Enclosure 1:

"NuScale Design Specific Emergency Planning Zone Sizing Methodology and Program," PM-0415-13885-NP, Revision 0, nonproprietary version

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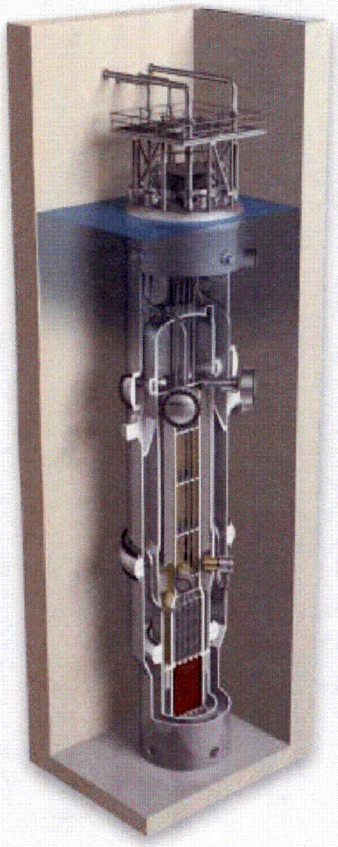
NuScale Design-Specific Emergency Planning Zone Sizing Methodology and Program



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Acknowledgement & Disclaimer

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Agenda

- Overview of emergency planning (EP) program status
- Licensing strategy and schedule
- Technical results
- Summary and path forward

Overview of EP Program Status

NRC SMR EP History

- SECY-11-0152 (October 28, 2011)
  - NRC intent to develop technology neutral dose-based consequence-oriented EP framework for SMRs
  - concept of scalable EPZ; 1 rem dose limit examples of site boundary, 2-mile, 5-mile, and current 10-mile EPZ
  - modularity and collocation considerations identified
- SECY-14-0095 (August 28, 2014)
  - NRC readiness to review SMR 10 CFR 52 applications
  - NRC staff preparing SMR EP policy notation vote for NRC in early 2015
- SECY-15-0077 (May 29, 2015)
  - two SMR EP rulemaking options
    - rulemaking to revise 10 CFR 50.47 and 10 CFR 50 Appendix E
    - exemptions in accordance with 10 CFR 50.12

NuScale SMR EP-Related Presentations

- NuScale presentations
  - Design-Specific EPZ Size, September 2014
  - PRA and Severe Accidents, March 2014
  - PRA Status and Update, December 2012
  - Mechanistic Source Term, October 2012
- ANS SMR Conference, Washington, D.C.
  - Emergency Planning and Execution, November 2013
- NuScale planned future presentation
  - EPZ Size, December 2015

NEI EP NRC Engagements

- NEI presentations at NRC meetings
  - Generic Framework for SMR Emergency Preparedness (EP), December 17, 2014
  - SMR Source Terms and Responses to NRC RAIs on NEI EPZ white paper, October 28, 2014
  - Proposed Methodology and Criteria for Establishing the Technical Basis for SMR Emergency Planning Zone Sizing, April 2014
  - Proposed Industry Approach to Accident Source Term Analysis and Emergency Planning Evaluation for SMRs, December 2012
  - SMR Source Term Position Paper, December 2012
- NEI Letter to NRC on update of industry SMR EP activities (June 30, 2015)
  - industry support of NuScale EPZ size topical report as part of SMR EPZ issue resolution
- NEI Letter to Chairman Burns supporting SECY-15-0077 Option 1 (July 8, 2015)
- NEI submitted Proposed EP Regulations and Guidance for SMRs white paper (July 8, 2015)

Areas for Further NEI NRC Engagements on EP

- NEI ongoing work for 2015-2016 (supported by NuScale)
  - EP framework
  - protective action recommendations (PAR) guidance
  - emergency action levels (EALs)
  - Emergency Response Organization (ERO) staffing guidance

TVA SMR EP Activities

- Clinch River SMR early site permit application (ESPA)—dual site boundary or 2-mile plume exposure EPZ
  - October 2014 site tour and examination of status of ER
  - NRC meetings in September 2014; December 2014; February 2015; and May 2015
- NRC Readiness Review August 3-7, 2015
- ESPA submittal first quarter of 2016

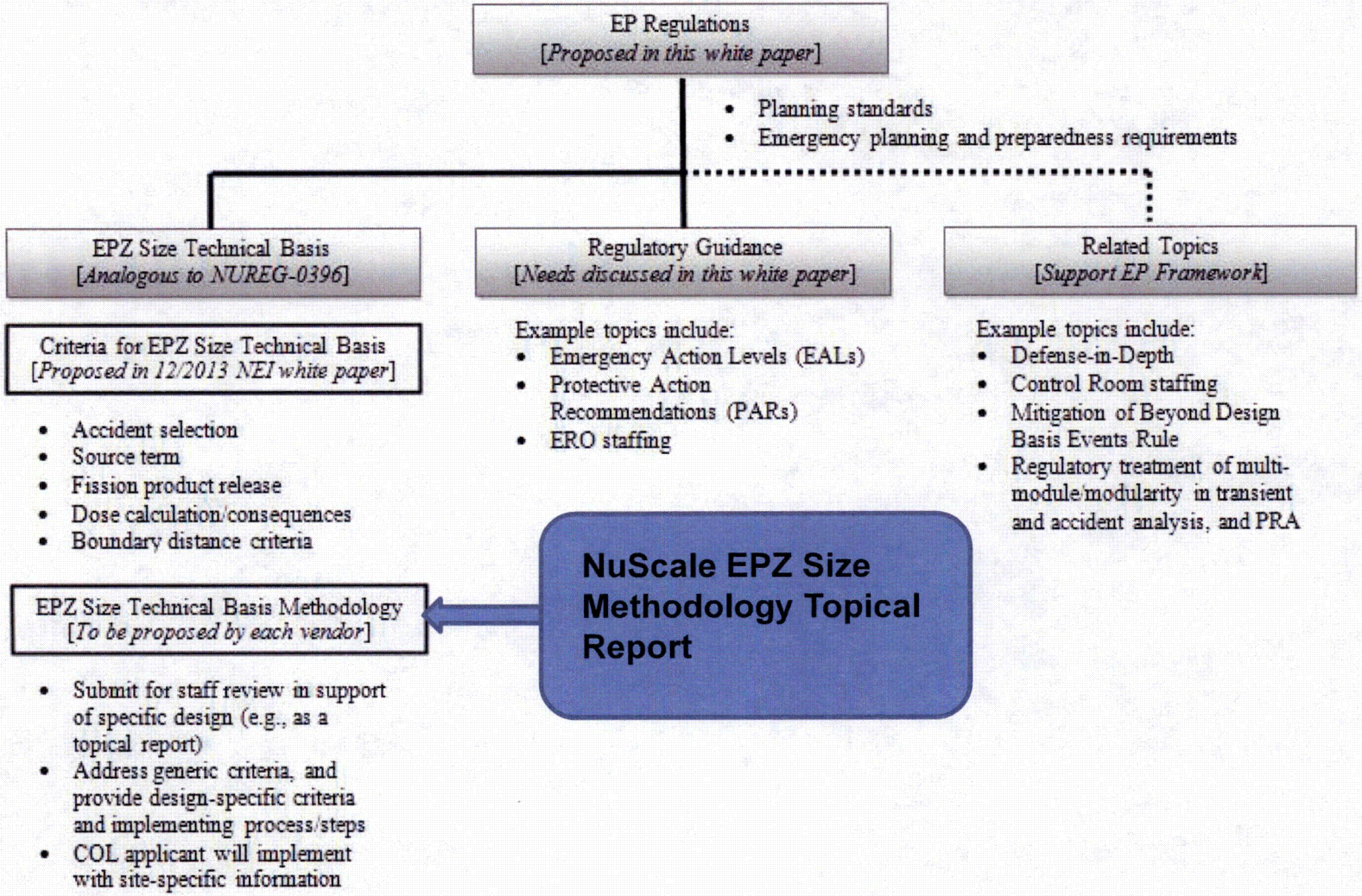
EPRI SMR EP Activities

- Joint DOE-EPRI funding (NuScale participation)
  - SMR containment aerosol deposition
    - Phase 1 (analytical) completed—report issued September 2014
    - Phase 2 (tests) scope developed—expect start later in 2015
  - iPWR Containment Aerosol Deposition Behavior NRC presentation, October 2014
- Supporting industry efforts on EPZ

Summary of SMR EP Industry NRC Interactions

- Since 2012, 18 SMR EP NRC meetings conducted by
  - NuScale (5); NEI (6); EPRI (1); TVA (6)
- NEI has submitted three SMR EP-related papers to the NRC
  - SMR Source Term Position Paper, December 2012
  - SMR EPZ Size Methodology White Paper, December 2013
    - NRC questions to NEI, June 2014
    - industry responses presented in meeting, October 2014
    - formal industry response to NRC questions submitted, November 2014
  - Proposed EP Regulations and Guidance for SMRs White Paper July 2015
- TVA Clinch River ESPA NRC readiness review was conducted August 3-7, 2015; ESPA to be submitted first quarter of 2016
- EPRI issued publicly-available iPWR Containment Aerosol Deposition Technical Report in September 2014

NuScale EPZ Size Topical Report Relationship Developing an SMR-Appropriate EP Program



Source: EP Regulations and Guidance for SMRs White Paper, submitted by NEI on July 8, 2015

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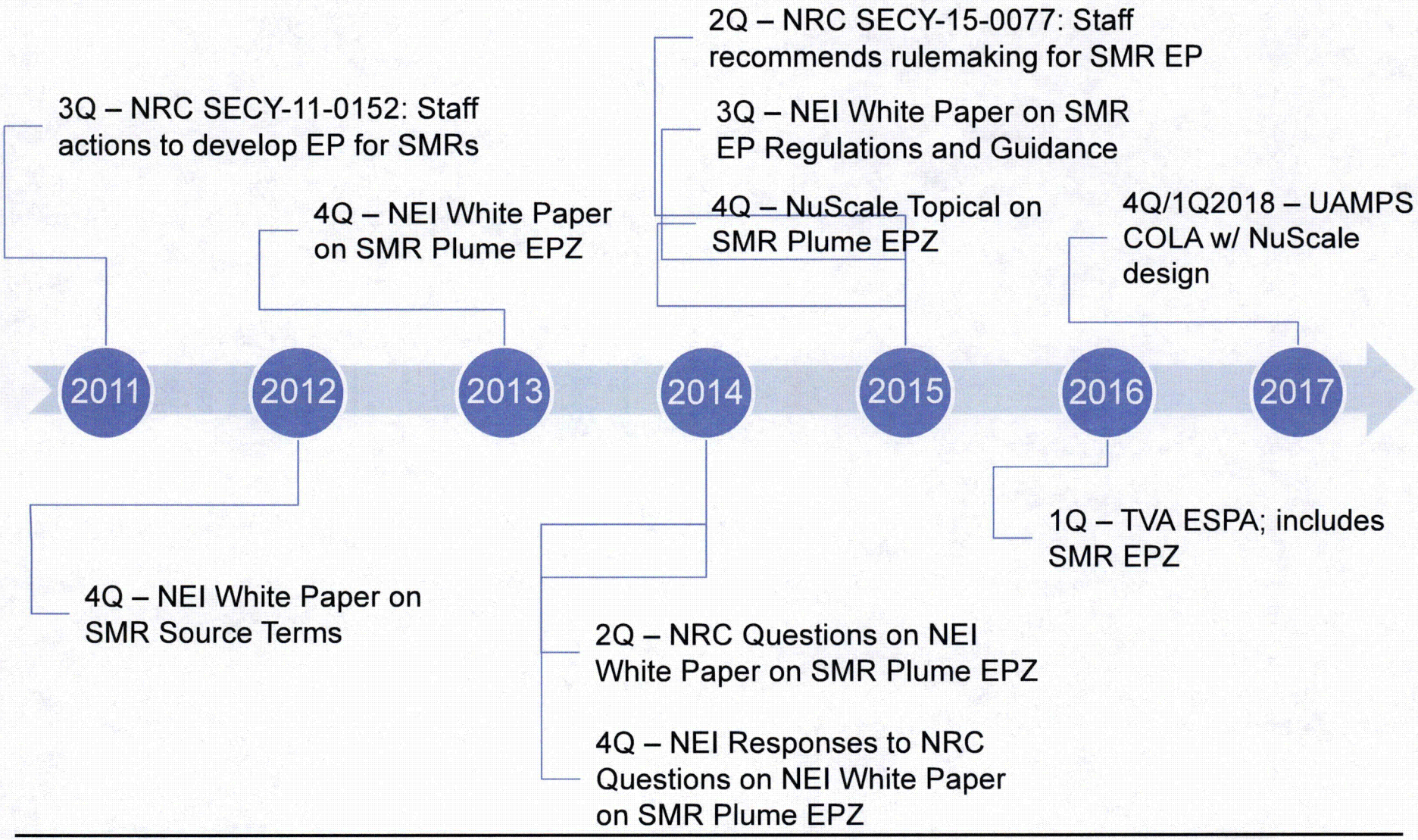
SMR EPZ Related Submittals



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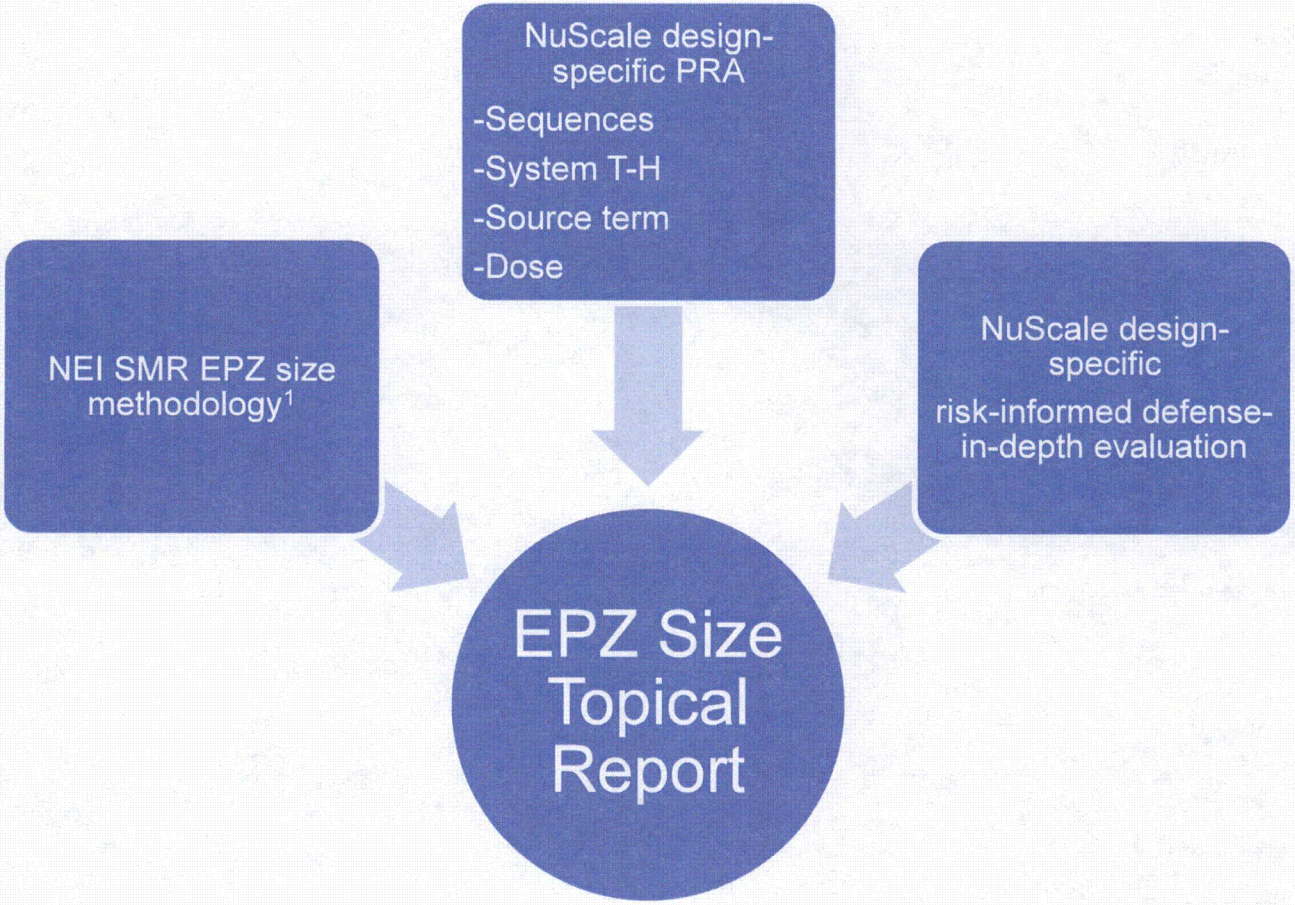
EPZ Size Topical Report Inputs



[1]Based on NEI white paper, Proposed Methodology and Criteria for Establishing the Technical Basis for Small Modular Reactor Emergency Planning Zone, December 23, 2013

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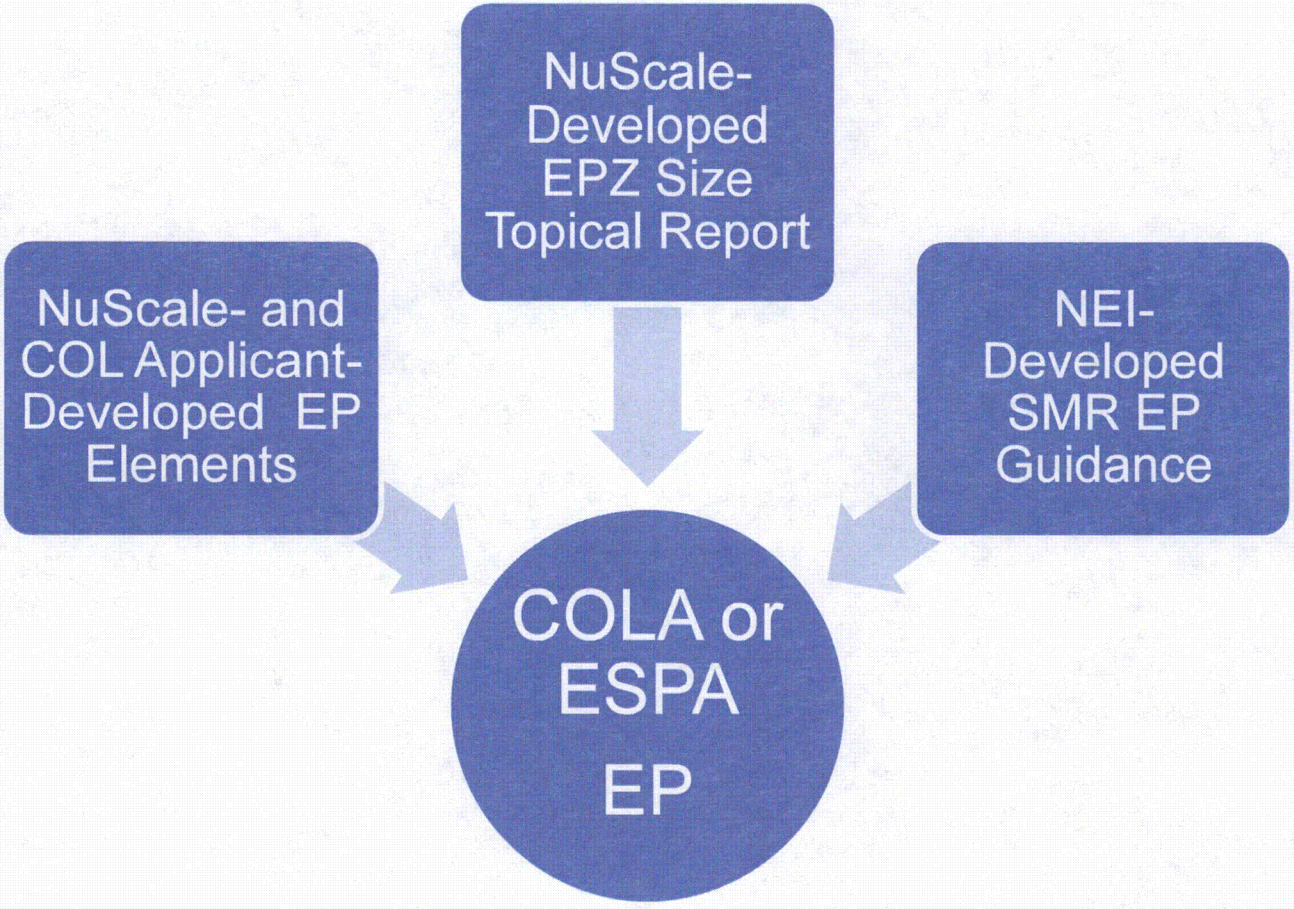
COLA Integration of SMR EP Inputs



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Roles and Responsibilities

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- EPZ size technical justification
- Design-specific EAL
- Design-specific PAR
- Preapplication engagements with NRC and FEMA (jointly with COL applicant)

COL/ESP Applicant

- Site-specific characterization (seismic, population distribution and meteorology)
- Site-specific emergency plan elements
- Engagement with site-specific state and local government, as well as tribal organizations

Licensing Strategy and Schedule

EP Licensing Strategy

- NuScale design offers unique opportunities to optimize emergency planning size and requirements
  - smaller plume exposure and ingestion EPZ size
  - revised emergency action levels (EALs) and technical justification
  - revised protective action recommendations (PAR)
  - revised Emergency Response Organization (ERO) staffing
  - other programmatic aspects of emergency planning (scope or need for 16 planning standards from NUREG-0654, Table B-1)
- Emergency planning is addressed in COLA or ESP
- EPZ size project underway at NuScale
  - draws on DC design and analysis information but not part of DC
  - parallel EP development to support COLA or ESPA

EP Topic Lead Responsibilities

Planning Standard Designation ID	Emergency Plan Topic	NuScale Lead Responsibility	COLA Applicant
	EPZ Size Technical LTR	X	
	COLA Emergency Plan		
A	Assignment of Responsibility		X
B	Onsite Emergency Organization	X	
C	Emergency Response Support and Resources		X
D	Emergency Classification System (including technical basis)	X	
E	Notification Methods and Procedures		X
F	Emergency Communications		X
G	Public Education and Information		X
H	Emergency Facility and Equipment	X	
I	Accident Assessment	X	
J	Protective Response		X
K	Radiological Exposure Control		X
L	Medical and Public Health Support		X
M	Recovery & Reentry Planning and Post Accident Operations	X	
N	Exercises and Drills		X
O	Radiological Emergency Response Training		X
P	Responsibility for the Planning Effort		X
Q	Emergency Plan Certifications		X
	Letters of Agreement		X
	Estimated Time for Evacuation		X
	Memoranda of Understanding		X

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EP Licensing Strategy Schedule

EP Milestone	Scheduled Date
Multiple NuScale and COL applicant NRC and FEMA meetings	2015-2017
Submittal of EPZ Size Topical Report, Revision 0	December 2015
NRC review, RAIs, and RAI responses	February-October 2016
EPZ Size Topical Report, Revision 1	January 2017
NRC issues SER for EPZ Size Topical Report	June 2017
Submit COLA (including EP referencing EPZ Size Topical Report)	Between October 2017 and March 2018
COLA EP approval by NRC and FEMA	December 2020

EP Licensing Strategy Summary

- EP will be submitted with COLA and references EPZ size LTR
- EPZ size LTR uses NEI methodology as applied to NuScale-specific design with NuScale PRA, defense-in-depth inputs and insights
- Some EP elements assigned to NuScale while others require COL/ESP applicant resource allocation
- Coordination and integration of EP elements with ongoing and planned NEI and EPRI SMR EP Projects
- NuScale and COL/ESP applicant presubmittal EP engagements with NRC and FEMA are critical to successful review and approval
- Site-specific EP elements require presubmittal engagement by COL/ESP applicant with state, local, and tribal organizations

Technical Results

Design-Specific EPZ Methodology and Implementation Update for Multi-Module Plant

- NuScale design-specific EPZ work initiated in 2014
  - first design-specific EPZ update for NRC was September 2014
  - EPZ work being performed in parallel with DCD preparation
  - draws on DCD design (but not part of design certification)
- Approach based on NEI paper, NRC feedback, and key NRC EPZ-related documents (NUREG-0396, SECY-97-020, SECY-11-0152, and SECY-15-0077)
- Incorporate experience and lessons from risk-informed decision-making in regulatory applications "to determine appropriate accidents to be evaluated" (SECY-15-0077)
  - use risk-informed evaluation which balances risk considerations and defense-in-depth by combining insights from:
    1. Assessment of defense-in-depth—deterministic, engineering information emphasizing traditional safety margin *(mainly qualitative)*
    2. Risk information from the PRA required for new plants *(mainly quantitative)*

Design-Specific EPZ Methodology and Implementation—Methods and Results to be Discussed Today

1. Identification and evaluations of more probable, less severe scenarios to be addressed for EPZ
2. Identification of less probable, more severe scenarios and risk-informed evaluations of the credibility of these scenarios
3. Defense-in-depth source term evaluations and potential release paths for less probable, more severe scenarios
4. Update on multi-module accidents and other issues

- Results are preliminary
  - pending completion of the NuScale design
  - PRA supporting the DCD
  - implementing the methodology on a COL and/or ESP application

Dose-Based Criteria and Time to Core Damage Precedents

- From EP regulatory basis in NUREG-0396 (1978) and restated in SECY-97-020; EPZ should be sized according to the following criteria:
  - Criterion a - projected dose from design-basis accidents (DBAs) < protective action guides (PAGs) (1–5 rem TEDE)
  - Criterion b - consequences of more probable, less severe core melt accidents < PAGs
  - Criterion c - substantial reduction in early severe health effects in the event of less probable, more severe core melt accidents

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Identify More Probable, Less Severe Scenarios

- Use SOARCA-like process to determine scenarios, but with additional considerations for completeness, applicability to SMRs, and EPZ
  - initial step: review all CD sequences from the NuScale PRA and select those with mean CDF > 1E-8 per plant year*
  - EOPs credited but not SAMGs and EDMGs
  - assure high fraction of total CDF is considered (e.g., > 95%)
  - sequences mapped into scenarios by equipment availability and time to CD
  - apply NEI paper and SOARCA CDF guideline of 1E-6 per reactor-year for "most scenarios"
  - given the expected low CDF for NuScale, go to 1E-7 per plant-year or even lower intact containment scenarios if necessary

** Results based on NuScale January 2015, single module, internal events at power PRA. Per plant-year frequency for NuScale design is assumed to be per module-year frequency x 12.*

More Probable, Less Severe PRA Accident Sequences (January 2015 NuScale Internal Events, at Power PRA)

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More Probable, Less Severe Scenarios for EPZ

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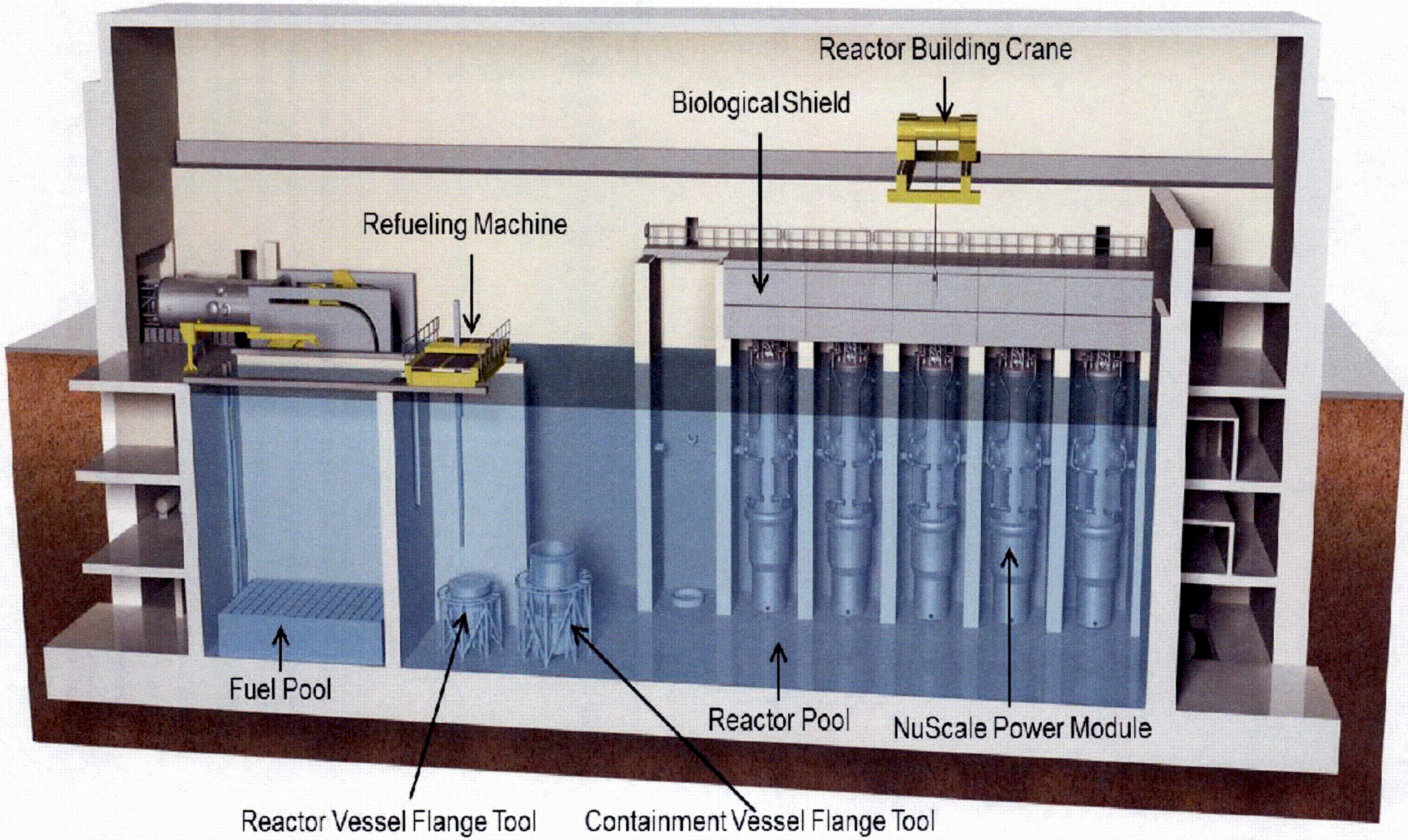
Work continues looking at different versions of these scenarios including varying location (size and elevation) of the break, mode of ECCS failure, RPV overpressure, and ATWS events

RXB and Pool Illustration



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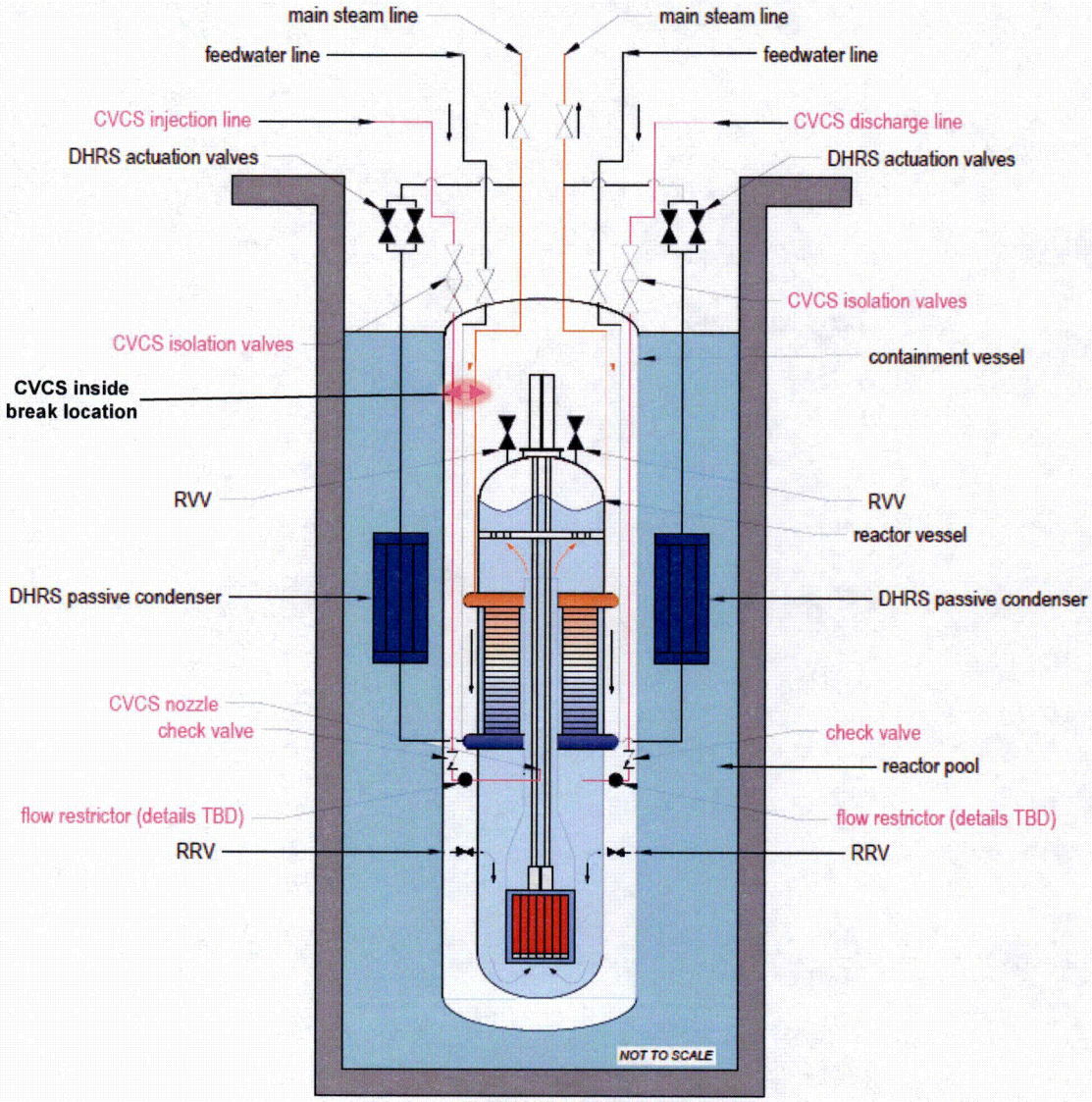
CVCS LOCA Inside Containment Sequence

- CVCS for boron control and start-up
  - nominal 2-inch injection, discharge lines
  - entire system designed for full RCS pressure
  - positive motive-force, double-valve isolation
  - isolation fail-safe on loss of power
  - check valve inside containment
  - flow restrictors adjacent to RPV penetrations
- Accident scenario initiation
  - normal, full power operation
  - CVCS line break with loss of power
  - reactor trip
- Accident progression to core damage for break inside containment
  - containment isolation actuation
  - check valve failure
  - ECCS failure
  - DHRS actuation
  - no coolant makeup



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MACCS2 Model—Inputs and Assumptions

- MACCS2 version: WinMACCS 3.10.0, MELMACCS Version 1.7.1
- Doses calculated at 0.5 km (0.31 mile) based on MACCS building wake dispersion modeling uncertainty for distances < 0.5 km

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MACCS2 Model—Inputs and Assumptions

- Radionuclides considered
  - SOARCA-based radionuclides and pseudo-stable radionuclides
- Dose conversion factors
  - FGR-11 (for inhaled exposure), FGR-12 (for external exposure), and FGR-13 (for cancer risk coefficients)
- No-evacuation model used for EPZ dose calculations
  - parameters set for no movement of population
  - peak dose found on spatial grid used for results
  - TEDE (ICRP60ED) used for EPA PAG threshold calculations
  - acute whole body (represented by A-Red Marrow) used for 200 rem limit calculations
- NuScale document, Consequence Analysis Software Input Parameters, EE-0000-2372, lists basis and assumptions

Dose Results for Typical More Probable, Less Severe Sequence

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Identify Less Probable, More Severe Scenarios and Perform Risk-Informed Evaluations of the Credibility of these Scenarios

- Use SOARCA-like process for mapping sequences into scenarios, with additional considerations for completeness, applicability to SMRs, and EPZ
  - same initial steps as Criterion b, except select scenarios > 1E-8 per plant-year
  - address multi-module and external hazards

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Less Probable, More Severe Accident Sequences (Using January 2015 NuScale Internal Events, at Power PRA)

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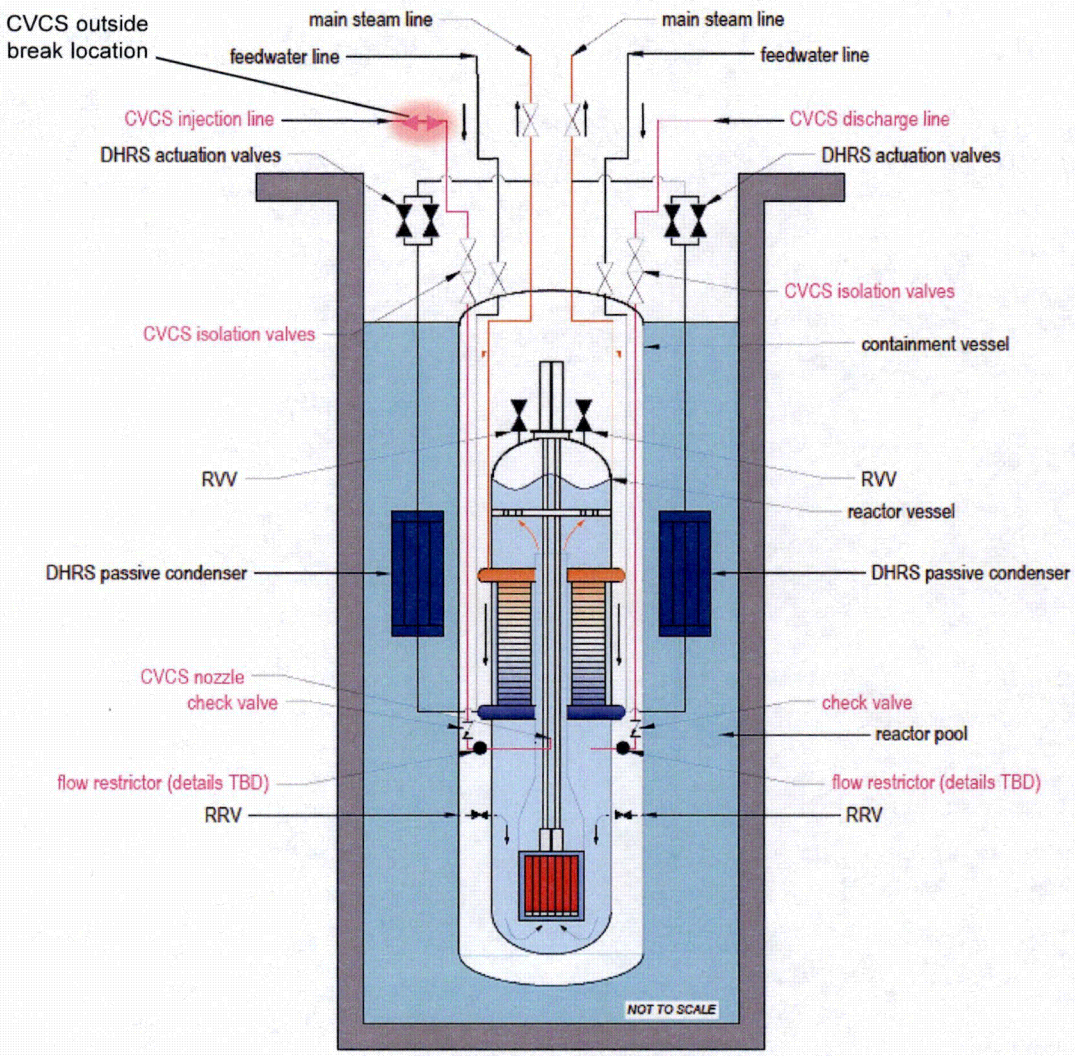
CVCS Outside Break Sequence

- CVCS for boron control and start-up
  - nominal 2-inch injection, discharge line
  - entire CVCS system designed for full RCS pressure
  - positive motive-force, double-valve isolation
  - isolation fail-safe on loss of power
  - check valve inside containment
  - flow restrictors adjacent to RPV penetrations
- Accident scenario initiation
  - normal, full-power operation
  - CVCS injection line break with loss of power
  - reactor trip
- Accident progression to core damage for break outside containment
  - containment isolation valves failure
  - check valve failure
  - ECCS failure (no actuation signal)
  - DHRS actuation
  - no coolant makeup



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Preliminary Risk-Informed Evaluation of Credibility—CVCS Outside Breaks

- CVCS injection and discharge line unisolated outside breaks (rows 1–4 from table on slide 35)

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Pressure-Induced SG Tube Failure Sequence (Unisolable Secondary Line Break)

- MS and FW lines

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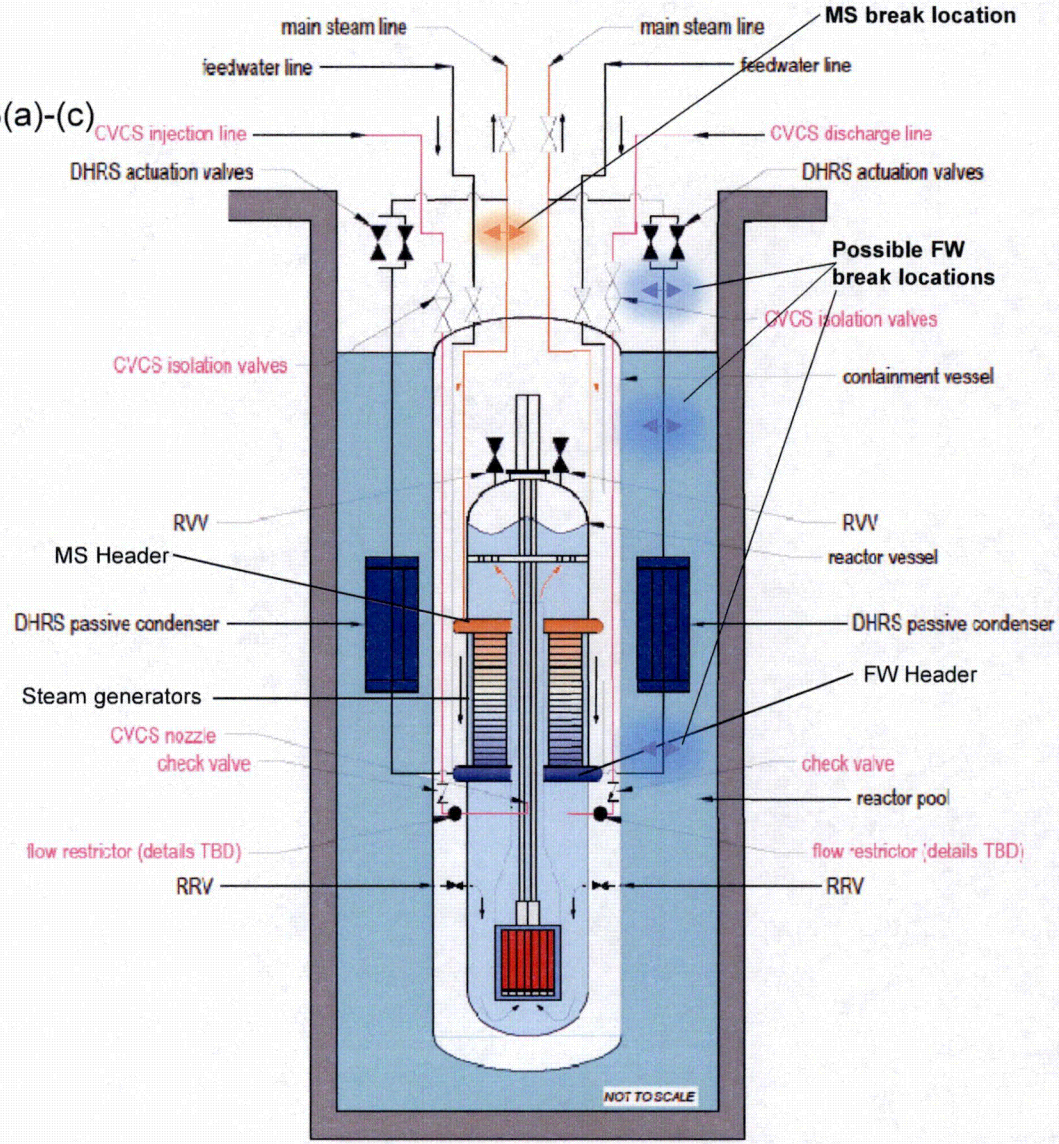
  - FW penetrates top of containment and runs down into FW header; MS exits MS header and runs up and out top of containment
  - MS—short run of unisolable pipe between containment and first isolation valve
  - FW—no unisolable pipe outside containment other than DHRS line
- Accident scenario initiation
  - normal, full-power operation
  - secondary line break in unisolable location
  - reactor trip
- Accident progression
  - MS and FW isolation valves close
  - DHRS actuation
  - SG tube assumed to fail
  - containment isolation
  - no ECCS (no actuation signal)
  - no coolant makeup



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Preliminary Risk-Informed Evaluation of Credibility—Pressure-Induced SG Tube Failure (Secondary Line Break)

- Pressure-induced SG tube failure-unisolable secondary line break (slide 35, rows 5–6)

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Secondary Line Illustration

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Secondary Line and Module Illustration

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Preliminary Risk-Informed Evaluation of Credibility—SG Tube Failure and Containment Isolation Failure

- Unisolated SG tube failure sequence (slide 35, rows 7–8)

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- Containment isolation failure (slide 35, row 9)

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Preliminary Risk-Informed Evaluations of Credibility—Summary Observations

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2. Risk-informed evaluations to date indicate none of the less probable, more severe sequences are credible for internal events, at power
3. Defense-in-depth, provisional source term evaluations are being considered for some of the scenarios defined from these sequences
   - address release timing and potential release paths which would bound consequences from large external hazards and other events with uncertainties that are hard to quantify
   - provisional because the source term evaluations, or the need for them, could be impacted by design changes under consideration

Defense-in-Depth Source Term Provisional Evaluations—Less Probable, More Severe EPZ Scenarios*

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** January 2015 NuScale internal events, at power PRA*

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Defense-in-Depth Source Term Provisional Evaluation—Release and Dose Calculation for CVCS Outside Break Scenario

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Defense-in-Depth Source Term Provisional Evaluation—Time to Start of CD Calculation for Pressure-Induced SG Tube Failure (1)

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Update on Multi-Module Risk Approach and Other Issues

- NuScale is considering the potential for multi-module (MM) accidents
- For multi-unit sites, the current regulatory framework is applied on a per unit (reactor) basis; this is appropriate for most events relevant to NuScale:
  - most external events should be treated on a per-unit basis
    - beyond-design-basis (BDB) seismic events, external floods, external fires, and high winds do not require consideration of multiple units at existing LWR sites
    - differences in spacing between NuScale modules and between reactors at typical, existing multi-unit LWR sites are irrelevant given the geographic areal extent of these events, especially severe events
  - possible exceptions—localized BDB external events, such as an aircraft impact or small areal extent but severe weather events (e.g., tornados)
  - shared systems will be evaluated consistent with approach for shared systems at existing multi-unit sites

Other Issues

- NuScale is considering a spectrum of other scenarios and activities for Chapter 19 and to support EPZ
  - containment failure—from steam, hydrogen, or other phenomena
    - analyses to date indicate no failure expected from such phenomena
    - reports documenting these analyses are being completed

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  - loss of all AC and DC power—module designed to handle this indefinitely (no core damage) with no operator action
  - internal fires and floods—being addressed; expect internal events at power to be limiting

Other Issues

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- Additional external events—designing RXB for aircraft impact; natural phenomena (high winds, tornados, flooding) being addressed
- Security events—TBD; will consider potential MM risk
- Operationally-focused mitigation capability—TBD
- Uncertainty analyses—TBD

Design-Specific EPZ Methodology and Implementation—Overall Summary

1. For more probable, less severe accident scenarios, core damage does not start for many hours and doses at 0.3 miles are well below the PAGs
2. Risk-informed evaluations to date indicate that none of the less probable, more severe scenarios is credible for internal events, at power in NuScale design
3. Provisional, defense-in-depth source term evaluations indicate:
   - long time to core damage (tens of hours)
   - significant margin exists to the 200 rem WB dose criterion at 0.3 miles
4. Work continues
   - Assess need for and nature of the provisional, defense-in-depth source term evaluations (i.e., impact of design changes under consideration)
   - more formally address uncertainties
   - consider external events, multi-module risk, and other issues

Overall Summary and Path Forward

1. Extensive NuScale and industry NRC interactions and submittals on EPZ have occurred and are planned going forward
2. Clearly defined NuScale EP Licensing plan integrates NEI guidance and joint NuScale-COL applicant tasks
3. NuScale design offers unique opportunities to optimize EPZ size for SMRs
   - update the 1970s generic process where EPZ margins were "qualitatively found adequate as a matter of judgment" (SECY-97-020)
   - perform risk-informed evaluations to balance insights from a deterministic assessment of the adequacy of defense-in-depth with quantitative risk insights
   - use severe accident knowledge from last 40 years and plant-specific PRA
4. Preliminary NuScale EPZ results indicate significant times to start of core damage and significant margin to dose limits
5. EPZ update NRC presentation planned around time of LTR submittal

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