

Dynamical System Scaling Methodology



Dr. José N. Reyes, Jr.
Chief Technology Officer

February 29, 2012

**U.S. Nuclear Regulatory Commission
Pre-Application Meeting
Rockville, MD**



DRAFT

© NuScale Power, LLC 2012

Introduction

- As part of its pre-engagement activities with NRC, NuScale is seeking feedback on its scaling methodology topical report.
 - *Dynamical System Scaling (DSS) Methodology, NP-TR-1010-867, Revision 1* was issued to NRC on February 2011.
- Independent review of DSS Method 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 Objectives and Outline

- 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 (DSS) – 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)}

[[

]]^{3(a)-(c)}

]]3(a)-(c)

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.

]]3(a)-(c)

]]^{3(a)-(c)}

]]^{3(a)-(c)}

[[

]]3(a)-(c)

]]^{3(a)-(c)}

]]3(a)-(c)

]]^{3(a)-(c)}

]]3(a)-(c)

[[

]]^{3(a)-(c)}

]]3(a)-(c)

[[

]]3(a)-(c)

[[

]]^{3(a)-(c)}

[[

]]^{3(a)-(c)}

[[

]]^{3(a)-(c)}

]]3(a)-(c)

]]^{3(a)-(c)}

]]3(a)-(c)

]]3(a)-(c)

[[

]]3(a)-(c)

PART 2

Application of DSS to integral Systems

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.

[[

]]^{3(a)-(c)}

]]^{3(a)-(c)}

[[

]]3(a)-(c)

]]3(a)-(c)

[[

]]^{3(a)-(c)}

PART 3

Application of DSS to EMDAP

[[

]]^{3(a)-(c)}

[[

]]3(a)-(c)

[[

]]3(a)-(c)

PART 4

Application of DSS to the NuScale IST – Single-Phase Natural Circulation

[[

]]3(a)-(c)

]]3(a)-(c)

[[

]]3(a)-(c)



[[

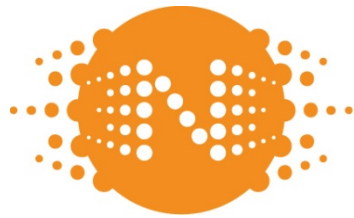
]]3(a)-(c)

]]3(a)-(c)

[[

]]^{3(a)-(c)}

- DSS Methodology is being applied to the design of NuScale IST and SET facilities.
- As part of its pre-engagement activities with NRC, NuScale is seeking feedback on its scaling methodology topical report.
 - Dynamical System Scaling (DSS) Methodology, NP-TR-1010-867, Revision 1 was issued to NRC on February 2011.
- Provided an overview of the Dynamical System Scaling Methodology
 - Part 1: [[]]^{3(a) (b)}
 - Part 2: Dynamical System Scaling (DSS) – 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



NUSCALE POWER™

*1100 NE Circle Blvd., Suite 350
Corvallis , OR 97330
541-207-3931*

<http://www.nuscalepower.com>

