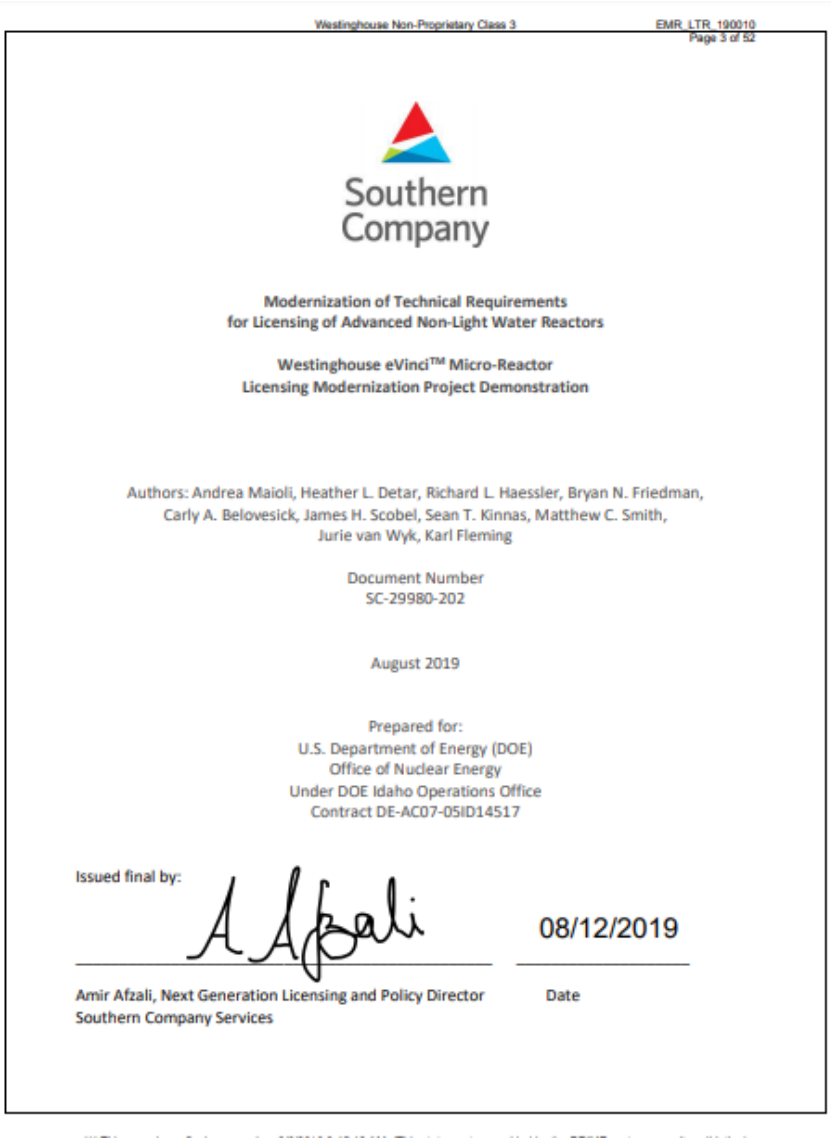
References

- NRC Draft Regulatory Guide DG-1353, “Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors,” April 2019.
- American Society of Mechanical Engineers and American Nuclear Society, “Probabilistic Risk Assessment Standard for Advanced Non-LWR Nuclear Power Plants,” ASME/ANS RA-S-1.4-2013, December 2013.
- Southern Company Document Number SC-29980-202, Modernization of Technical Requirements for Licensing of Advanced Non-Light Water Reactors. Westinghouse eVinci™ Micro-Reactor Licensing Modernization Project Demonstration (ML19227A322)



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Modernization of Technical Requirements for Licensing of Advanced Non-Light Water Reactors

Westinghouse eVinci™ Micro-Reactor Licensing Modernization Project Demonstration

Authors: Andrea Maioli, Heather L. Detar, Richard L. Haessler, Bryan N. Friedman, Carly A. Belovesick, James H. Scobel, Sean T. Kinnas, Matthew C. Smith, Jurie van Wyk, Karl Fleming

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Southern Company Services

Date

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