October 17, 2022

TP-LIC-LET-0043
Project Number 99902100

U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
ATTN: Document Control Desk

Subject: TerraPower Emergency Planning Zone Sizing Methodology Presentation Material

This letter provides the TerraPower, LLC presentation material for the upcoming "Emergency Planning Zone Sizing Methodology" pre-application engagement meeting (Enclosures 2, 3, and 4). The presentation material contains proprietary information and as such, it is requested that Enclosure 4 be withheld from public disclosure in accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding." An affidavit certifying the basis for the request to withhold Enclosure 4 from public disclosure is included as Enclosure 1. The proprietary material has been redacted from the presentation material in Enclosure 3.

This letter and enclosures make no new or revised regulatory commitments.

If you have any questions regarding this submittal, please contact Ryan Sprengel at rsprengel@terrapower.com or (425) 324-2888.

Sincerely,

Ryan Sprengel
Director of Licensing, Natrium
TerraPower, LLC

Enclosures:
1. TerraPower, LLC Affidavit and Request for Withholding from Public Disclosure (10 CFR 2.390(a)(4))
2. "Emergency Planning Zone Sizing Methodology" Presentation Material – Open Meeting – Non-Proprietary (Public)
3. "Emergency Planning Zone Sizing Methodology" Presentation Material – Closed Meeting – Non-Proprietary (Public)
4. "Emergency Planning Zone Sizing Methodology" Presentation Material – Closed Meeting – Proprietary (Non-Public)

cc: Mallecia Sutton, NRC
William Jessup, NRC
Nathan Howard, DOE
Jeff Ciocco, DOE

ENCLOSURE 1

TerraPower, LLC Affidavit and Request for Withholding from Public Disclosure (10 CFR 2.390(a)(4))

Enclosure 1
TerraPower, LLC Affidavit and Request for Withholding from Public Disclosure
(10 CFR 2.390(a)(4))

I, George Wilson, hereby state:

1. I am the Vice President, Regulatory Affairs and I have been authorized by TerraPower, LLC (TerraPower) to review information sought to be withheld from public disclosure in connection with the development, testing, licensing, and deployment of the Natrium™ reactor and its associated fuel, structures, systems, and components, and to apply for its withholding from public disclosure on behalf of TerraPower.

2. The information sought to be withheld, in its entirety, is contained in Enclosure 4, which accompanies this Affidavit.

3. I am making this request for withholding, and executing this Affidavit as required by 10 CFR 2.390(b)(1).

4. I have personal knowledge of the criteria and procedures utilized by TerraPower in designating information as a trade secret, privileged, or as confidential commercial or financial information that would be protected from public disclosure under 10 CFR 2.390(a)(4).

5. The information contained in Enclosure 4 accompanying this Affidavit contains non-public details of the TerraPower regulatory and developmental strategies intended to support NRC staff review.

6. Pursuant to 10 CFR 2.390(b)(4), the following is furnished for consideration by the Commission in determining whether the information in Enclosure 4 should be withheld:

    a. The information has been held in confidence by TerraPower.

    b. The information is of a type customarily held in confidence by TerraPower and not customarily disclosed to the public. TerraPower has a rational basis for determining the types of information that it customarily holds in confidence and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application and substance of that system constitute TerraPower policy and provide the rational basis required.

    c. The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR 2.390, it is received in confidence by the Commission.

    d. This information is not available in public sources.

    e. TerraPower asserts that public disclosure of this non-public information is likely to cause substantial harm to the competitive position of TerraPower, because it would enhance the ability of competitors to provide similar products and services by reducing their expenditure of resources using similar project methods, equipment, testing approach, contractors, or licensing approaches.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on: October 17, 2022

George Wilson

George Wilson
Vice President, Regulatory Affairs
TerraPower, LLC

ENCLOSURE 2

"Emergency Planning Zone Sizing Methodology" Presentation Material – Open Meeting

Non-Proprietary (Public)

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NATRIUM

a TerraPower & GE-Hitachi technology

Emergency Planning Zone Sizing Methodology

NATD-LIC-PRSNT-0034

SUBJECT TO DOE COOPERATIVE AGREEMENT NO. DE-NE0009054

Overview

- Natrium™ Reactor Overview
- Natrium™ Emergency Planning Strategy
- Natrium™ Plume Exposure Pathway EPZ Methodology and Application
- Questions

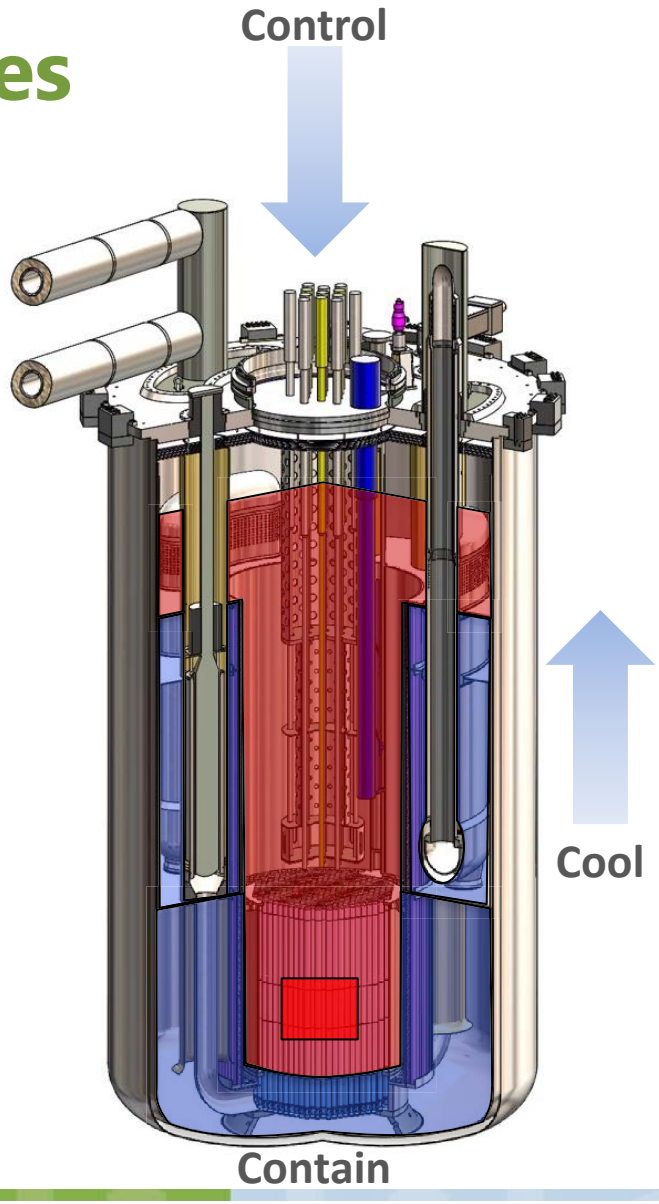
Natrium Reactor Overview

- The Natrium project is demonstrating the ability to design, license, construct, startup and operate a Natrium reactor within a seven-year timeframe.

- Pre-application interactions are intended to reduce regulatory uncertainty and facilitate the NRC's understanding of the Natrium design and its safety case.

Natrium Safety Features

- Pool-type Metal Fuel SFR with Molten Salt Energy Island
  - Metallic fuel and sodium have high compatibility
  - No sodium-water reaction in steam generator
  - Large thermal inertia enables simplified response to abnormal events
- Simplified Response to Abnormal Events
  - Reliable reactor shutdown
  - Transition to coolant natural circulation
  - Indefinite passive emergency decay heat removal
  - Low pressure functional containment
  - No reliance on Energy Island for safety functions
- No Safety-Related Operator Actions or AC power
- Technology Based on U.S. SFR Experience
  - EBR-I, EBR-II, FFTF, TREAT
  - SFR inherent safety characteristics demonstrated through testing in EBR-II and FFTF



Control

- Motor-driven control rod runback
- Gravity-driven control rod scram
- Inherently stable with increased power or temperature

Cool

- In-vessel primary sodium heat transport (limited penetrations)
- Intermediate air cooling natural draft flow
- Reactor air cooling natural draft flow – always on

Contain

- Low primary and secondary pressure
- Sodium affinity for radionuclides
- Multiple radionuclides retention boundaries

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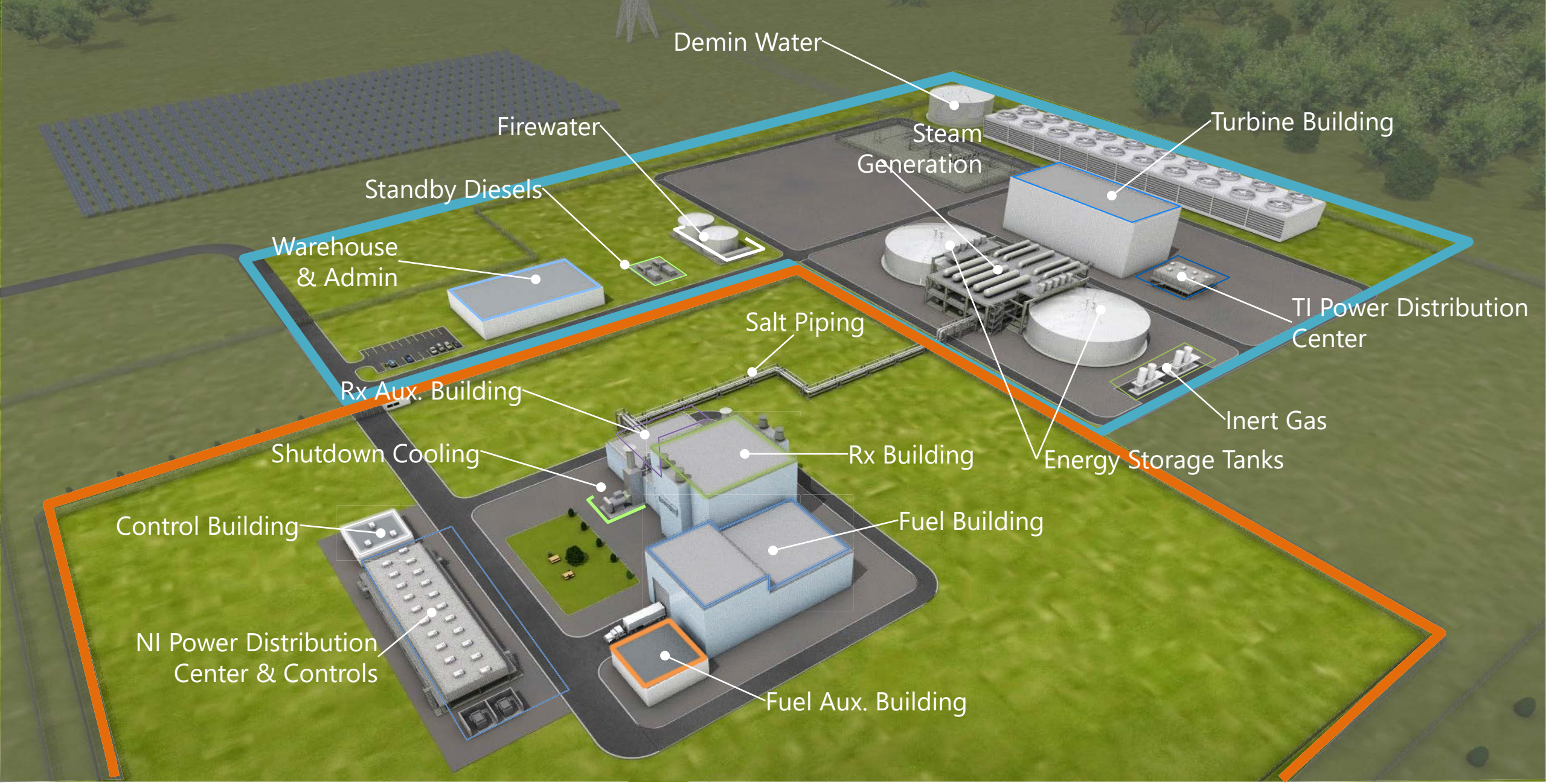

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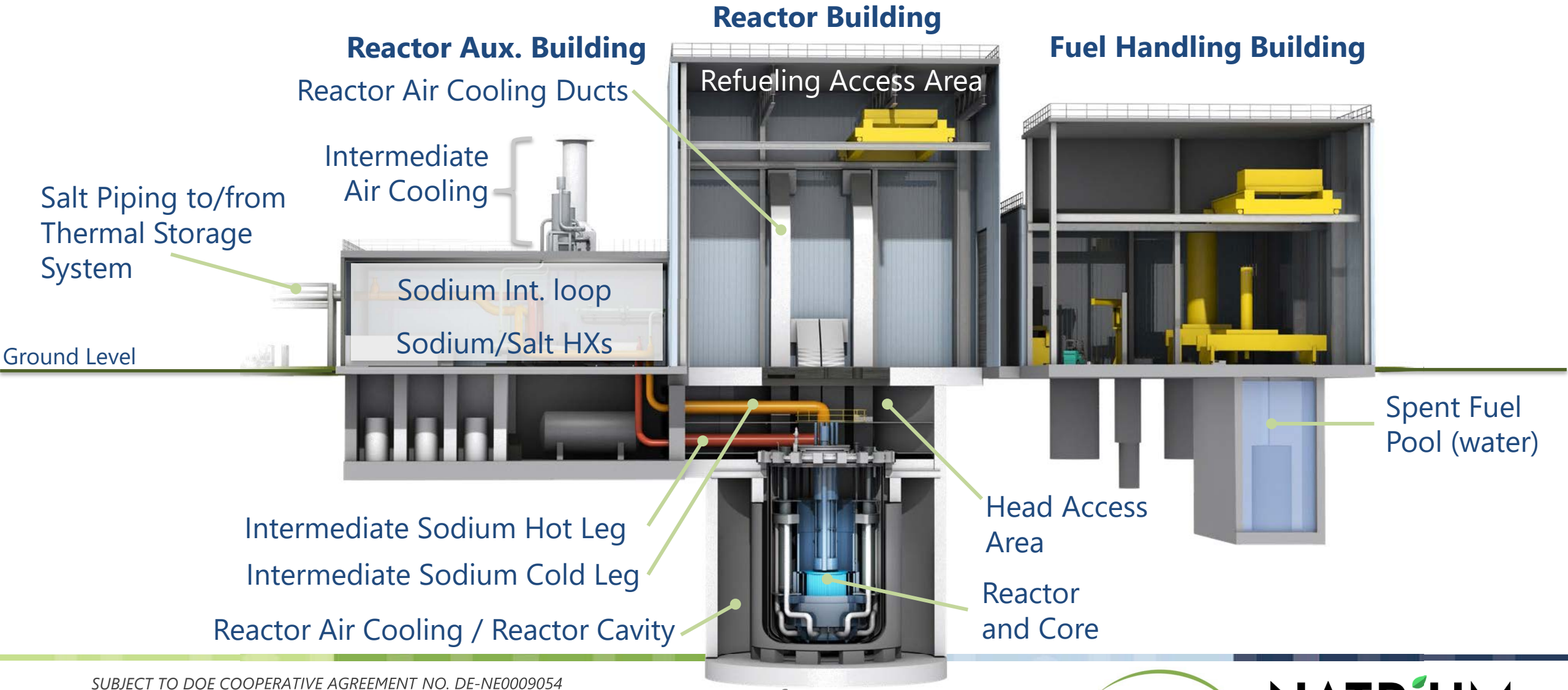
Plant Overview



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NATRIUM REACTOR PLUME EXPOSURE PATHWAY EPZ METHODOLOGY AND APPLICATION

Application of
Proposed RG 1.242, "Performance-Based Emergency Preparedness for Small Modular Reactors, Non-Light-Water Reactors, and Non-Power Production or Utilization Facilities"

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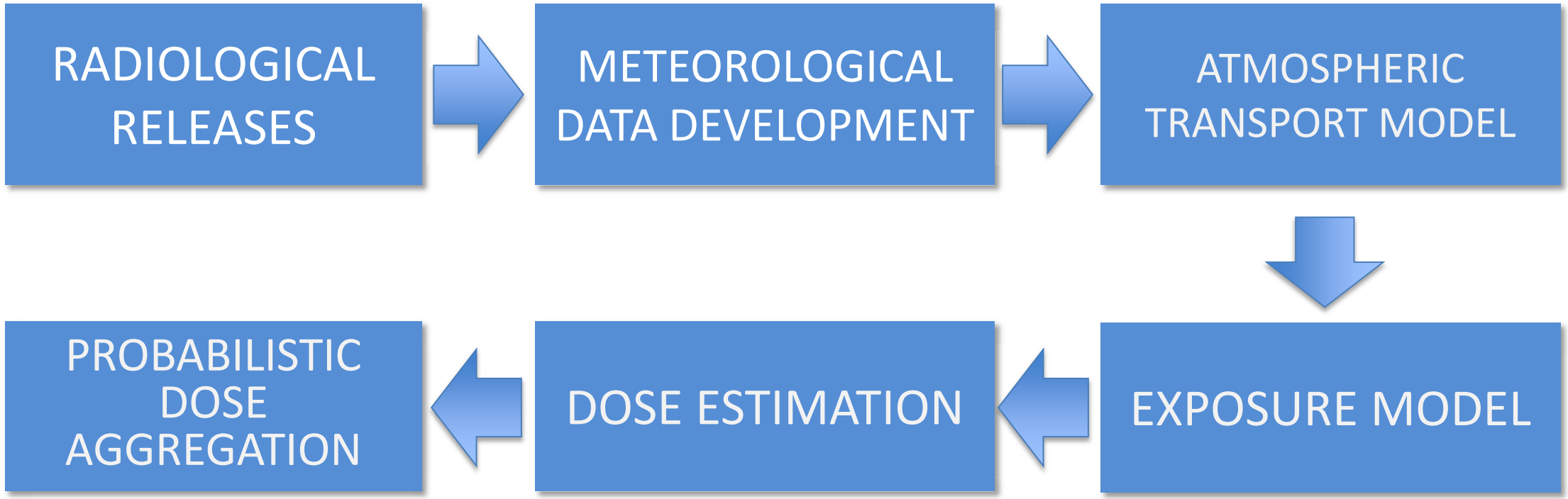
EPZ Methodology Strategies

- Proposed Natrium PEP EPZ methodology follows current guidance in draft RG 1.242, "Performance-Based Emergency Preparedness for Small Modular Reactors, Non-Light-Water Reactors, and Non-Power Production or Utilization Facilities," for establishing EPZ boundary size and preforming supporting calculations
  - If RG 1.242 PEP EPZ guidance is changed, then revision to proposed PEP EPZ methodology will be considered and adopted as appropriate
- RG 1.242 is based on issuance of proposed final rule, "Emergency Preparedness for Small Modular Reactors and Other New Technologies"
  - If proposed rule is not issued, then will still follow RG 1.242 and submit necessary exemptions to current PEP EPZ regulations to establish PEP EPZ sizing to under 10 miles

Plume Exposure Pathway Requirements

- Based on guidance in proposed RG 1.242, Appendix A, "General Methodology for Establishing Plume Exposure Pathway Emergency Planning Zone Size," TerraPower will demonstrate the following in the technical analysis:
  a. Area in which it is expected that predetermined prompt protective measures will be necessary by establishing a PEP EPZ boundary
  b. Events screened into the analysis (or not) utilizing event selection criteria
  c. Exact shape of the PEP EPZ boundary will be established utilizing probabilistic dose aggregation at the PEP EPZ boundary and ensuring it meets dose guidelines

Plume Exposure Pathway Generalized Methodology



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Radiological Releases for Internal Events

- Internal events will be included into the analysis to establish the PEP EPZ
  - Selection criteria will be as follows:
    - All accident sequences contributing 1% or more to overall release frequency
    - All DBAs will be included
    - Groups with sums greater than the frequency 1E-8 will be considered for cliff edge effects
  - All relevant events will have identified source term information
- PRA will evaluate all hazards, all modes, and all significant radionuclide sources
- Uncertainty will be considered, and cliff-edge events will be included into the EPZ analysis
  - Cliff-edge events will be identified where a small deviation in a plant parameter abruptly transitions from one plant status to another

Radiological Releases for External Events

- External event selection will be proposed in Topical Report
  - Most external events will have selection process identical to the internal events
  - Exception will be seismic events
    - Seismic events will likely be evaluated at a higher frequency and a gap analysis will be conducted to ensure that seismic risk has been adequately captured
- Uncertainty will be considered, and cliff-edge events will be included into the analysis
  - Cliff-edge events will be identified where a small deviation in a plant parameter abruptly transitions from one plant status to another

Meteorological Data Development

- Data collection will occur in accordance with RG 1.23, "Meteorological Monitoring for Nuclear Power Plants"
- Meteorological data that will be collected will include wind speed, wind direction, and temperature
- Meteorological data will be taken at least at two elevations to ensure atmospheric stability
- Quality and completeness of data will be assessed
- Data collection will occur for two years

Atmospheric Transport Model/Exposure Model/Dose Estimation

- Source term information will be used in the analysis
- χ/Qs will be developed for the events up to Site Boundary and beyond for specific events, as needed
- MAACS will be used to determine individual and societal dose to demonstrate the PAGs are met
- Dose rates will be compared to proposed criteria to ensure that PAG guidelines are met
- Dose/distance curve will be developed to ensure that dose rates decrease rapidly from EPZ boundary

Probabilistic Dose Aggregation

- Probabilistic dose aggregation in RG 1.242 demonstrated the PEP EPZ was of sufficient size such that the following conditions were met:
  A. Projected doses from the traditional design-basis accidents would not exceed PAG levels outside the PEP EPZ
  B. Projected doses from most radiological release sequences would not exceed PAG levels outside the PEP EPZ
  C. Worst radiological release sequences, immediate life-threatening doses would generally not occur outside the PEP EPZ
- Methodology establishes criteria that provides confidence that appropriate PEP EPZ will be identified

Applying Methodology to Fit Criterion A

- Criterion A - Projected doses from the traditional design-basis accidents would not exceed PAG levels outside the PEP EPZ
  - DBAs derived from DBEs
  - Will ensure DBA mean 4-day TEDE* dose < 1 rem
  - Will ensure DBA 95% 4-day TEDE dose < 5 rem

* *Total Effective Dose Equivalent (TEDE) - sum of the internal and external exposure to ionizing radiation*

Applying Methodology to Fit Criterion B

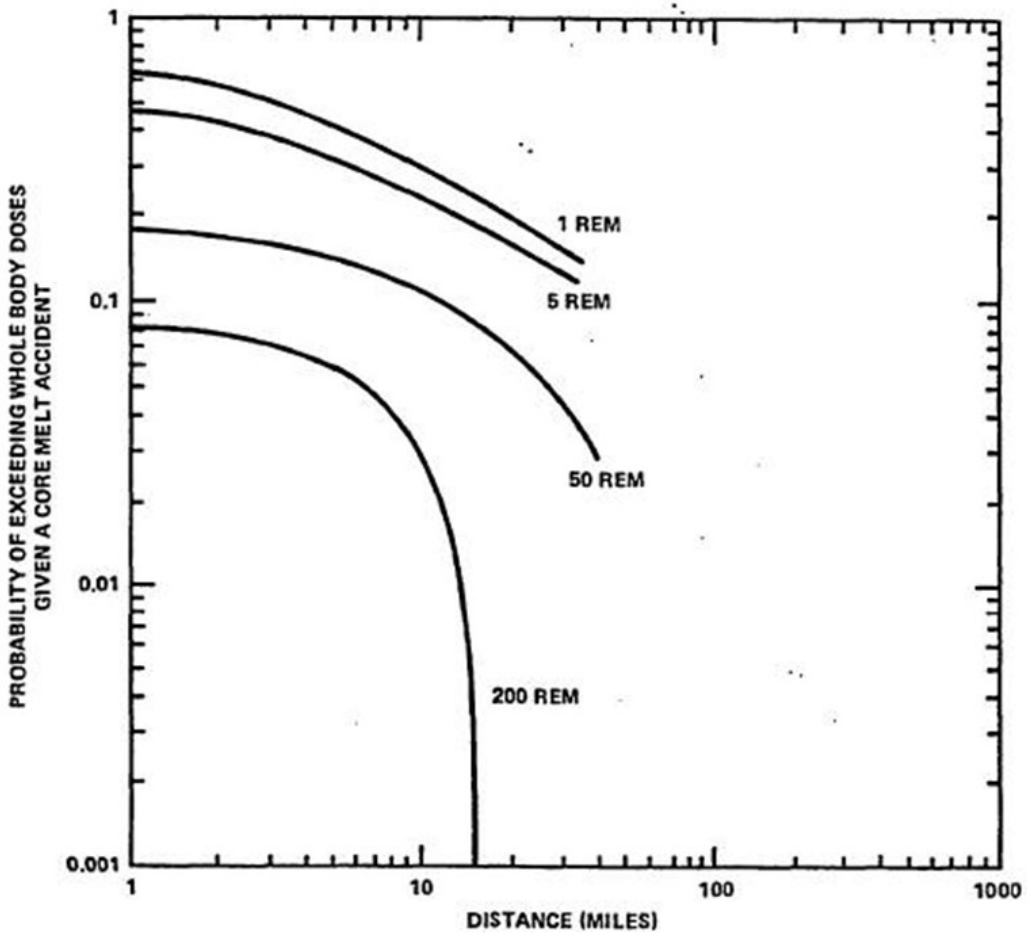
- Criterion B - Projected doses from most radiological release sequences would not exceed PAG levels outside the PEP EPZ
  - Events with mean release frequency greater than 1E-6
  - Will ensure BDBE mean 4-day TEDE dose < 1 rem
  - Will ensure BDBE 95% 4-day TEDE dose < 5 rem

Applying Methodology to Fit Criterion C

- Criterion C - Worst radiological release sequences, immediate life-threatening doses would generally not occur outside the PEP EPZ
  - All groups with mean release frequency > 1E-8 will be considered
  - Events with 95% release frequency > 1E-7 will be included
  - Will ensure that events have a mean 4-day acute dose < 200 rem
  - NUREG-0396 used whole body acute dose, three exposure pathways
    - Cloud shine
    - Ground shine
    - Inhalation
  - Will produce dose as a function of distance chart to ensure that dose drops off rapidly at EPZ boundary

Example Dose/Distance Curve from NUREG-0396

- Dose/Distance Curves will be developed to ensure Criterion C is met
- Events with frequencies from 1E-6 to 1E-7 will be evaluated to ensure that the dose does not exceed 200 rem acute dose and that it rapidly drops off from that point



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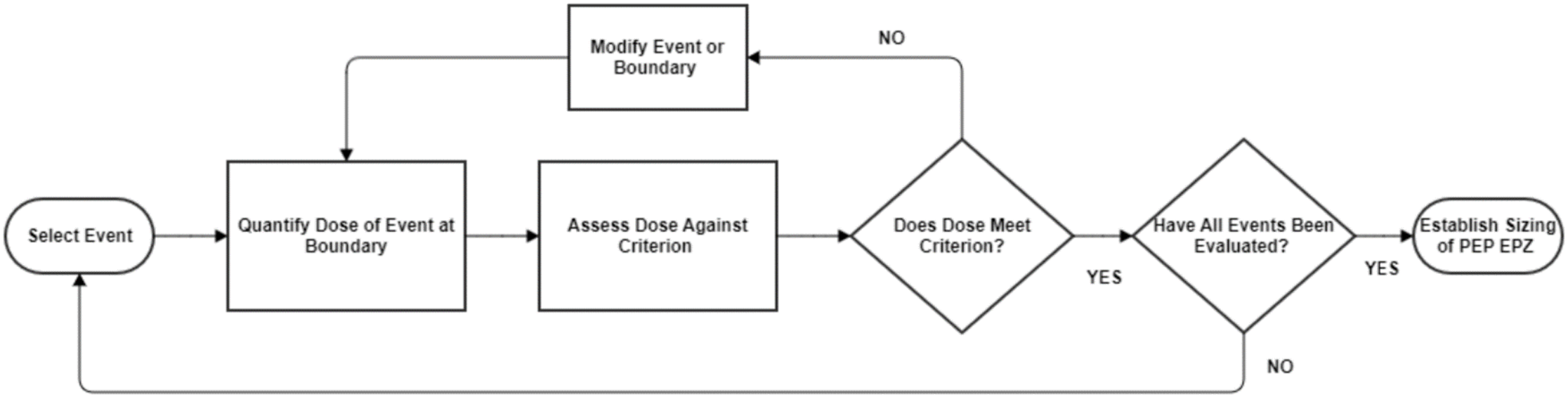
Establishing Boundaries

- Dose rates will be evaluated against Criteria A, B, and C
- Events will be initially assessed at site boundary for PEP EPZ determination.
- If an event does not meet Criteria, design modifications will be identified to improve the dose rates or the PEP EPZ will be expanded to meet Criteria A, B, and C
- For Criterion C, a dose chart as a function curve will be developed for the events to ensure that the dose rates at the established PEP EPZ boundary meet the criteria and that the dose drops off rapidly away from the PEP EPZ boundary

Establishing Boundaries Flowchart



Considerations on Whether Prompt Protective Measures are Necessary

- Analysis will consider whether predetermined prompt protective measures are necessary in addition to the consequence analysis
  - Timing from the initiation of the event to the start of radiological release to the environment for all accident scenarios evaluated in the radiological dose assessment to aid in the determination of the PEP EPZ will be considered
  - Capability to protect the public without needing to develop predetermined prompt protective measures will also be considered

PEP EPZ Methodology Next Steps

- Topical Report submittal targeted for before February 2023
  - Will include seismic methodology
- Initial calculations will be complete before CPA submittal

Wrap Up / Summary

- Analysis will be performed to support establishment of PEP EPZ
- There are no planned deviations from the methodology proposed within RG 1.242
- Analysis will be performed to identify the relevant events, calculate the expected dose to the public considering weather, time, and distance from site
- Events will be evaluated to ensure that they do not exceed the PAG Guidelines

Acronym List

BDBE – Beyond Design Basis Event
CFR – Code of Federal Regulations
DBA – Design Basis Accident
DBE – Design Basis Event
DOE – Department of Energy
EBR – Experimental Breeder Reactor
EPZ – Emergency Planning Zone
FFTF – Fast Flux Test Facility
LBE – Licensing Basis Event
MAACS – MELCOR Accident Consequence Code System
NRC – Nuclear Regulatory Commission
NUREG – Nuclear Regulatory Commission Technical Report
PAG – Protective Action Guidelines
PEP – Plume Exposure Pathway
PRA – Probabilistic Risk Assessment
rem – Roentgen Equivalent Man
RG – Regulatory Guide
SFR – Sodium Fast Reactor
TEDE – Total Effective Dose Equivalent
TREAT – Transient Reactor Test

ENCLOSURE 3

"Emergency Planning Zone Sizing Methodology" Presentation Material – Closed Meeting

Non-Proprietary (Public)

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NATRIUM

a TerraPower & GE-Hitachi technology

Emergency Planning Zone Sizing Methodology

NATD-LIC-PRSNT-0040

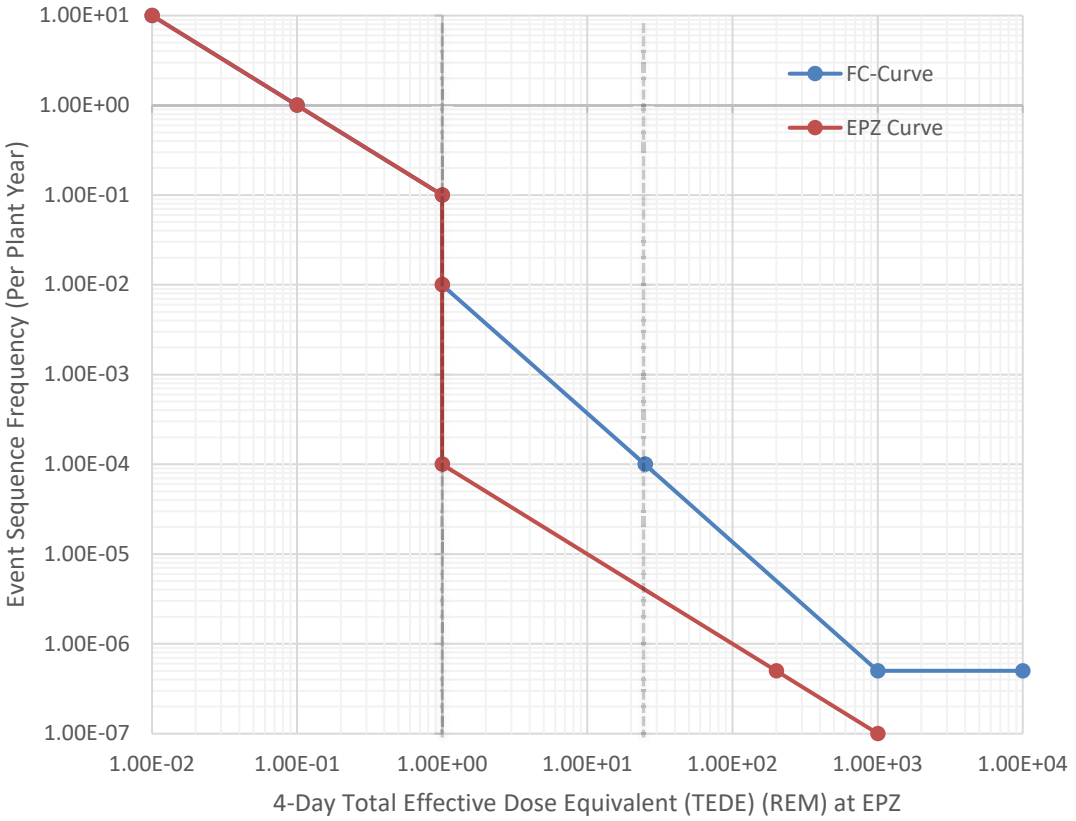
SUBJECT TO DOE COOPERATIVE AGREEMENT NO. DE-NE0009054

Portions of this presentation are considered proprietary and TerraPower, LLC requests it be withheld from public disclosure under the provisions of 10 CFR 2.390(a)(4).

Nonproprietary versions of this presentation indicate the redaction of such information using [[ ]]$^{(a)(4)}$.

EPZ Curve *(for reference)*

- NEI 18-04 allows for transposition of curve over F-C curve
- "The F-C Target used in Figure 3-1 provides the basis for establishing the risk significance of LBEs. The EPA PAG dose guidance value for a specified distance (e.g., the exclusion area boundary) may be overlaid against the F-C Target to define more ambitious target for those designs intending to establish alternative requirements of offsite emergency planning zones. However, the F-C Target in Figure 3-1 is still used to determine LBE and SSC risk significance."



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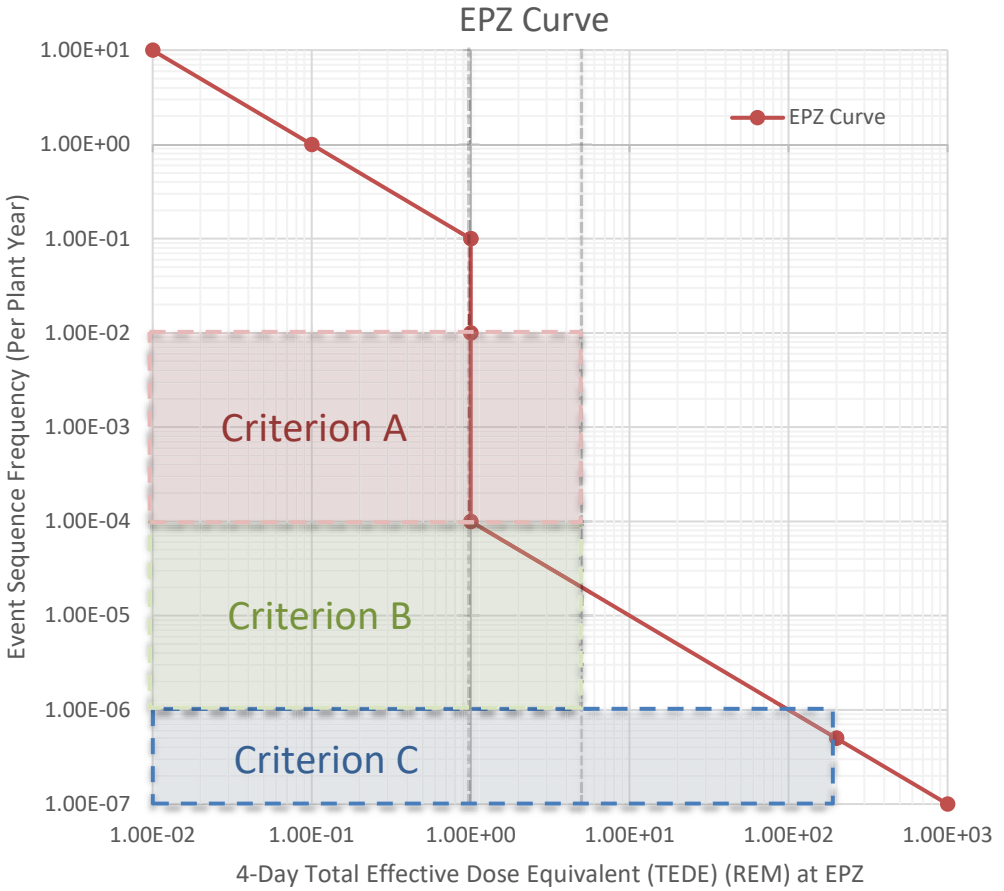
EPZ Curve *(for reference)*

- Criterion A will be met more conservatively using DBEs with 95% below 1 rem TEDE
- Criterion B will be met with iso-risk line anchored from 1 rem to 200 rem. This allows for higher frequency accidents to have stricter dose releases than lower frequency higher consequence accidents.
- Criterion C will be met by continuing iso-risk line to 1000 rem TEDE. TEDE is more conservative than acute and allows for consistency with chart. Distance curve will still be established to ensure fast drop off rapidly from EPZ boundary.



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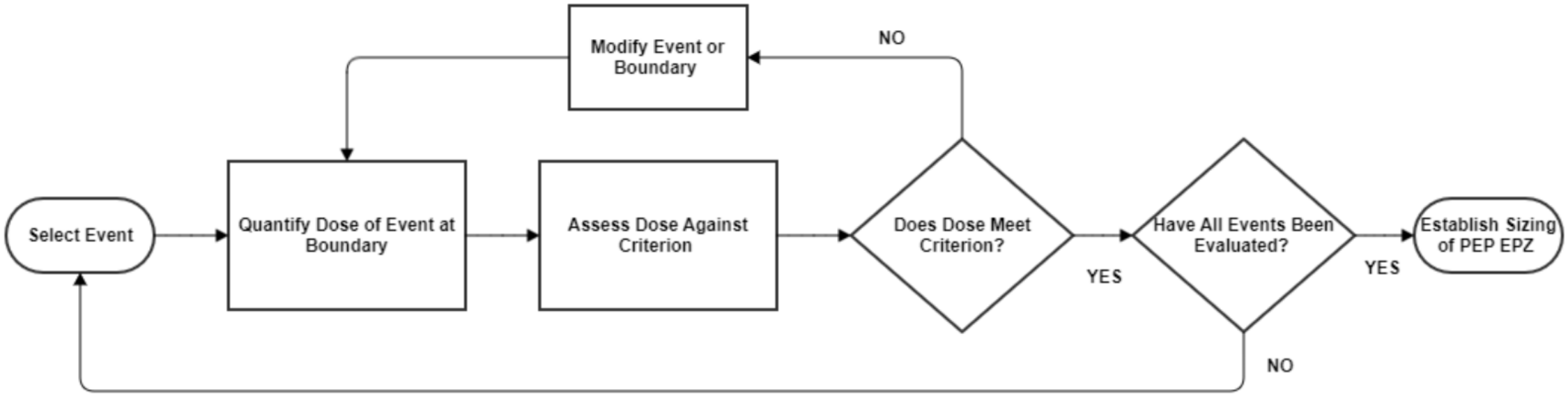
Applying Methodology to Events



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Selecting EXAMPLE Events

- Examples of events from the PRA to be evaluated
  - SCG Leakage Outside of Containment (DBE)
  - Fuel Drop Event in EVST (BDBE)
  - Transient Overpower Event [[ ]]$^{(a)(4)}$

EXAMPLE: SCG Leakage Outside Containment

- Event Description: SCG leakage outside of containment [[

]](a)(4)

Snapshot of EXAMPLE SCG Event Tree

[[

]](a)(4)

EXAMPLE: Fuel Drop Event in EVST

- Event Description: Fuel Drop Event in the EVST during LPSD [[

]](a)(4)

Snapshot of EXAMPLE Fuel Drop Event Tree

[[

]](a)(4)

EXAMPLE: Transient Overpower Event

- Event Description: [[

]]$^{(a)(4)}$

Snapshot of EXAMPLE Transient Overpower Event Tree

[[

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Snapshot of EXAMPLE Transient Overpower Event Tree

[[

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Acronym List

BDBE – Beyond Design Basis Event
CFR – Code of Federal Regulations
DBE – Design Basis Event
DOE – Department of Energy
EPA – Environmental Protection Agency
EPZ – Emergency Planning Zone
EVST – Ex-Vessel Storage Tank
F-C – Frequency-Consequence
LBE – Licensing Basis Event
LPSD – Low Power Shut Down
NEI – Nuclear Energy Institute
PAG – Protective Action Guidelines
PEP – Plume Exposure Pathway
PRA – Probabilistic Risk Assessment
REM/rem – Roentgen Equivalent Man
SCG – Sodium Cover Gas
TEDE – Total Effective Dose Equivalent