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The Power Journey –

A cursory Account of the Recent History of Power Spectral Density Functions in Seismic Input Motion Development

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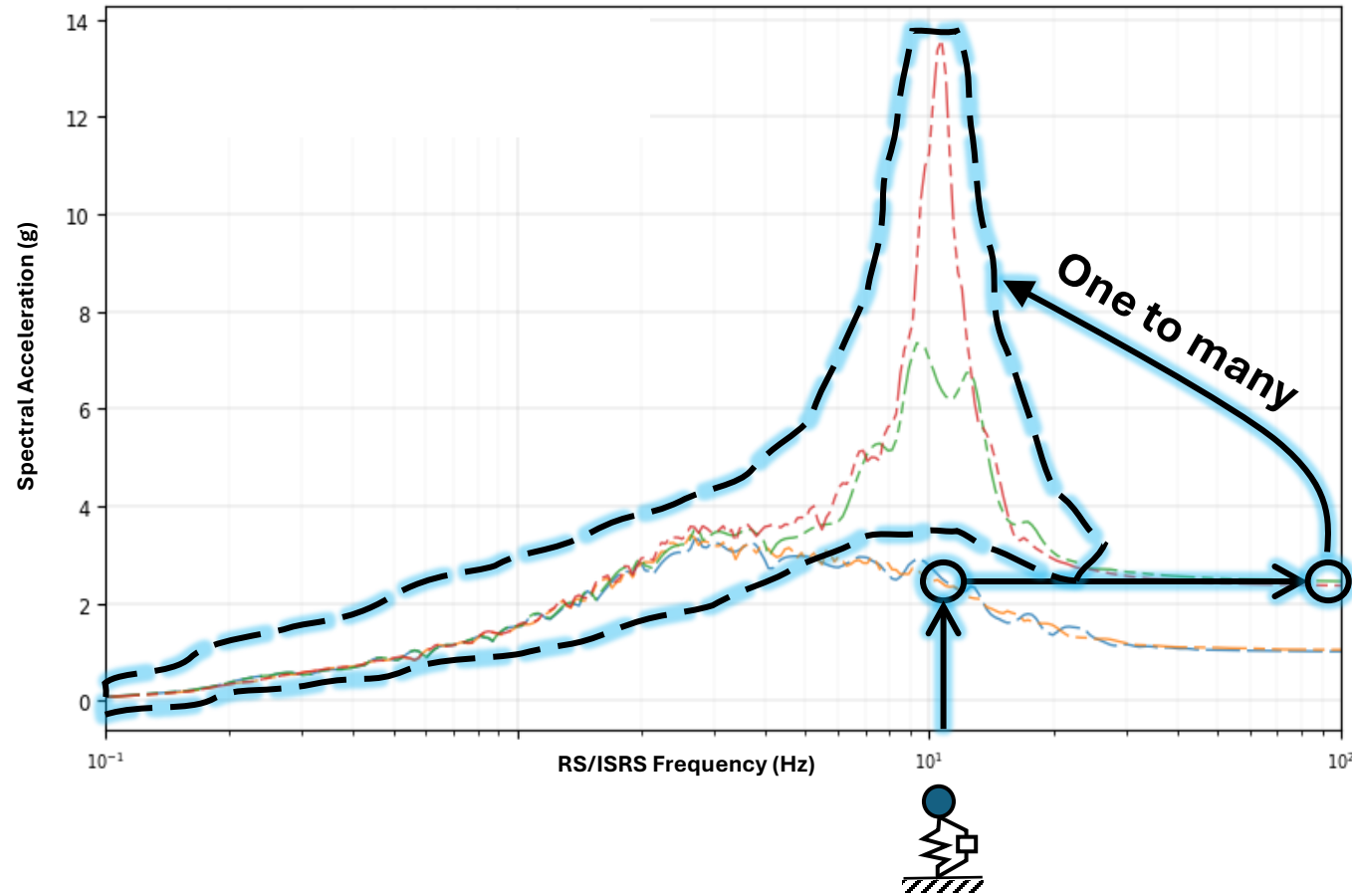
Goal

Seek a shared reflection of the century-long evolution of response spectra (RS) and power spectral density (PSD) in seismic motion characterization (SMC) and seismic input motion development (SIMD)

Outline

- Background
- The evolution of NRC's Standard Review Plan (SRP) on seismic input motion acceptance criteria
- A cursory account of the history of RS and PSD in SMC/SIMD
- One way to meet both PSD and RS criteria
- Introduction of the NRC/NEA SIMD Workshop in May 2026

Background: RS Matching Criteria Alone are Not Adequate

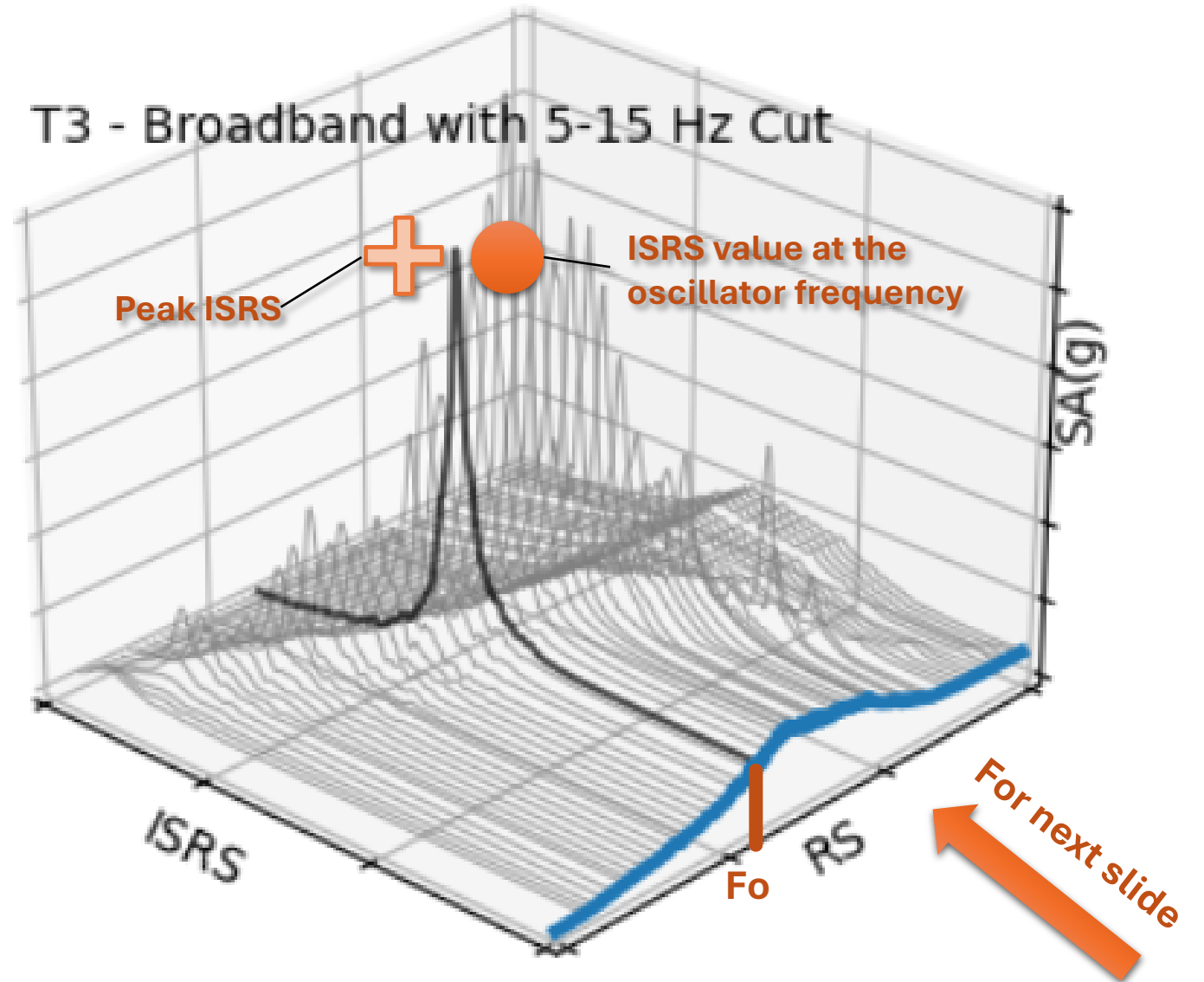


ZPA: Zero Period Acceleration
ISRS: In-Structure Response Spectra

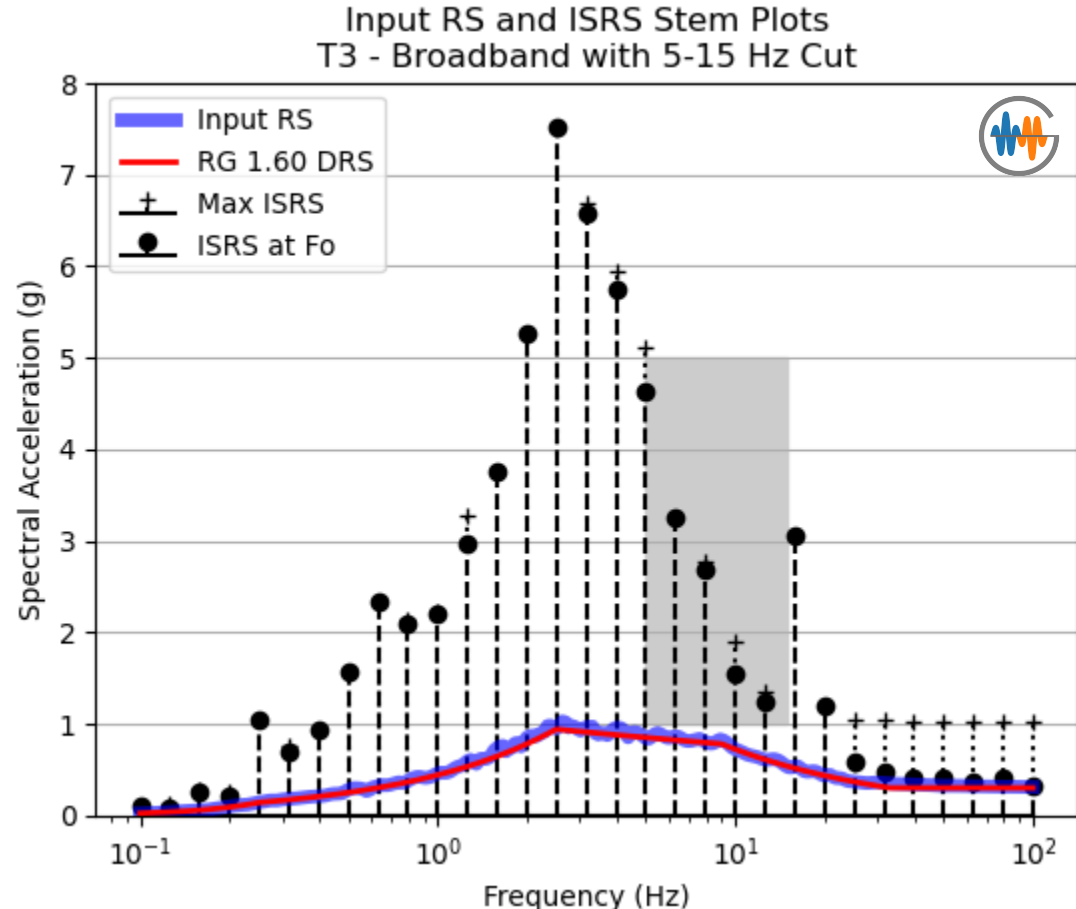
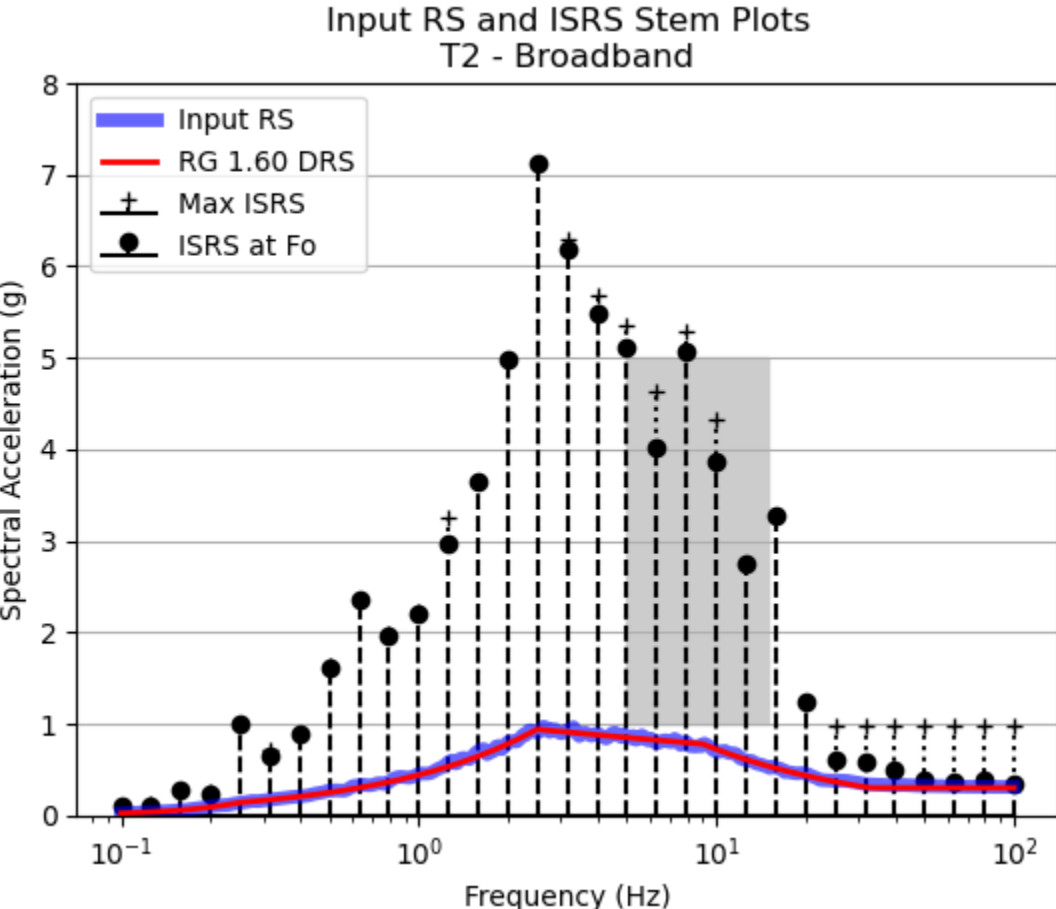
RS ≡ ZPA on ISRS

RS \equiv ZPA on ISRS
in 3D

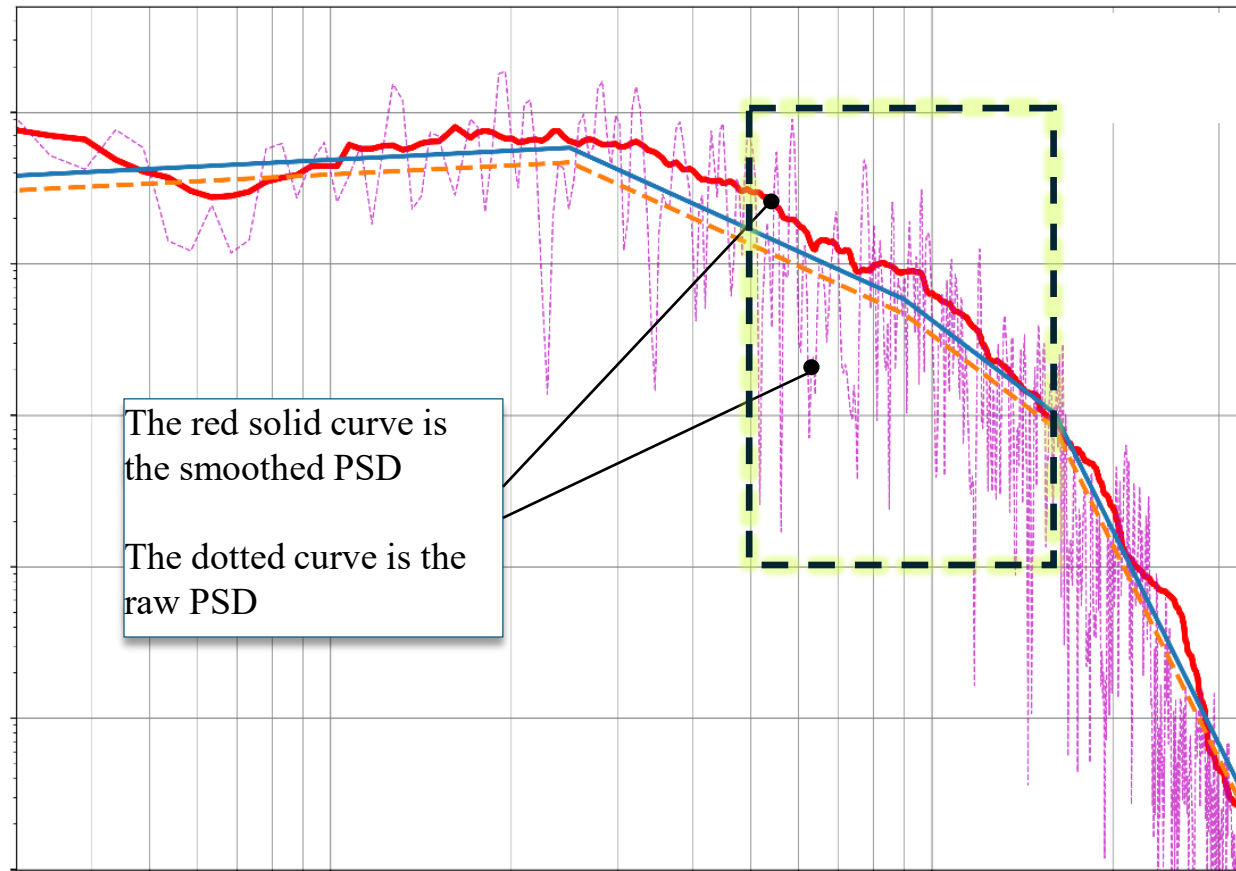
T3 - Broadband with 5-15 Hz Cut



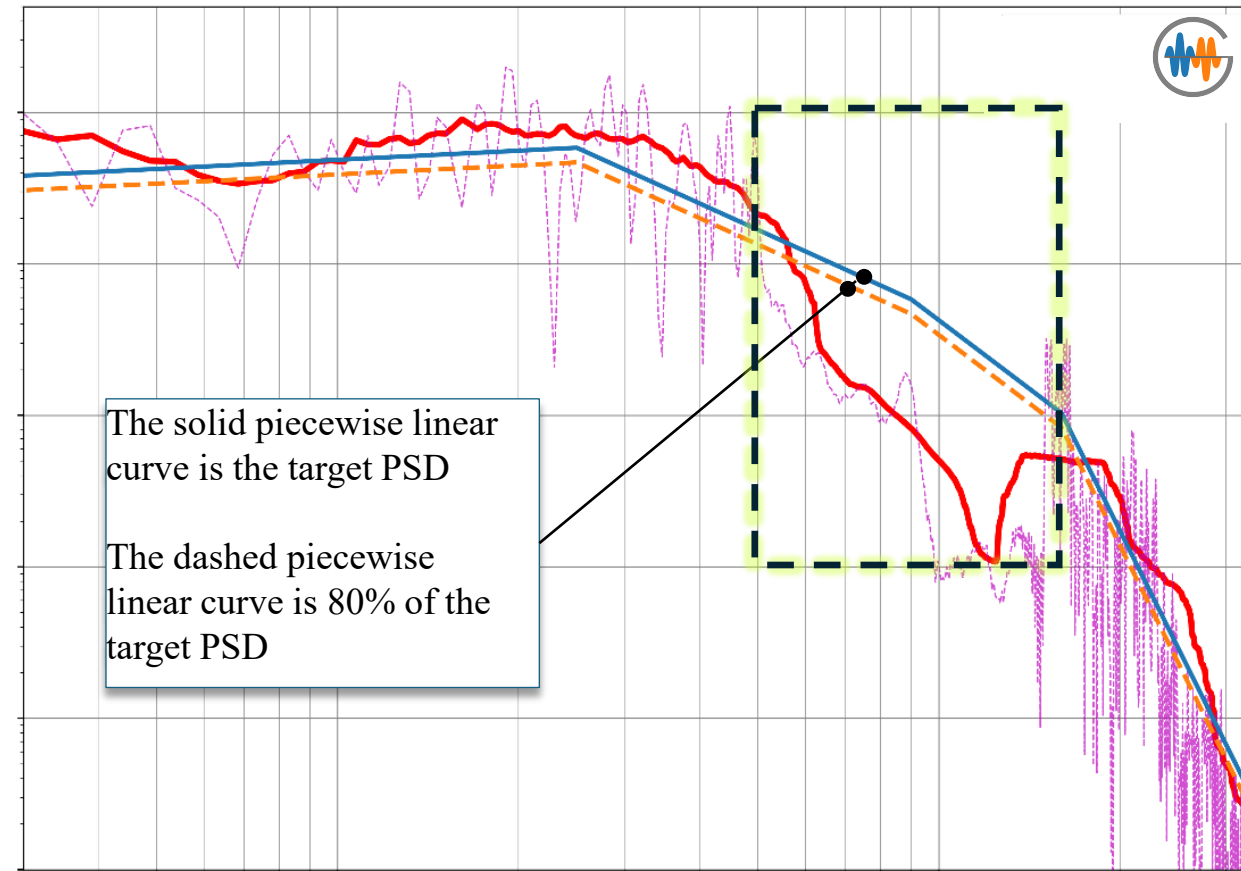
Very Similar RS but Vastly Different ISRS (5 Hz – 15 Hz)



Comparison of PSD from 5 Hz to 15 Hz

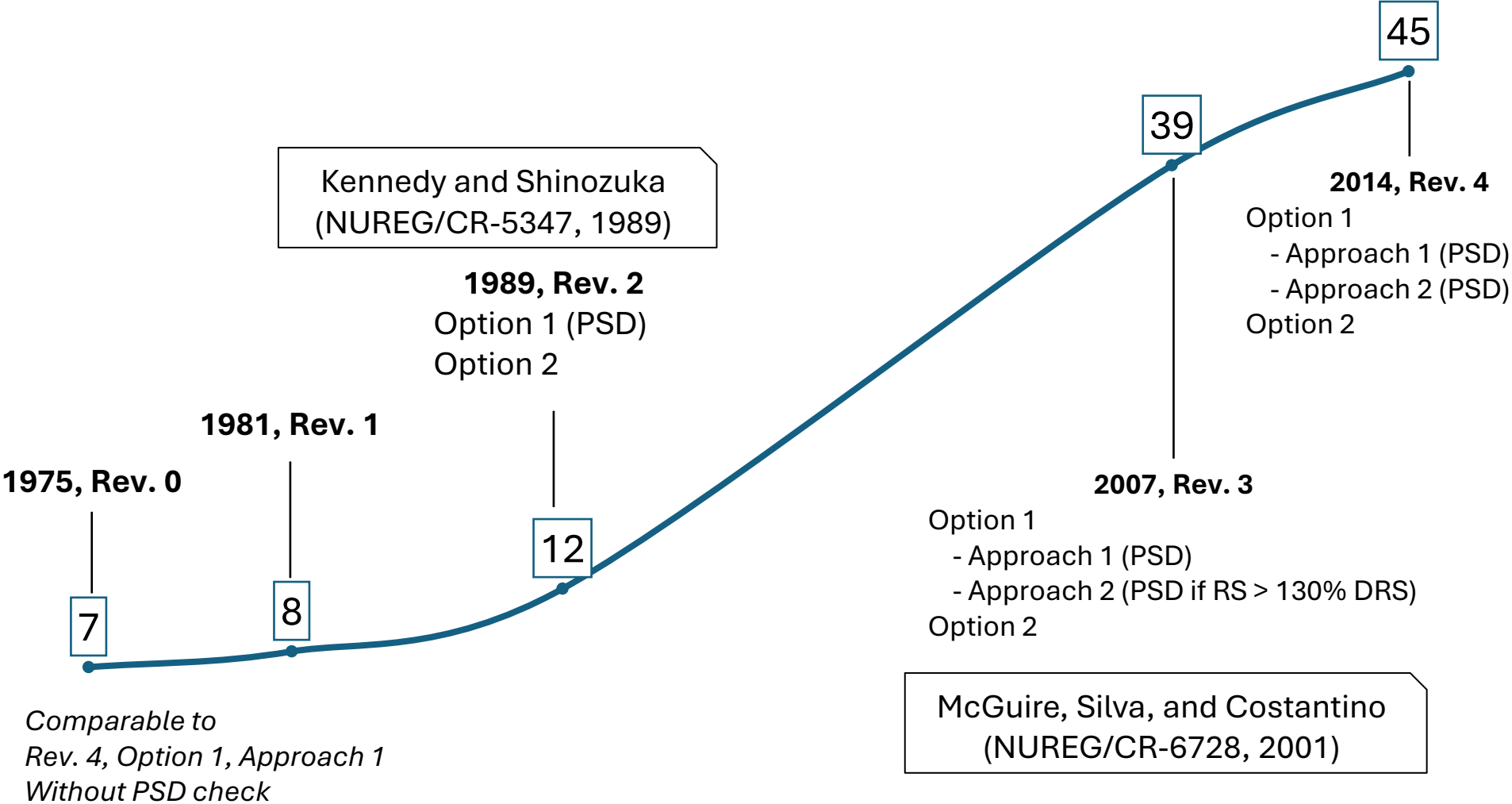


T2 - Broadband

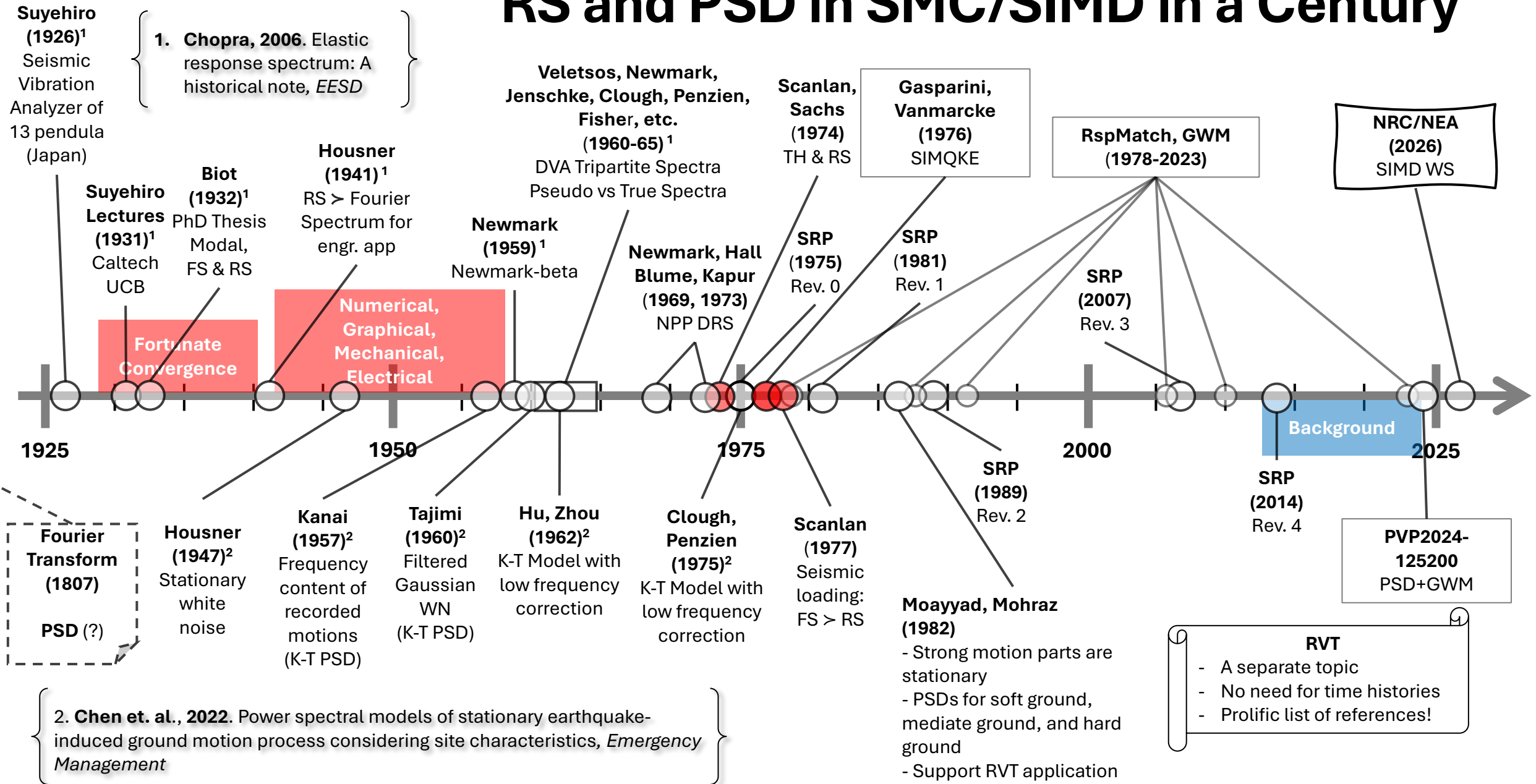


T3 - Broadband with 5-15 Hz Cut

SRP Section 3.7.1 Revision History

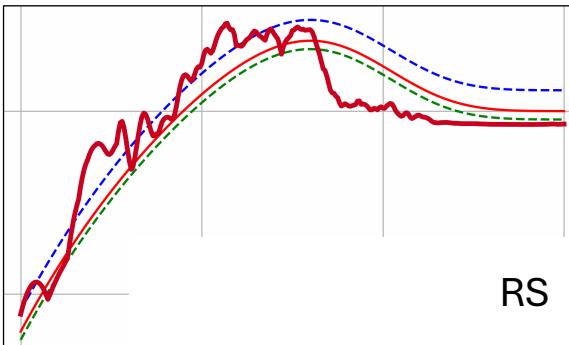
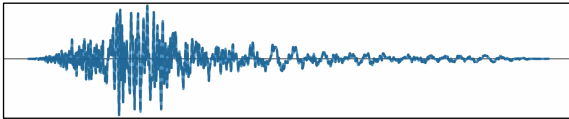


RS and PSD in SMC/SIMD in a Century

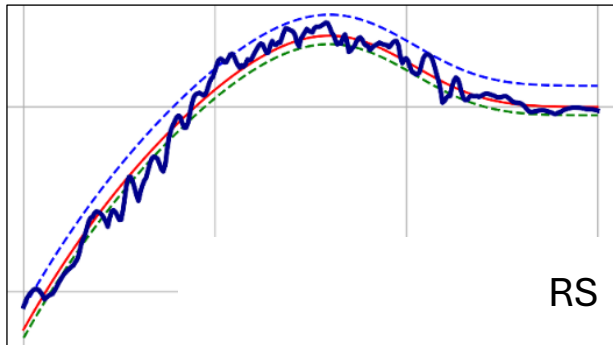
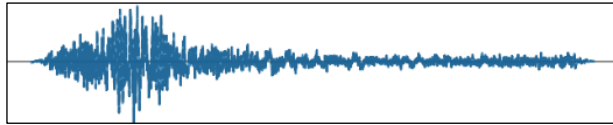


One Way to Meet Both PSD and RS Criteria (PVP2024-125200)

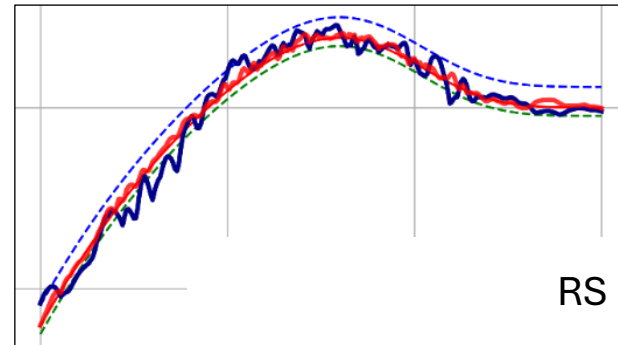
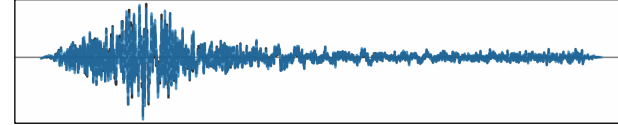
① Select an initial seed record



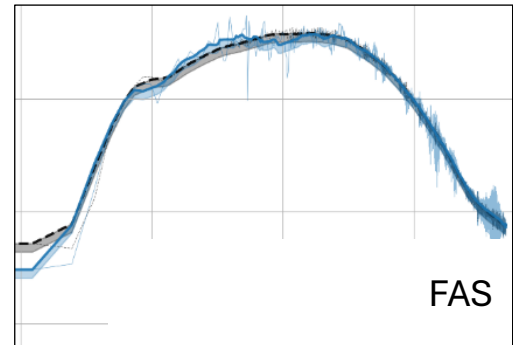
② Use target PSD to replace Fourier amplitudes



③ Use GWM for RS matching



Smooth & broad
Fourier amplitude
spectra (FAS)



The May 2026 NRC/NEA Workshop

Seismic Input Motion Development (SIMD) for Analysis and Design of Nuclear Installations

A convergence of (1) the evolution of the SRP and (2) the decades-long recognition that PGA and RS are incomplete indicators of the damaging capacity of seismic motions.

Objectives

- 1) Share the current state of practice in SIMD among member states,
- 2) Raise awareness of the necessity for PSD checks,
- 3) Achieve consensus for integration of RS matching and PSD checks, and
- 4) Explore future activities to complement RS with PSD or other good practices for seismic hazard analysis, seismic load specification, seismic analysis and design, and seismic risk assessment.

Welcome all to join the workshop!!!

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