# Burnup Credit for MPC-32

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May 15, 2001

# Burnup Credit for MPC-32 - Overview

- References
- Holtec MPC-32
- Content of Holtec Topical Report
- Burnup versus Initial Enrichment Curves
- Limitations of ISG-8, Rev. 1

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# References

- DOE Topical Report on Actinide-Only Burnup Credit for PWR Spent Nuclear Fuel Packages, DOE/RW-0472, Revision 2, September 1998
- NRC Interim Staff Guidance No. 8 (ISG8), Rev.1, July 1999
- RIL-178, “Burnup Credit for Transport and Dry Cask Storage of Spent Nuclear Fuel”, February 2001

# Holtec MPC-32

- High Density, Non-Fluxtrap Design
- Basket similar to Wet Storage Region 2 Rack
- Re-introduced in LAR 1014-1 (HI-STORM Storage), currently under review
- Credit for Soluble Boron in Pool Water for Storage
- Enrichment Limits for Fresh Fuel
  - 5 % *with* Credit for Soluble Boron (Storage, Loading Operations)
  - ~ 2 % *without* Credit for Soluble Boron (Transportation, Accident condition assuming flooded MPC)

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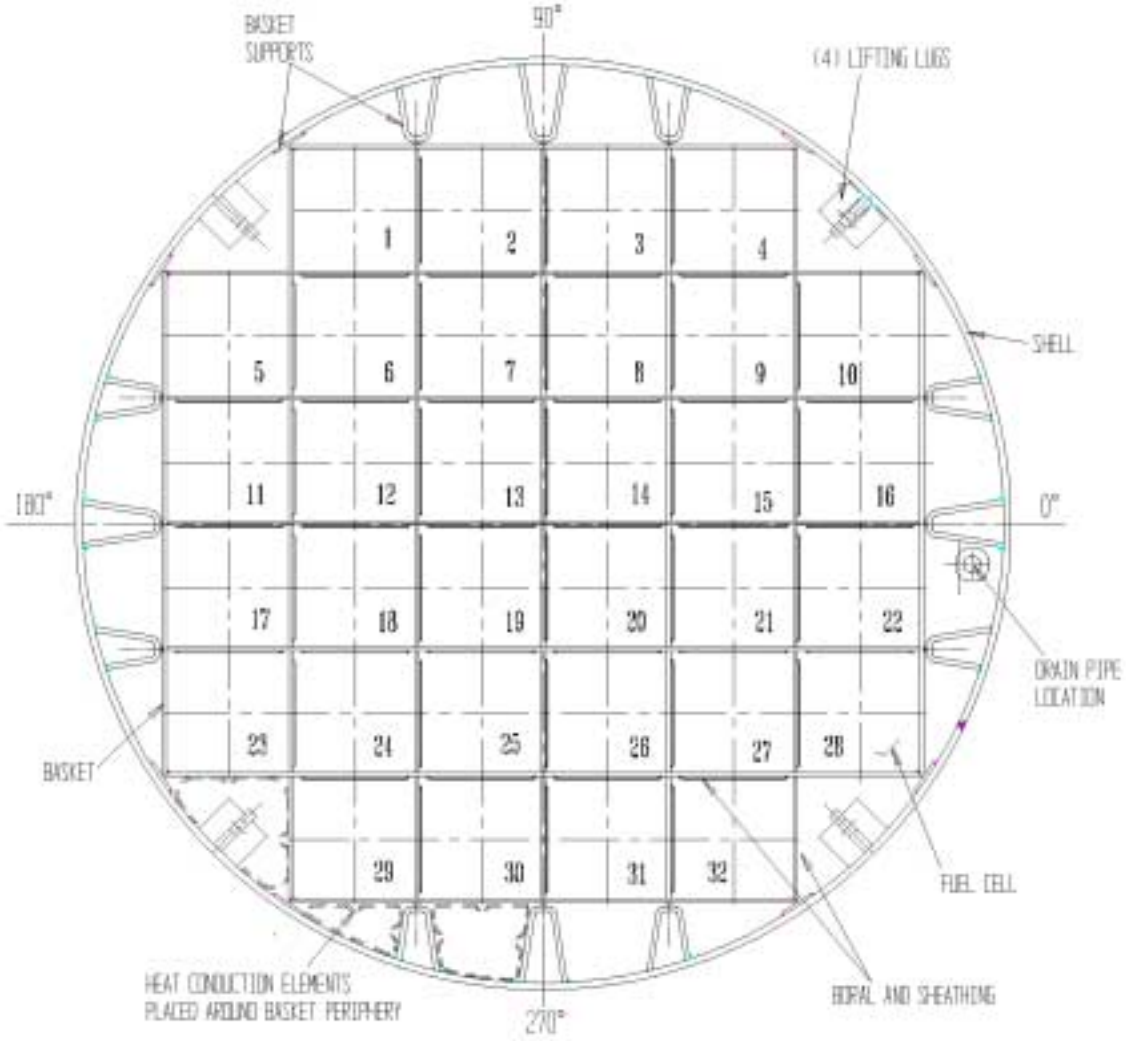
# MPC-32 Cross Section

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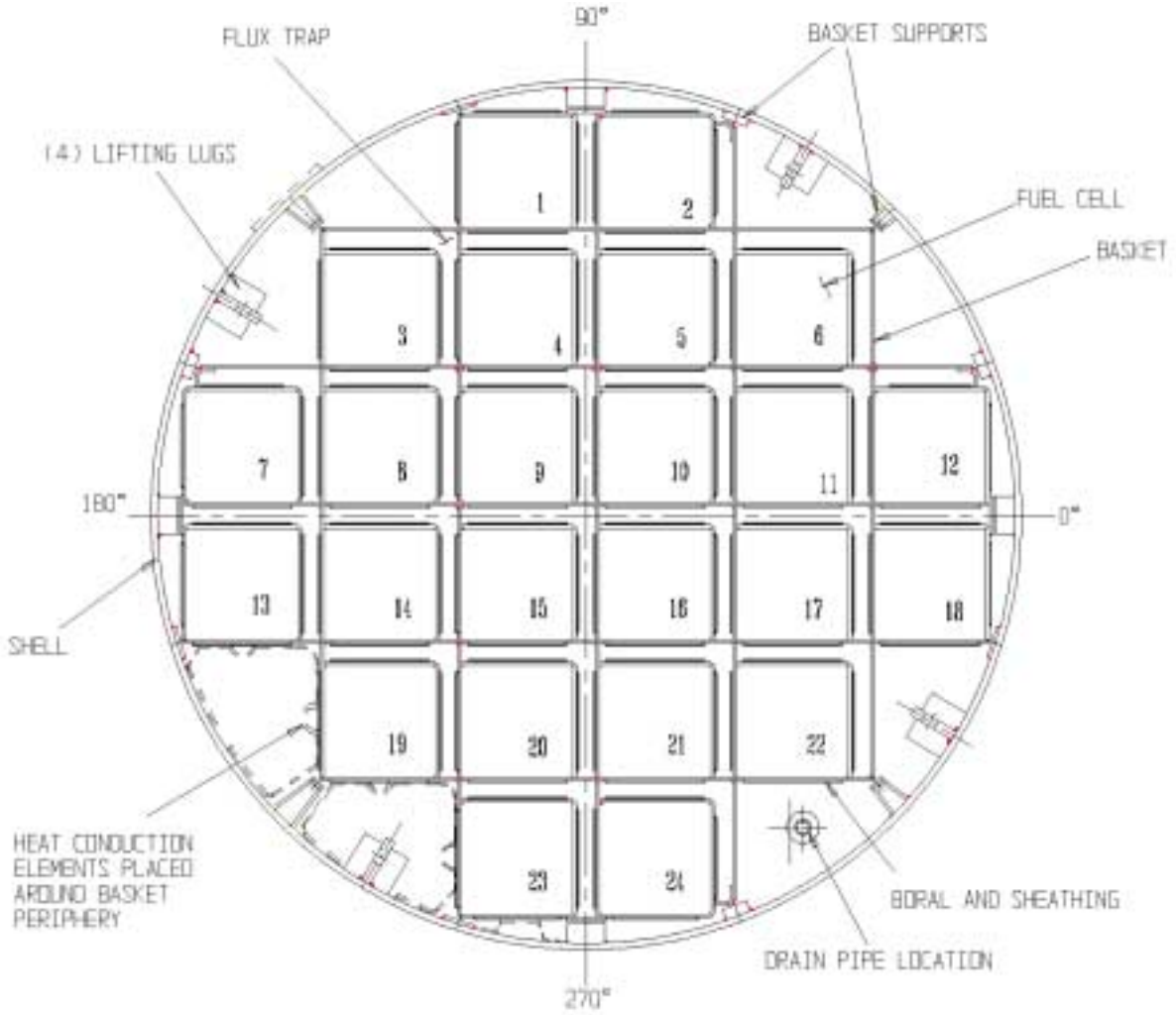
# MPC-24 Cross Section

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# Content of Holtec Topical Report

- Overall Goal
- Selection of Fuel Assemblies
- In-Core Operating Parameters
- Isotope Selection
- Axial Burnup Profiles
- Benchmarked Criticality Codes
- Burnup versus Initial Enrichment Curves
- Proposed Changes to ISG 8, Rev. 1

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# Overall Goal

- MPC-32 transportable with reasonable initial enrichment / burnup requirements
- Minimum required burnup as a function of initial enrichment for all fuel assembly types

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# Selection of Assemblies

- All PWR assembly types (14x14, 15x15, …) listed in our current CoCs and LAR
- Separate Burnup vs. Enrichment curve for each assembly type
- ISG 8 excludes assemblies with burnable absorbers
  - Assemblies with integrated absorbers (IFBA, Gadolinia, Erbia)
  - Assemblies that contained BPRAs or similar devices during in-core operation

# In-Core Operating Parameters

- Reactivity of spent fuel not only depends on burnup and initial enrichment, but also on in-core operating parameters
  - Fuel Temperature
  - Moderator (Water) Temperature
  - Power Density
  - Soluble Boron Concentration
- Bounding values for these parameters are established for six different assembly types:
  W 14x14, 15x15 and 17x17, B&W 15x15, CE 14x14 and 16x16

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# Isotope Selection

- Burnup vs. Enrichment Curves
  - 10 major actinides (U, Pu, Am)
  - Benchmarked through chemical assays
- Demonstration of  reactivity margin
  - All Actinides and Fission Products
- ISG 8 Limits cooling time to 5 years
  - Reactivity decreases with increased cooling time

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# Axial Burnup Profiles

- Reactivity of spent fuel is dominated by the lower burned ends of the assemblies
- Profiles depend on burnup and assembly type
  - Profiles tend to become flatter with increasing burnup
  - Some assembly types show different profiles due to control components
- Profiles must be bounding
- Holtec developed methodology to determine bounding profiles
- Based on YAEC database of ~3000 profiles
- Sets of bounding profiles for different assembly types

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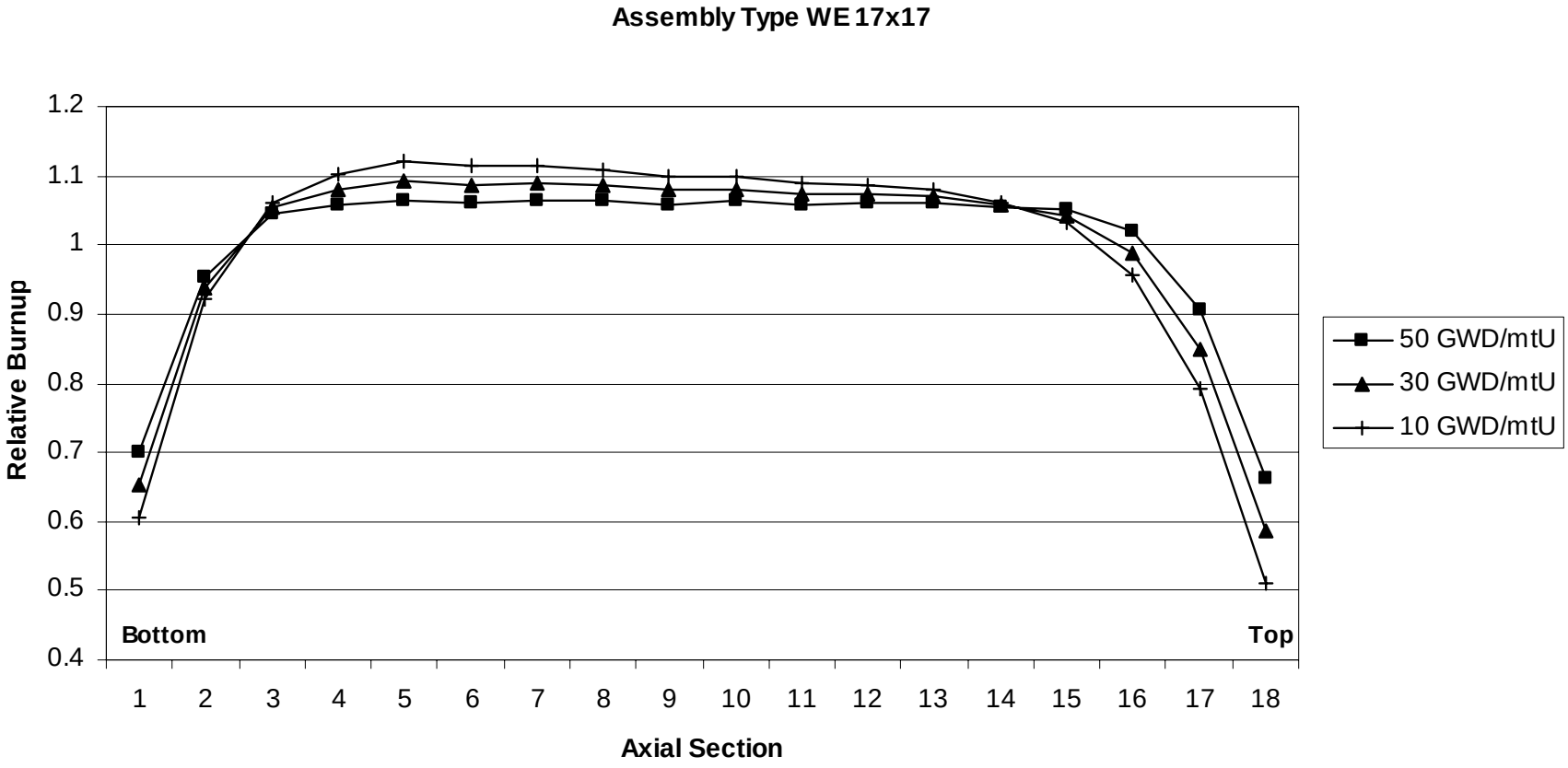
# Axial Burnup Profiles (cont'd)

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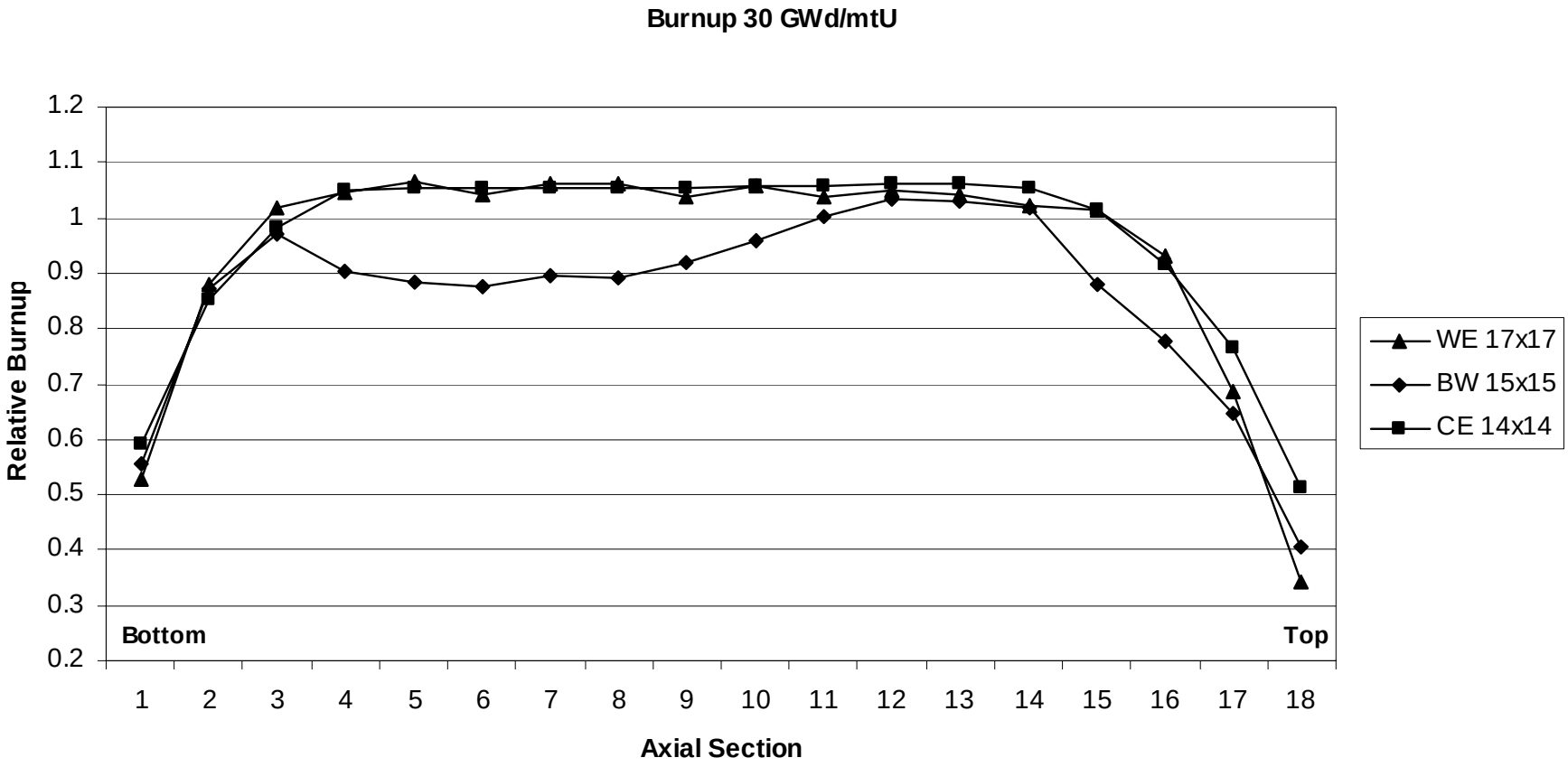
# Axial Burnup Profiles (cont'd)

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# Benchmarked Criticality Codes

- MCNP4a
- Benchmark calculations using critical experiments
  - Fresh UO2 fuel (56 experiments)
  - Fresh MOX fuel, which is similar to spent fuel in its actinide composition (36 experiments).

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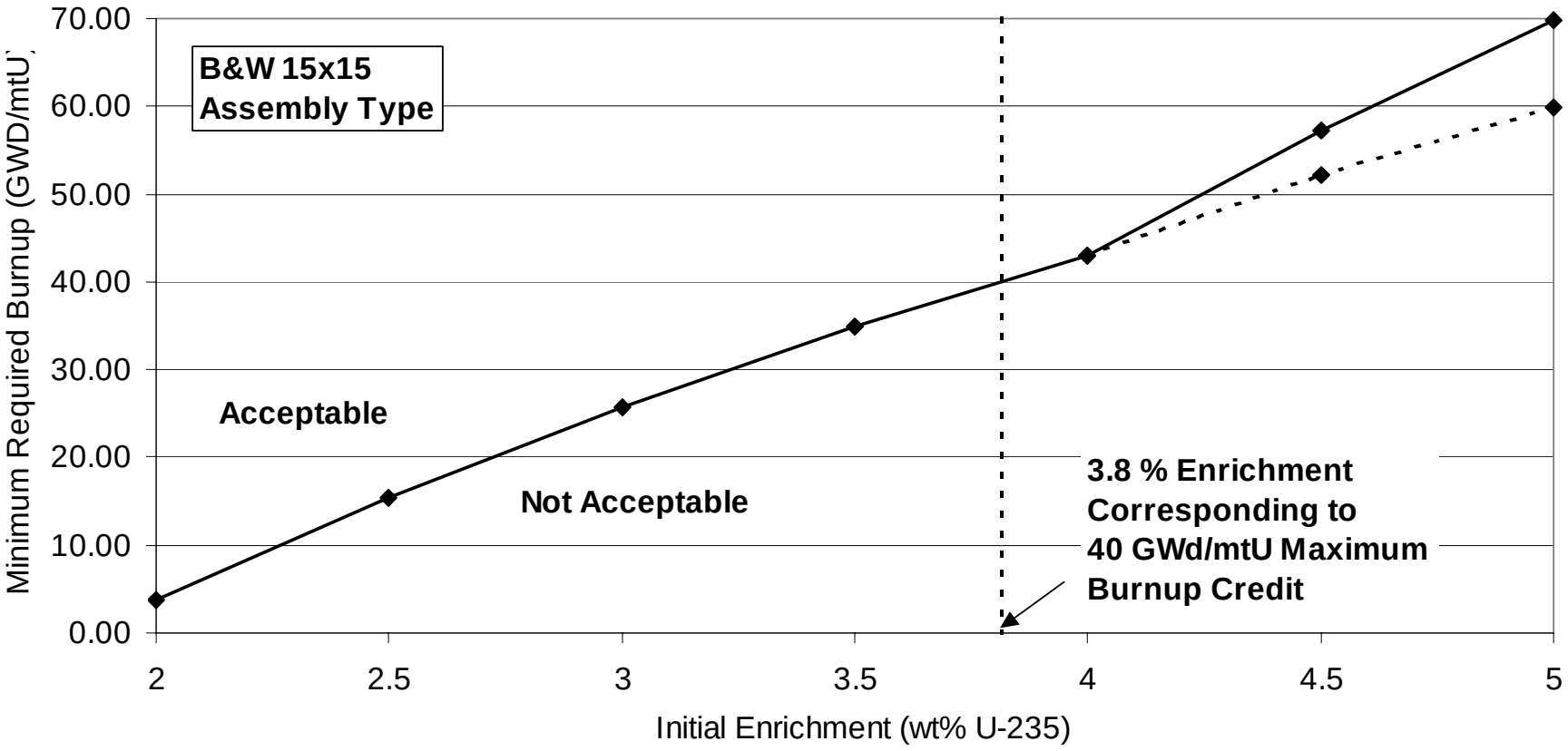
# Burnup versus Initial Enrichment Curves (ISG 8, Rev. 1)

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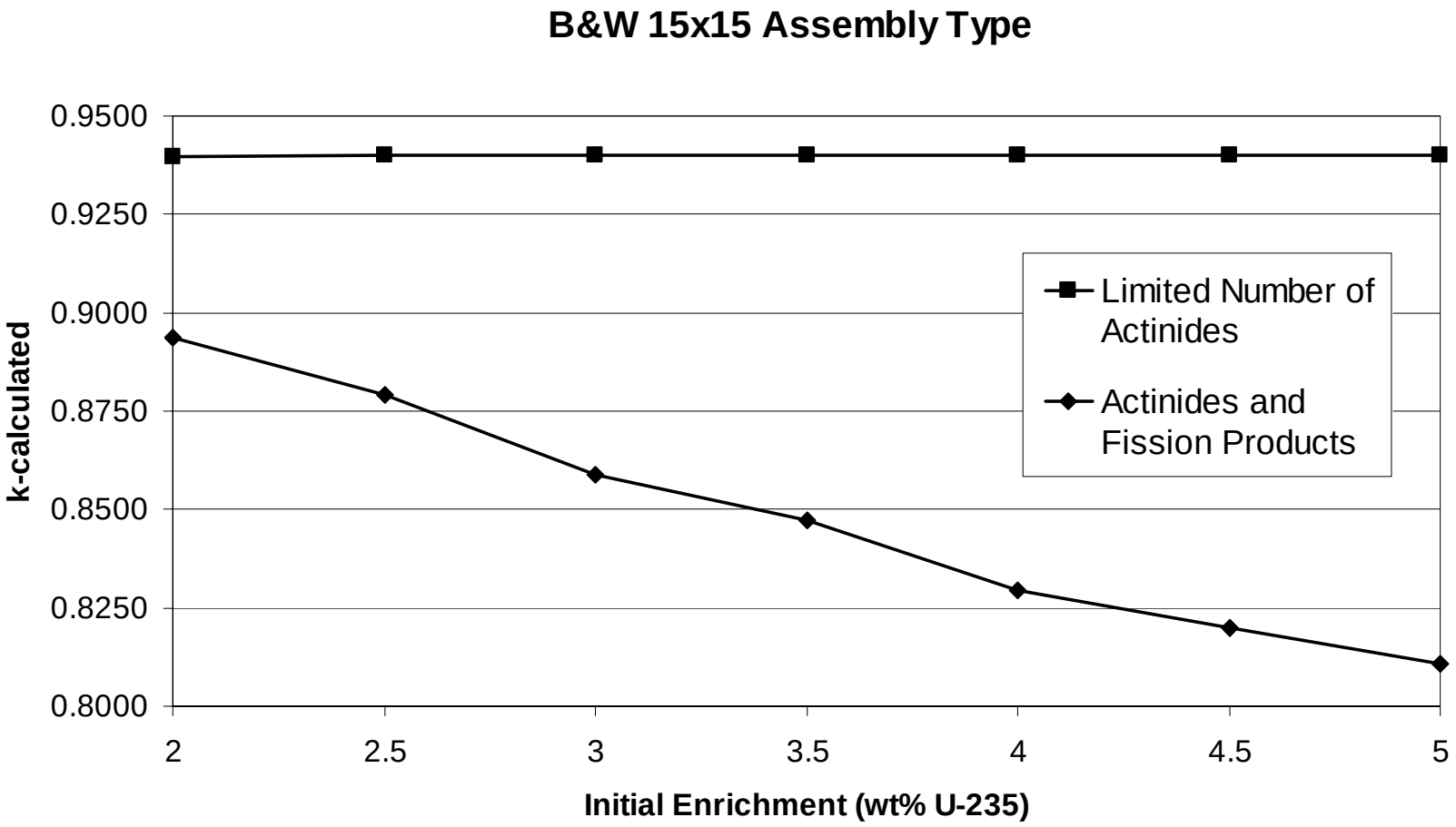
# Safety Margins in Reactivity

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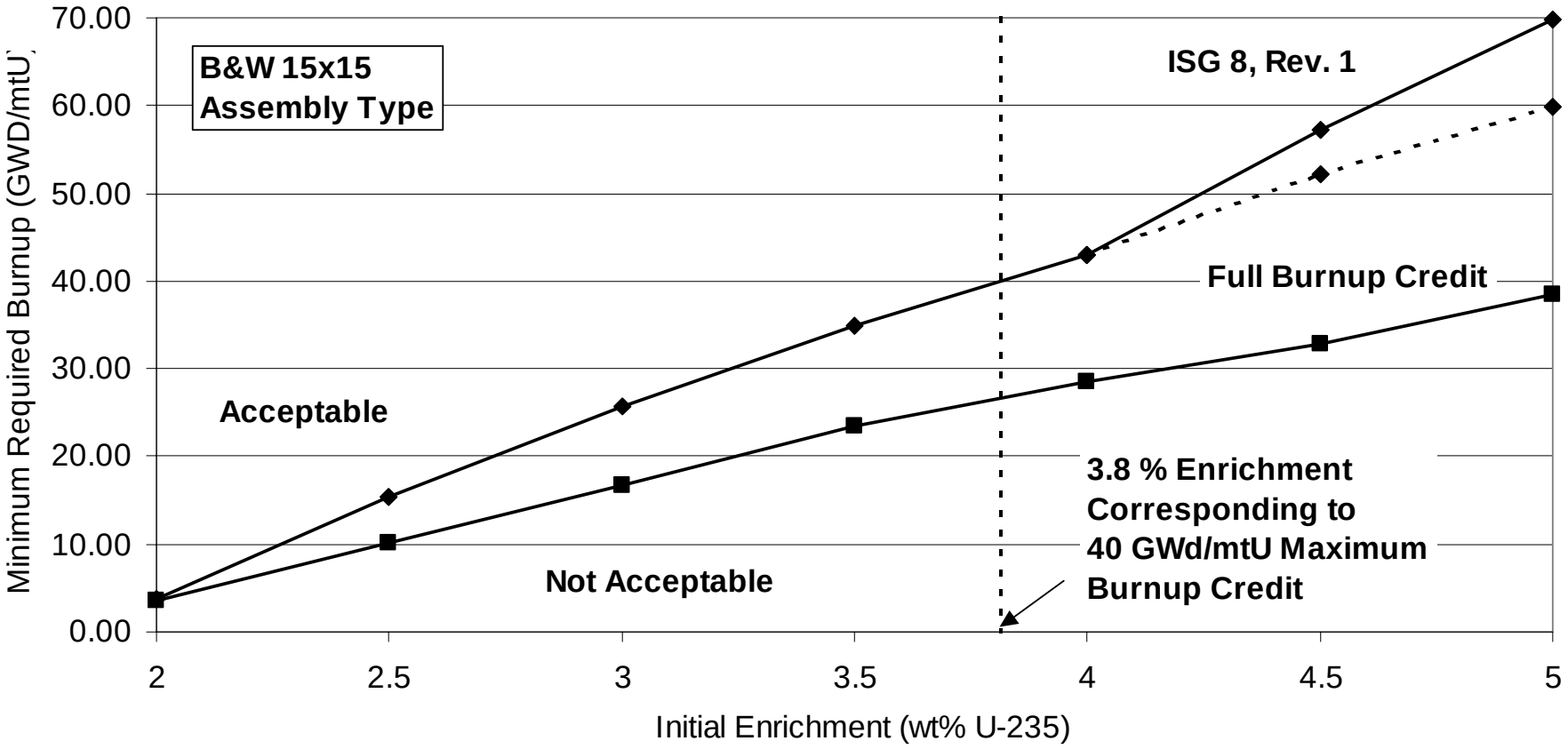
# Burnup versus Initial Enrichment Curves (ISG 8, Rev. 1 and Full Burnup Credit)

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# Limitations of ISG-8, Rev. 1

- Limitations addressed in RIL-178
  - Excludes assemblies with burnable absorbers
    - Assemblies that contained BPRAs or similar devices during in-core operation
    - Assemblies with IFBA rods, Gadolinium, Erbium
  - 5 years cooling time only
    - Reactivity reduces with longer cooling time
    - Longer cooling times are more representative for transportation
  - Additional penalty for > 4% initial enrichment
- Burnup credit limited to 40 GWD/mtU
- Credit only for a limited number of actinides (no fission product credit)

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