Dynamical System Scaling Methodology

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NuScale Power™

Introduction

- As part of its pre-engagement activities with the NRC, NuScale is seeking review and approval of its scaling methodology topical report.
  - *Dynamical System Scaling (DSS) Methodology, NP-TR-1010-867-P, Revision 1* was issued to NRC on February 2011 (ML 110680401, Project 0769).
- Independent review of the DSS Methodology and supporting mathematics was performed by M.L. Corradini and M. Sracic, University of Wisconsin-Madison, with support from faculty in dynamical systems analysis and dynamical system identification.

Presentation Objective and Outline

- The objective of this presentation is to provide an overview of the Dynamical System Scaling Methodology.
  - *Part 1: [[ ]]* 3(a)-(b)
  - *Part 2: Dynamical System Scaling – Integral System Scaling*
  - *Part 3: Application of the DSS Methodology to the Evaluation Model Development and Assessment Process (EMDAP) described in NRC Regulatory Guide 1.203*
  - *Part 4: Application to Single-Phase Natural Circulation*

PART 1

[[ ]]3(a)-(b)

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Definitions

- **System:** A finite control volume containing a conserved quantity such as mass, momentum, or energy and acted upon by internal and external agents of change.

- **Conserved Process:** The sequential transition of the state of the system; the transition sequence governed by an integral system balance law constrained by the system's initial state and boundary conditions.

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PART 2

Dynamical System Scaling – Integral System Scaling

IST Facility Scaling Objectives

- To develop a properly scaled test facility, the following specific objectives must be met for each operational mode of interest.
  - The thermal hydraulic processes that should be modeled have been identified.
  - The similarity criteria that should be preserved between the test facility and the full-scale prototype have been obtained.
  - The priorities for preserving the similarity criteria have been established.
  - Specifications for the test facility design or modifications have been provided.
  - Biases due to scaling distortions have been quantified.
  - The critical attributes of the test facility that must be preserved to meet Quality Assurance requirements have been identified.

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PART 3

Application of the DSS Methodology to the Evaluation Model Development and Assessment Process (EMDAP) described in NRC Regulatory Guide 1.203

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PART 4

Application to Single-Phase Natural Circulation

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Summary and Conclusions

- Provided an overview of the Dynamical System Scaling Methodology.
  - *Part 1: [[ ]]*[3(a)-(b)]
  - *Part 2: Dynamical System Scaling – Integral System Scaling*
  - *Part 3: Application of the DSS Methodology to the Evaluation Model Development and Assessment Process (EMDAP) described in NRC Regulatory Guide 1.203.*
  - *Part 4: Application to Single-Phase Natural Circulation*
- DSS Methodology is being applied to the design of NuScale thermal fluid IST and SET facilities.
- As part of its pre-engagement activities with NRC, NuScale is seeking review and approval of its scaling methodology topical report.
  - *Dynamical System Scaling (DSS) Methodology, NP-TR-1010-867-P, Revision 1* was issued to NRC on February 2011 (ML 110680401, Project 0769).

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