



A BNFL Group Company

WCAP-15942-P Summary

Fuel Assembly Mechanical Design Methodology for Boiling Water Reactors – Supplement 1

NRC/Westinghouse Meeting
Washington, D.C.
July 8, 2004



Agenda

- **Background**
- **General Approach to WCAP-15942-P**
- **Contents and Summary of Anticipated WCAP-15942-P**
- **Discussion**

Background

- **Current Licensed Mechanical Design Methodology**
 - **CENPD-287-P-A: ABB Fuel Assembly Mechanical Design Methodology for BWR Fuel**
 - **CENPD-285-P-A: Fuel Rod Design Methods for Boiling Water Reactors (STAV, VIK, COLLAPS)**
- **SER Restrictions on STAV6.2 (CENPD-285-P-A)**
 - **50 GWd/MtU Rod Average Burnup**
 - **Restrictions on Creep Model Uncertainty for No Clad Lift Off**
 - **Very Conservative FGR model > 40 GWd/MtU**
 - **Melt Temperature Penalty – Lack of Conductivity Degradation**
 - **8 wt/% Maximum Gadolinia**
- **Restrictions accommodated in application methodology described in CENPD-287-P-A**

Overview of Goals

- Update STAV 6.2 Code and Methodology to Support 62 MWd/KgU Peak Rod Average Burnup
 - **Supplement to CENPD-285-P-A: STAV7.2 Code (WCAP-15836-P)**
 - **Supplement to CENPD-287-P-A: Methodology (WCAP-15942-P)**
- STAV7.2 Improvements – Supplement to CENPD-285-P-A
 - **Address NRC concerns, more physically-based models, improved data base, improved numerics**
- Methodology - Supplement to CENPD-287-P-A
 - **Improved methodology without requirements specific to STAV6.2**
 - **Justify application methodology to support rod-average burnup of 62 MWd/kgU**
- New Information Provided as Supplements to Existing LTRs to Facilitate NRC Review

Fuel Performance Methods Supplement - WCAP-15836-P

<u>Report No</u>	<u>Title</u>	<u>Submittal Date</u>	<u>Approval Date</u>
WCAP-15836	Fuel Rod Design Methods for Boiling Water Reactors – Supplement 1		

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- Responses to 23 RAI's submitted 4/04
- Responses to 10 remaining RAIs – 7/30

Fuel Performance Methods Supplement - WCAP-15836-P

■ STAV7.2 Improvements

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Fuel Performance Methods - WCAP-15836-P

- STAV7.2 Revisions described in RAI Responses



Fuel Performance Methodology - WCAP-15942-P

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WCAP-15942	Fuel Assembly Mechanical Design Methodology for Boiling Water Reactors – Supplement 1		

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General Approach - WCAP-15942-P

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Chapters – CENPD-287-P-A and WCAP-15942-P

- 1. Summary and Conclusions**
- 2. General Description**
- 3. Design Criteria**
- 4. Design methodology and Application**
- 5. Technical Data**
- 6. Code Description**
- 7. Operating Experience**
- 8. Prototype Testing**
- 9. Testing, Inspection, and Surveillance Plans**
- 10. References**

Chapter 4 - WCAP-15942-P

- 4 DESIGN METHODOLOGY AND APPLICATION**
- 4.1 Methodology for Evaluation of General Design Criteria**
- 4.2 Methodology and Application - Fuel Assembly Components**
 - 4.2.1 Compatibility with Other Fuel Types and Reactor Internals**
 - 4.2.2 Geometric Changes in the Assembly During Operation**
 - 4.2.3 Transport and Handling Loads**
 - 4.2.4 Hydraulic Lifting Loads During Normal Operation and AOOs**
 - 4.2.5 Assembly Stress and Strain During Normal Operation and AOOs**
 - 4.2.6 Fatigue of Assembly Components**
 - 4.2.7 Fretting Wear of Assembly Components**
 - 4.2.8 Corrosion of Assembly Components**
 - 4.2.9 Hydridding of Zircaloy Assembly Components other than Fuel Rods**

Chapter 4 - WCAP-15942-P

- 4.3 Methodology and Application - Fuel Rods**
- 4.3.0 Fuel Rod Power Histories**
- 4.3.1 Rod Internal Pressure**
- 4.3.2 Cladding Stresses**
- 4.3.3 Cladding Strain**
- 4.3.4 Hydriding**
- 4.3.5 Cladding Corrosion**
- 4.3.6 Cladding Collapse (Elastic and Plastic Instability)**
- 4.3.7 Cladding Fatigue**
- 4.3.8 Cladding Temperature**
- 4.3.9 Fuel Temperature**
- 4.3.10 Fuel Rod Bow**
- 4.3.11 Pellet-Cladding Interaction**

Chapter 4 - WCAP-15942-P

4.4 Steady-state Initialization for Transient and Accident Conditions

4.4.1 LOCA Initialization

4.4.2 Fast transients

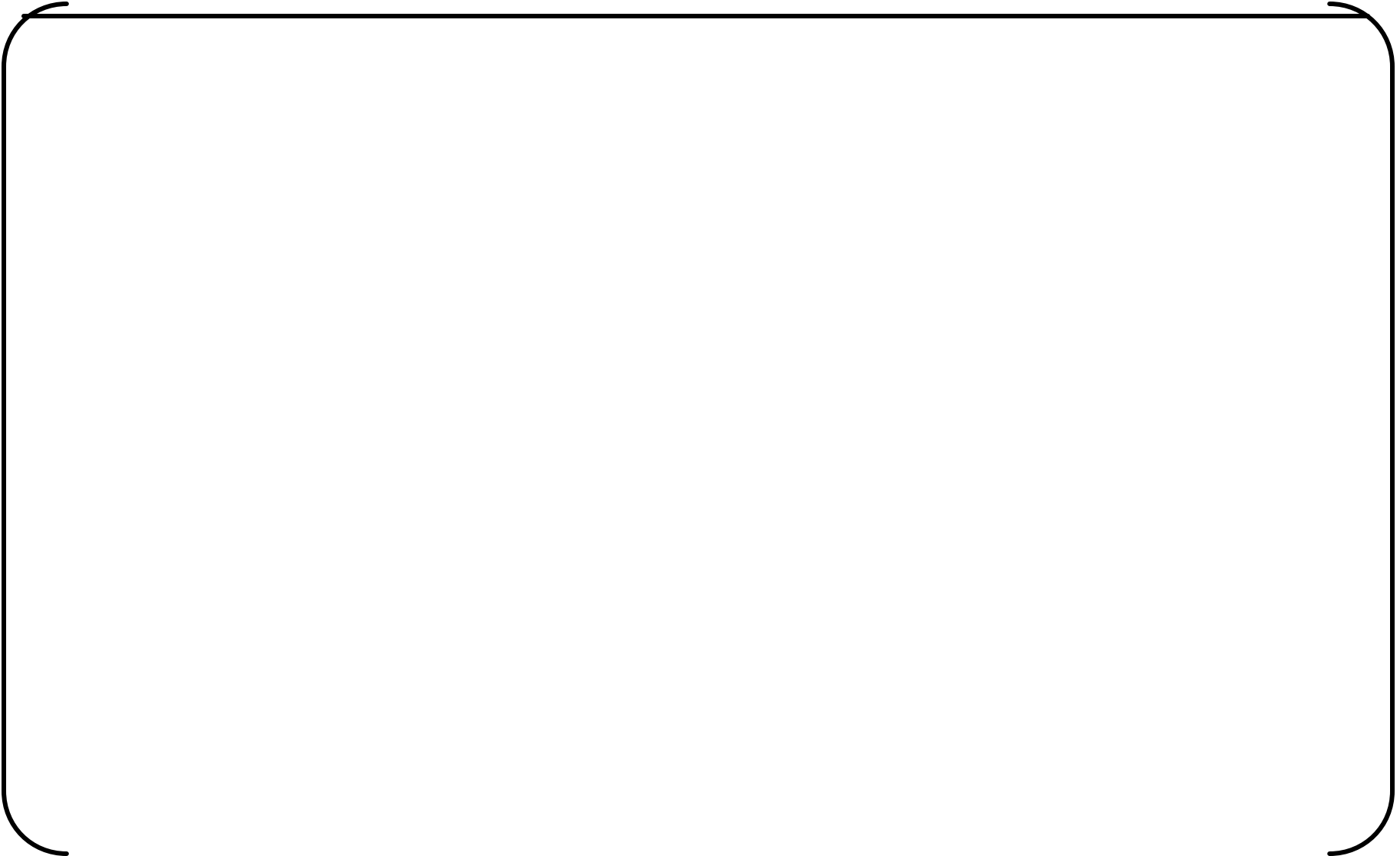
4.4.3 Control Rod Drop Accident

4.4.4 Stability Analysis

4.4.5 Dose Calculations

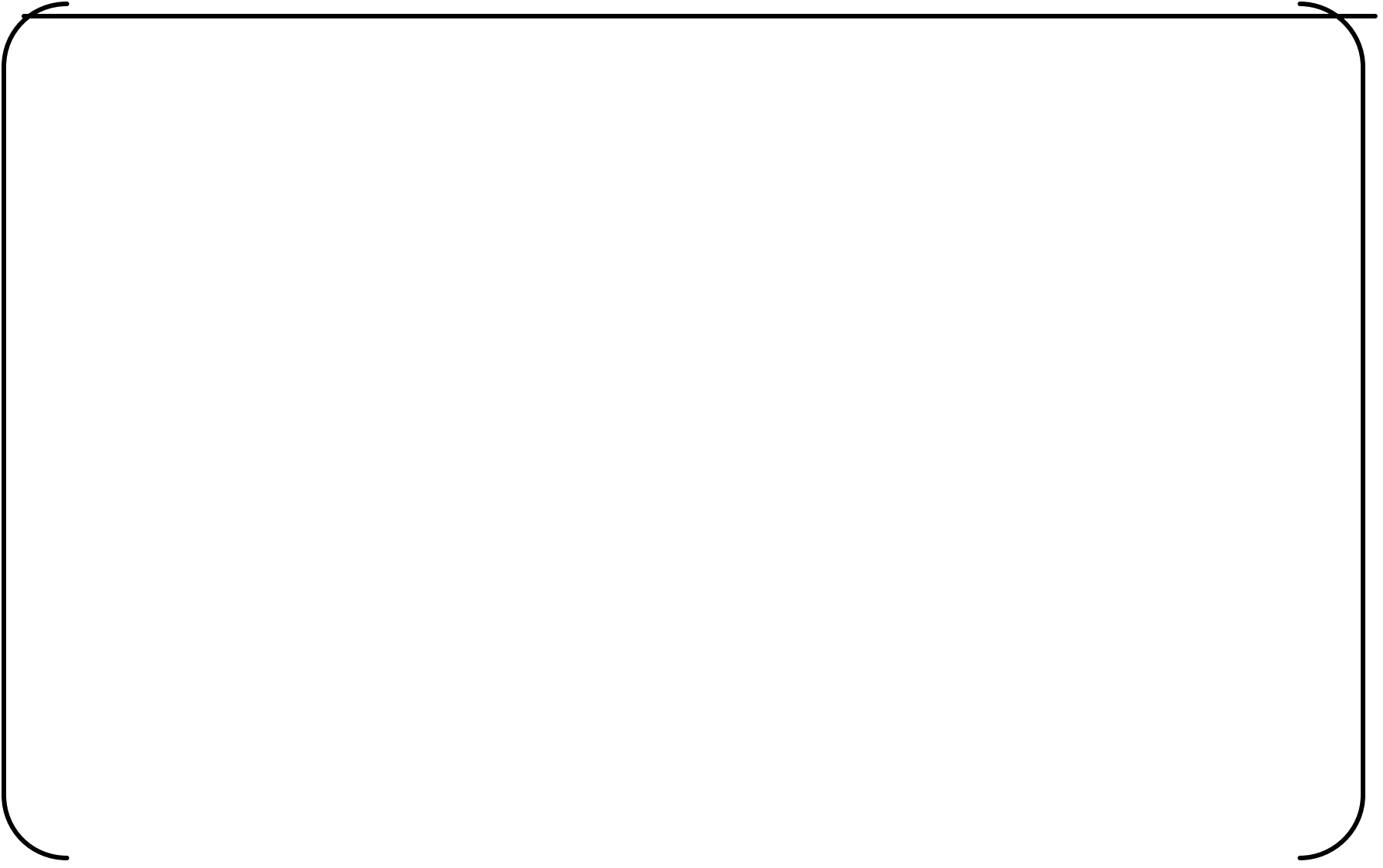
Extended Data Base – WCAP-15942-P

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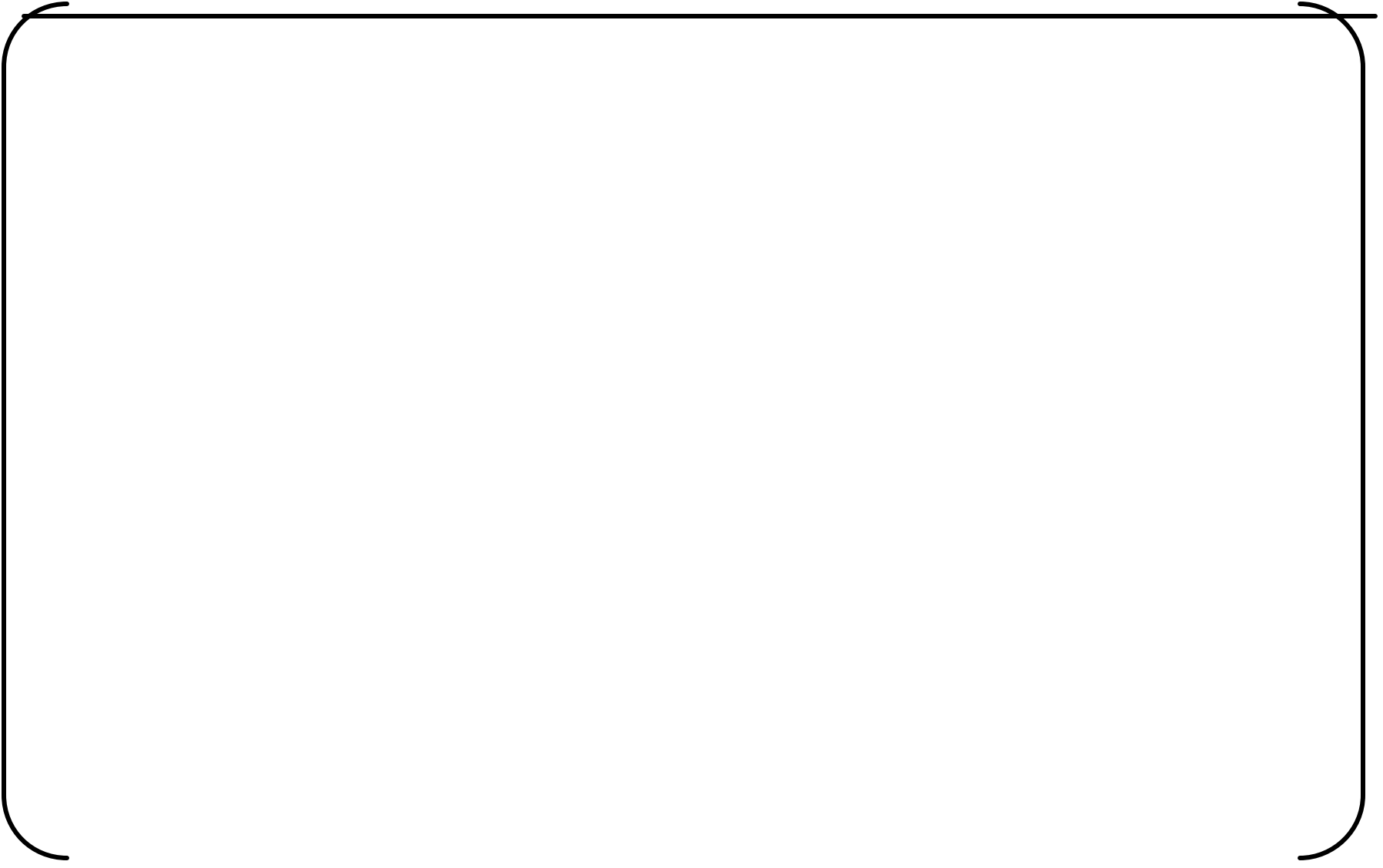
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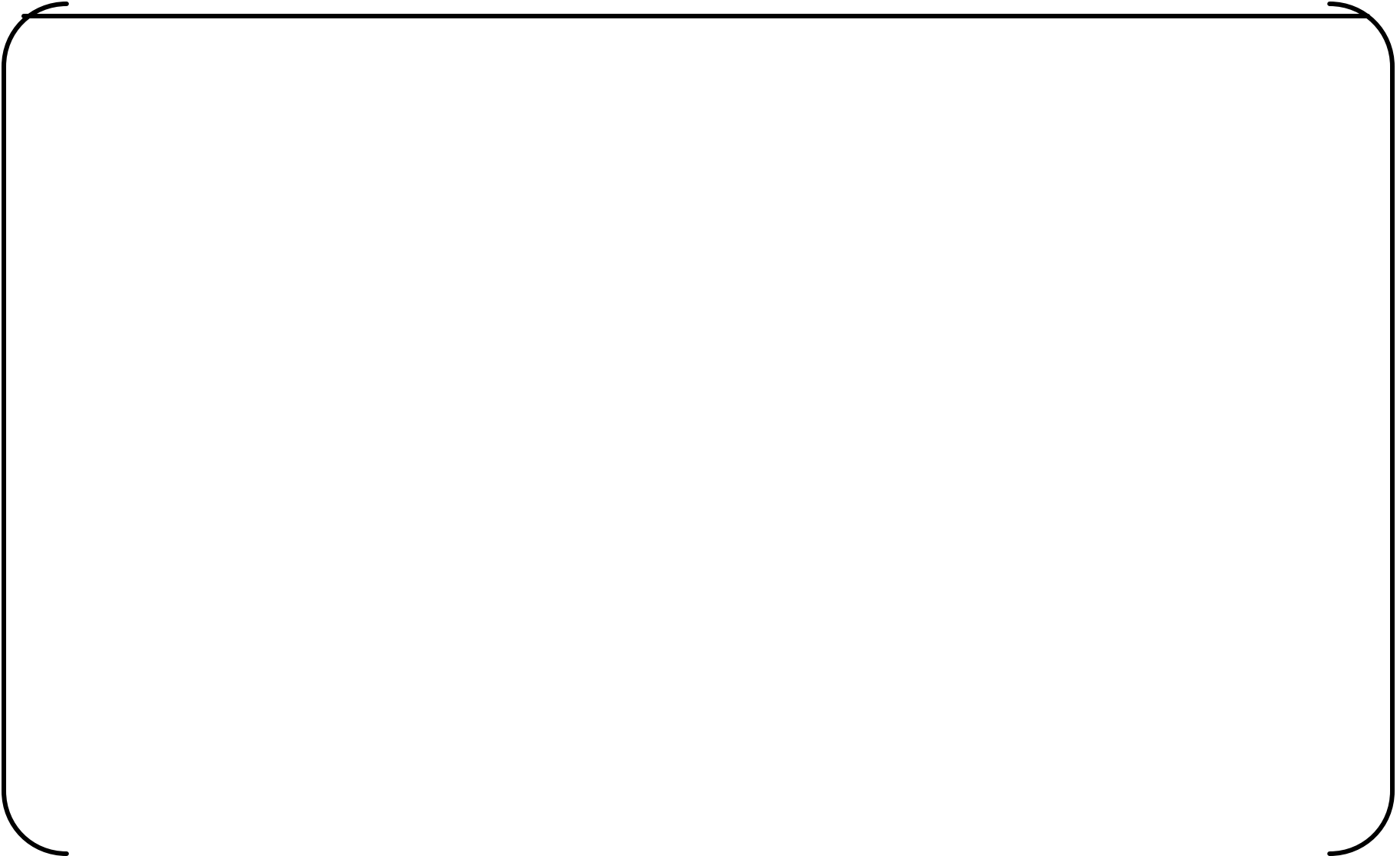
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