

**Enclosures 1 and 4 Contain Proprietary Information –
Withhold in Accordance with 10 CFR 2.390**

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Attn: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

10 CFR 50.90

**SUSQUEHANNA STEAM ELECTRIC STATION
SUBMITTAL OF UNIT 2 CYCLE 21 RELOAD
LICENSING DOCUMENTS TO SUPPORT
LICENSE AMENDMENT REQUESTING
APPLICATION OF ADVANCED FRAMATOME
METHODOLOGIES
PLA-7861**

**Docket No. 50-387
and 50-388**

Reference: 1) Susquehanna letter to NRC, "Proposed Amendment to Licenses NPF-14 and NPF-22: Application of Advanced Framatome Methodologies and TSTF-535 (PLA-7783)," dated July 15, 2019 (ADAMS Accession No. ML19196A270).

Pursuant to 10 CFR 50.90, Susquehanna Nuclear, LLC (Susquehanna), submitted, in Reference 1, a request for an amendment to the Technical Specifications (TS) for the Susquehanna Steam Electric Station (SSES), Units 1 and 2, Facility Operating License numbers NPF-14 and NPF-22. The proposed amendment would revise TS 5.6.5.b to allow application of Advanced Framatome Methodologies for determining core operating limits in support of loading Framatome fuel type ATRIUM 11, revise the low pressure safety limit in TS 2.1.1.1 and TS 2.1.1.2, and remove the neutronic methods penalties on Oscillation Power Range Monitor amplitude setpoint and the pin power distribution uncertainty and bundle power correlation coefficient.

In Enclosure 7 to Reference 1, Susquehanna committed to provide certain re-load licensing documents related to Unit 2, Cycle 21 (i.e., the first cycle expected to be loaded with ATRIUM 11 fuel), within 15 days of their approval. This letter provides the first two reports: Enclosure 1 provides the Unit 2, Cycle 21 Nuclear Fuel Design Report; and Enclosure 4 provides the Unit 2, Cycle 21 Fuel Cycle Design Report. Both reports are submitted for information only to aid in the NRC's review of the license amendment requested in Reference 1.

Information provided in Enclosures 1 and 4 is considered proprietary to Framatome. The proprietary information has been denoted therein by brackets. As owners of the proprietary information, Framatome has executed affidavits for the documents which identify the information as proprietary, is customarily held in confidence, and should be withheld from public disclosure in accordance with 10 CFR 2.390. Enclosures 2 and 5 provide non-proprietary versions of Enclosures 1 and 4, respectively. The Framatome affidavits are included as Enclosures 3 and 6.

There are no new or revised regulatory commitments contained in this submittal. This submittal satisfies Regulatory Commitments 7783-1 and 7783-2, as documented in Enclosure 7 to Reference 1.

Should you have any questions regarding this submittal, please contact Ms. Melisa Krick, Manager – Nuclear Regulatory Affairs, at (570) 542-1818.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 4/9/20



K. Cimorelli

Enclosures:

1. Framatome Topical Report ANP-3825P, "Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report" [**Proprietary Information – Withhold from Public Disclosure in accordance with 10 CFR 2.390**]
2. Framatome Topical Report ANP-3825NP, "Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report" (Non-Proprietary Version)
3. Framatome Affidavit for ANP-3825P, "Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report"
4. Framatome Topical Report ANP-3826P, "Susquehanna Unit 2 Cycle 21 Fuel Cycle Design Report" [**Proprietary Information – Withhold from Public Disclosure in accordance with 10 CFR 2.390**]
5. Framatome Topical Report ANP-3826NP, "Susquehanna Unit 2 Cycle 21 Fuel Cycle

Design Report” (Non-Proprietary Version)

6. Framatome Affidavit for ANP-3826P, “Susquehanna Unit 2 Cycle 21 Fuel Cycle Design Report”

Copy: NRC Region I
Ms. L. Micewski, NRC Sr. Resident Inspector
Ms. S. Goetz, NRC Project Manager
Mr. M. Shields, PA DEP/BRP (w/out Enclosures 1 and 4)

Enclosure 2 of PLA-7861

**Framatome Topical Report
ANP-3825NP**

**Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel
Nuclear Fuel Design Report**

(Non-Proprietary Version)



Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report

ANP-3825NP
Revision 0

March 2020

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ANP-3825NP
Revision 0

Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel
Nuclear Fuel Design Report

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Nature of Changes

Item	Section(s) or Page(s)	Description and Justification
1	All	Initial Issue

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Nomenclature

Acronym	Definition
BOL	beginning of life
BWR	boiling water reactor
EVC	plenum region in a fuel pin modeled as an evacuated section
GWd/MTU	gigawatt days per metric ton of initial uranium
kg/MTU	kilograms per metric ton of initial uranium
LHGR	linear heat generation rate
LPF	local peaking factor
MCPR	minimum critical power ratio
MWd/MTU	megawatt days per metric ton of initial uranium
NRC	(United States) Nuclear Regulatory Commission

1.0 INTRODUCTION

This report provides results of the neutronic design analyses performed by Framatome Inc. for the Susquehanna Unit 2 reload batch SUS2-21 ATRIUM 11 boiling water reactor (BWR) fuel assemblies scheduled to be loaded in Cycle 21.

Applicable neutronic design criteria are provided in the approved topical report ANF-89-98(P)(A) Revision 1 and Supplement 1 (Reference 1). Neutronic design analysis methodology used to determine conformance to design criteria has been reviewed and approved by the NRC in the topical report EMF-2158(P)(A) (Reference 2).

The fuel design includes Framatome Inc. [

] . Mechanical design criteria applicable to the design of these channels have been reviewed and approved by the NRC.

The neutronic design for the fabrication batch includes axially-varying enrichment and gadolinia designs with natural UO_2 blankets at the top and bottom of the assembly. The fabrication batch consists of the following fuel assemblies:

- []
- []
- []

Pertinent fuel and reactor core design information associated with this fabrication batch is given in Section 2.0 and in Appendices A through D.

2.0 NEUTRONIC DESIGN

The results of the Susquehanna Unit 2 fabrication batch SUS2-21 ATRIUM 11 neutronic design analyses are presented in this section. The fuel was designed to meet applicable design criteria, as well as reactivity and control requirements. Reactor core loading patterns and the number of assemblies to be loaded will depend upon final cycle energy requirements as specified by the utility. Applicable neutronic design criteria outlined in Reference 1 are summarized below:

- **Power Distribution.** The local power distribution in the fuel assembly combined with the core power distribution shall result in Linear Heat Generation Rate (LHGR) and Minimum Critical Power Ratio (MCPR) values that are within the limits established for each fuel design.
- **Kinetics Parameters.** The moderator void reactivity coefficient due to boiling in the active channels and the Doppler fuel temperature reactivity coefficient shall be negative. The negative void and Doppler reactivity coefficients ensure a negative power coefficient during reactor operation. Additional calculations were performed to show that the assembly average Doppler and void reactivity coefficients remain negative for the life of the assembly. These results demonstrate that the Reference 1 kinetics criteria are met on a bundle average basis.
- **Control Blade Reactivity.** The design of the fuel assembly and the reactor core loading shall be such that the technical specification shutdown margin requirement is met for all reactor conditions.

2.1 *Neutronic Design Description*

The neutronic design parameters for fabrication batch SUS2-21 are presented in Table 2.1.

The key ATRIUM 11 reload assembly nuclear design characteristics are summarized below:

- The fuel assembly contains []
- Each fuel assembly has top and bottom natural uranium blankets.
- The enrichments are designed to yield a local power distribution which results in a balanced design relative to MCPR, LHGR, and other reactor operating requirements, e.g., power peaking.
- Gadolinia (Gd_2O_3 blended with UO_2) rods are designed to control assembly reactivity in order to meet reactivity control requirements in the reactor, e.g. cold shutdown margin.
- The reload batch [] designs which vary axially in enrichment and/or gadolinia. The axial distributions of the lattices in the assemblies are shown in

Figures 2.1, 2.2, and 2.3. The fuel rod distribution and axial descriptions are presented in Figures 2.4 through 2.8. The enrichment and gadolinia distribution maps for each of the reload assembly lattices are displayed in Appendix D.

- The fuel assembly incorporates the Framatome Inc. advanced fuel channel which improves uranium utilization.

2.2 *Lattice Control Blade Worths and Kinetics Parameters*

Beginning of life (BOL) lattice reactivities (k_{∞}) have been calculated for moderator and fuel conditions ranging from cold to hot operating conditions. From these reactivities, BOL control blade worths and kinetics parameters have been determined based on GE Duralife 160, GE Marathon, GE Original Equipment, and Westinghouse 99 control blades.

Kinetics parameters are calculated for fuel temperature (Doppler), moderator void, and moderator temperature. [

] The results of these calculations are presented in Tables 2.2 through 2.127.

2.3 *Enriched Lattice Uncontrolled Reactivities and Isotopic Data*

The enriched lattice exposure-dependent uncontrolled reactivities [

] are presented graphically in Appendix A, and in tabular format in Appendix B. The enriched lattice exposure-dependent isotopic data [] are presented in Appendix C.

2.4 *Criticality Compliance*

The Susquehanna Unit 2 fabrication batch SUS2-21 ATRIUM 11 fuel assemblies satisfy the fuel design critical safety limits established for new and spent fuel storage at the Susquehanna Unit 2 facility per References 3 and 4. Additionally, these reload assemblies conform to the nuclear criticality requirements as provided to the NRC for the Reference 5 shipping container.

Table 2.1 Neutronic Design Parameters

Table 2.1 Neutronic Design Parameters (Continued)

Table 2.1 Neutronic Design Parameters (Continued)

Table 2.1 Neutronic Design Parameters (Continued)

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Table 2.1 Neutronic Design Parameters (Continued)

Table 2.1 Neutronic Design Parameters (Continued)

Table 2.2 Lattice [] Control Blade Worths at BOL for Control Blade Type GE Duralife 160

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Table 2.5 Lattice [] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

Table 2.6 Lattice [] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

[illegible]

[illegible]

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[illegible]

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[illegible]

[illegible]

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[illegible]

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**Table 2.47 Lattice [] Control Blade Worths at BOL
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**Table 2.48 Lattice [] Control Blade Worths at BOL
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[illegible]

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**Table 2.54 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Original Equipment**

[illegible]

Table 2.57 Lattice [] Kinetics Parameters at BOL

[illegible]

[illegible]

Table 2.60 Lattice [] Control Blade Worths at BOL for Control Blade Type GE Marathon Lower

[illegible]

Table 2.62 Lattice [] Control Blade Worths at BOL for Control Blade Type Westinghouse 99 Top

[illegible]

**Table 2.66 Lattice [] Control Blade Worths at BOL for
Control Blade Type GE Marathon**

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Table 2.68 Lattice [] Control Blade Worths at BOL for Control Blade Type GE Original Equipment

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**Table 2.76 Lattice [] Control Blade Worths at BOL
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**Table 2.79 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Duralife 160**

**Table 2.80 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Marathon**

**Table 2.81 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Marathon Lower**

[illegible]

[illegible]

[illegible]

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[illegible]

The image consists of a solid white rectangular area enclosed within a thin black frame. The frame is composed of four L-shaped corner pieces at each corner, which meet to form a continuous border around the central white space.

[illegible]

[illegible]

**Table 2.93 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Duralife 160**

**Table 2.95 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Marathon Lower**

[illegible]

**Table 2.97 Lattice [] Control Blade Worths at BOL
for Control Blade Type Westinghouse 99 Top**

Table 2.99 Lattice [] Kinetics Parameters at BOL

[illegible]

The image shows a completely blank white rectangular area. This central area is enclosed within a thick, solid black frame that runs along all four edges of the image. The frame consists of two parallel black lines, one on the outside and one on the inside, creating a wide black border around the white space.

**Table 2.102 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Marathon Lower**

**Table 2.104 Lattice [] Control Blade Worths at BOL
for Control Blade Type Westinghouse 99 Top**

Table 2.106 Lattice [] Kinetics Parameters at BOL

**Table 2.107 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Duralife 160**

[illegible]

**Table 2.109 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Marathon Lower**

Table 2.113 Lattice [] Kinetics Parameters at BOL

[illegible]

[illegible]

**Table 2.116 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Marathon Lower**

[illegible]

[illegible]

Table 2.120 Lattice [] Kinetics Parameters at BOL

[illegible]

**Table 2.122 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Marathon**

**Table 2.123 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Marathon Lower**

**Table 2.124 Lattice [] Control Blade Worths at BOL
for Control Blade Type GE Original Equipment**

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[illegible]

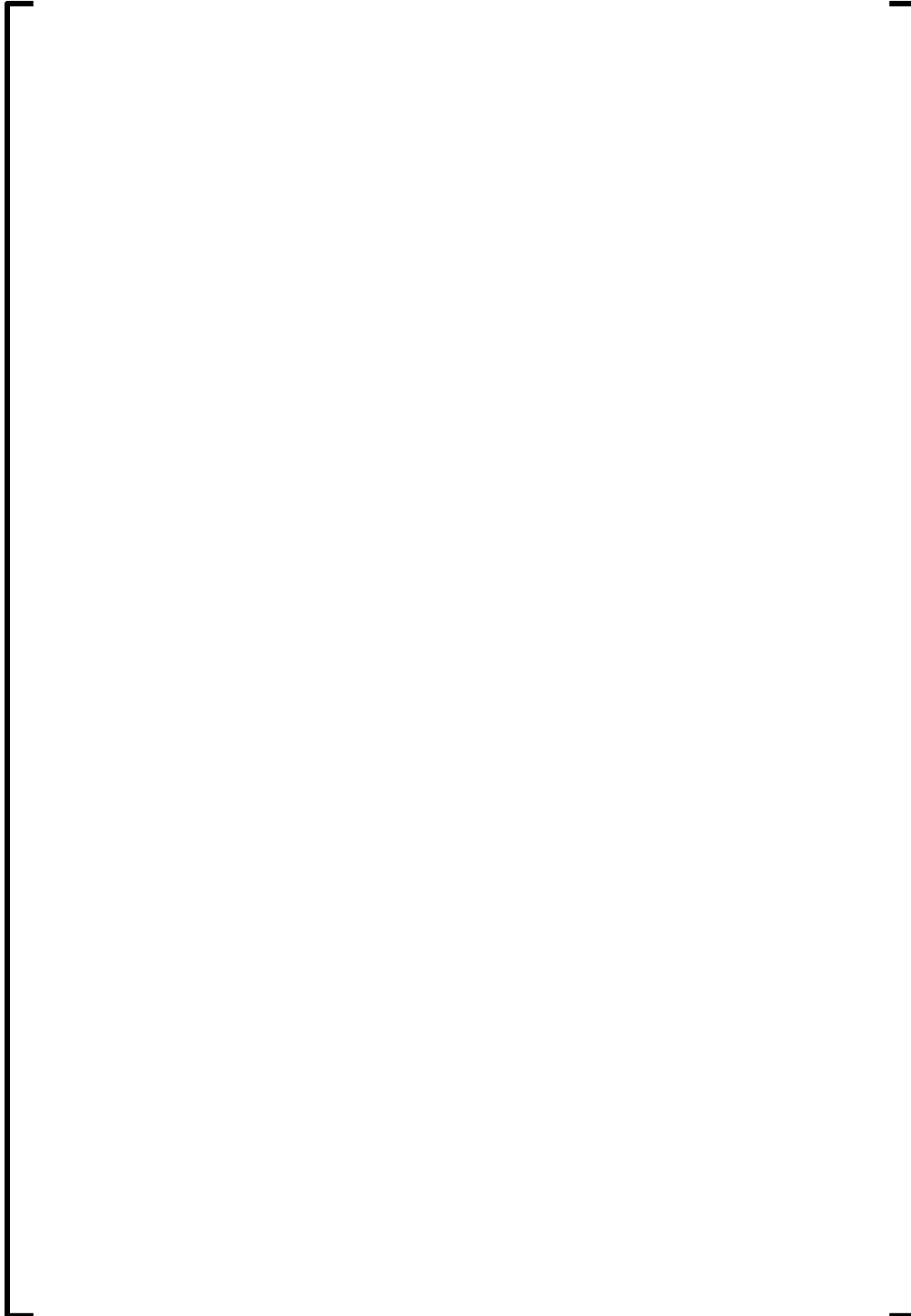


Figure 2.1 Assembly Map

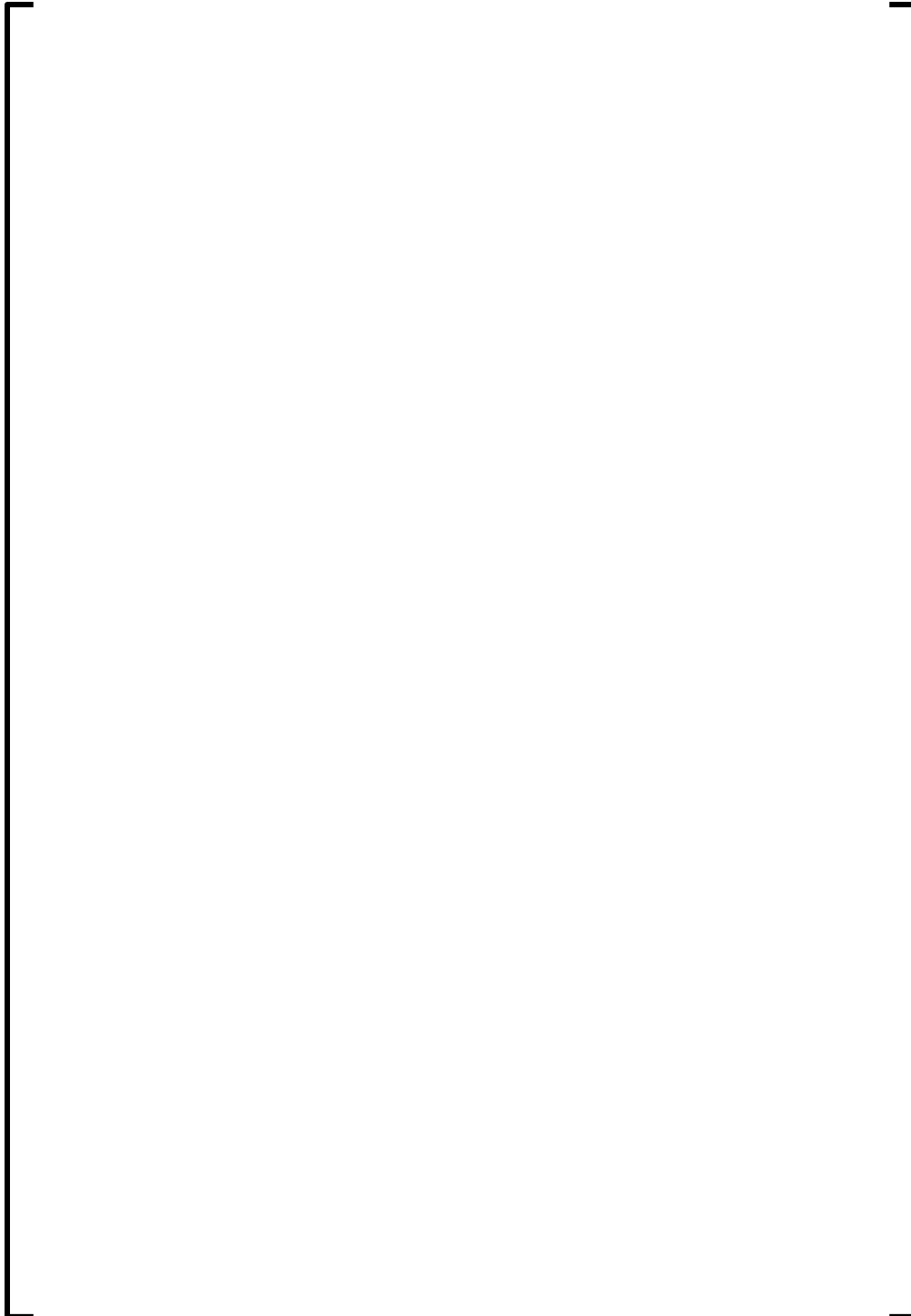


Figure 2.2 Assembly Map

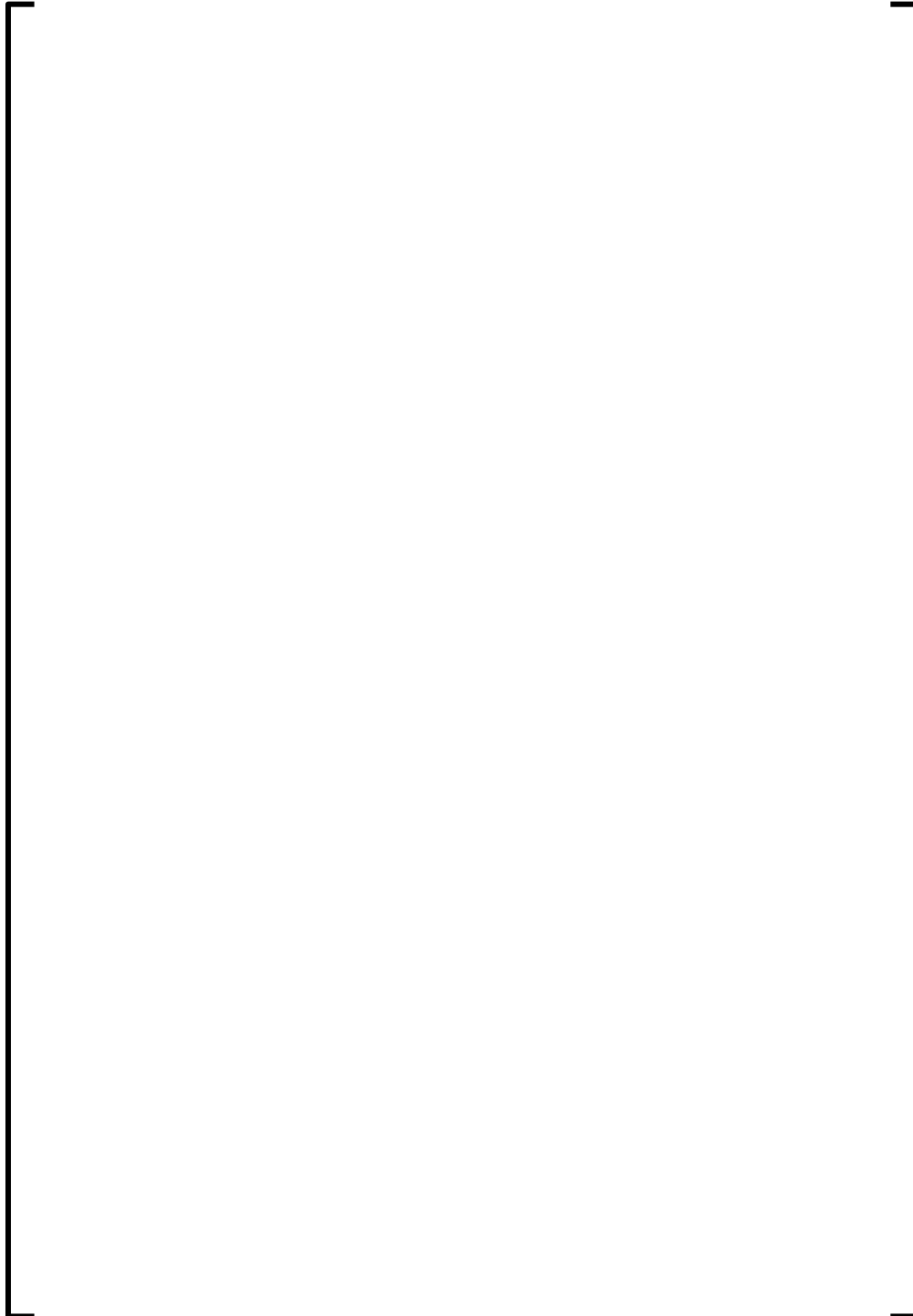


Figure 2.3 Assembly Map

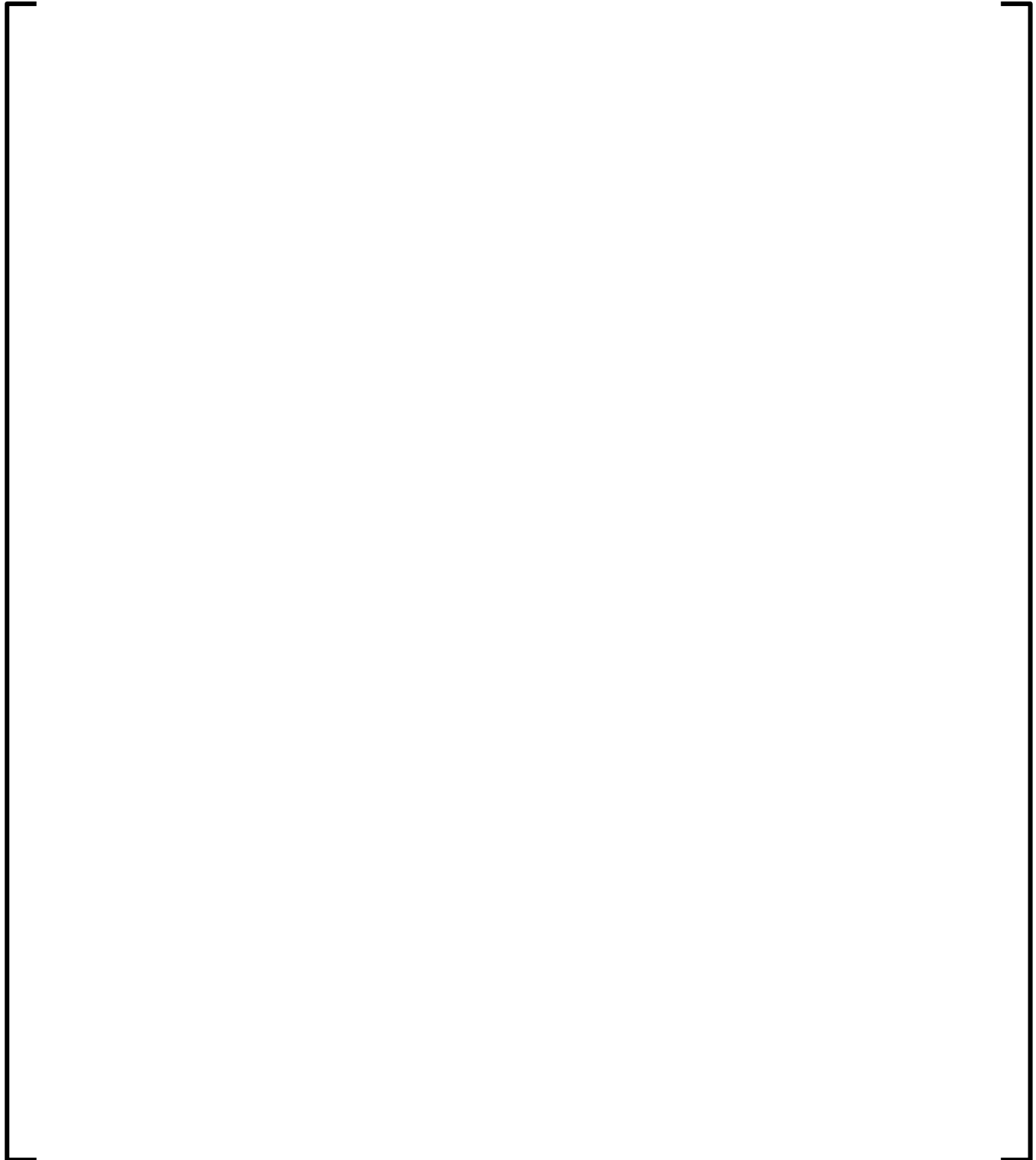


Figure 2.4 Fuel Rod Distribution

Figure 2.5 Fuel Rod Distribution

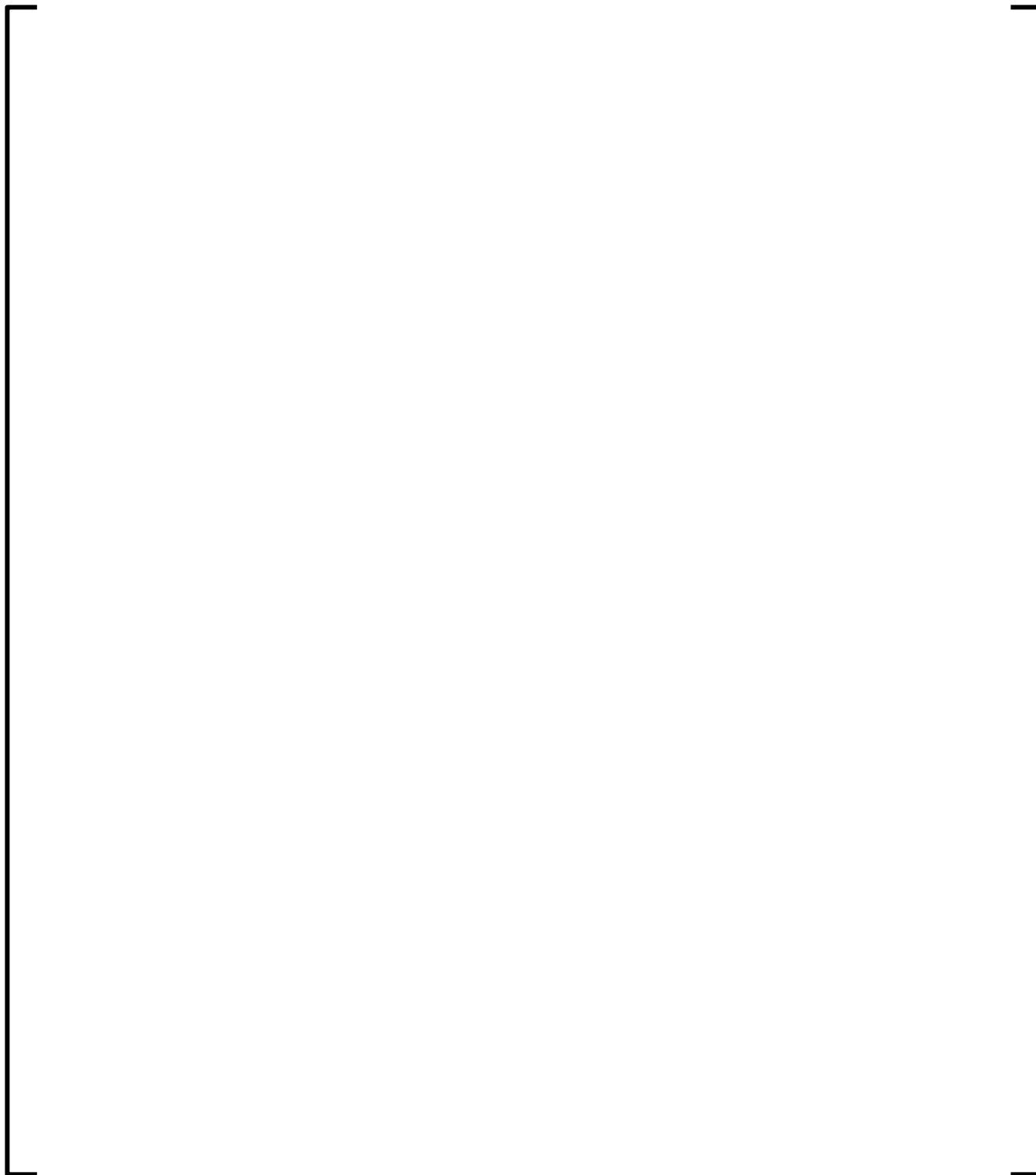


Figure 2.6 Fuel Rod Distribution

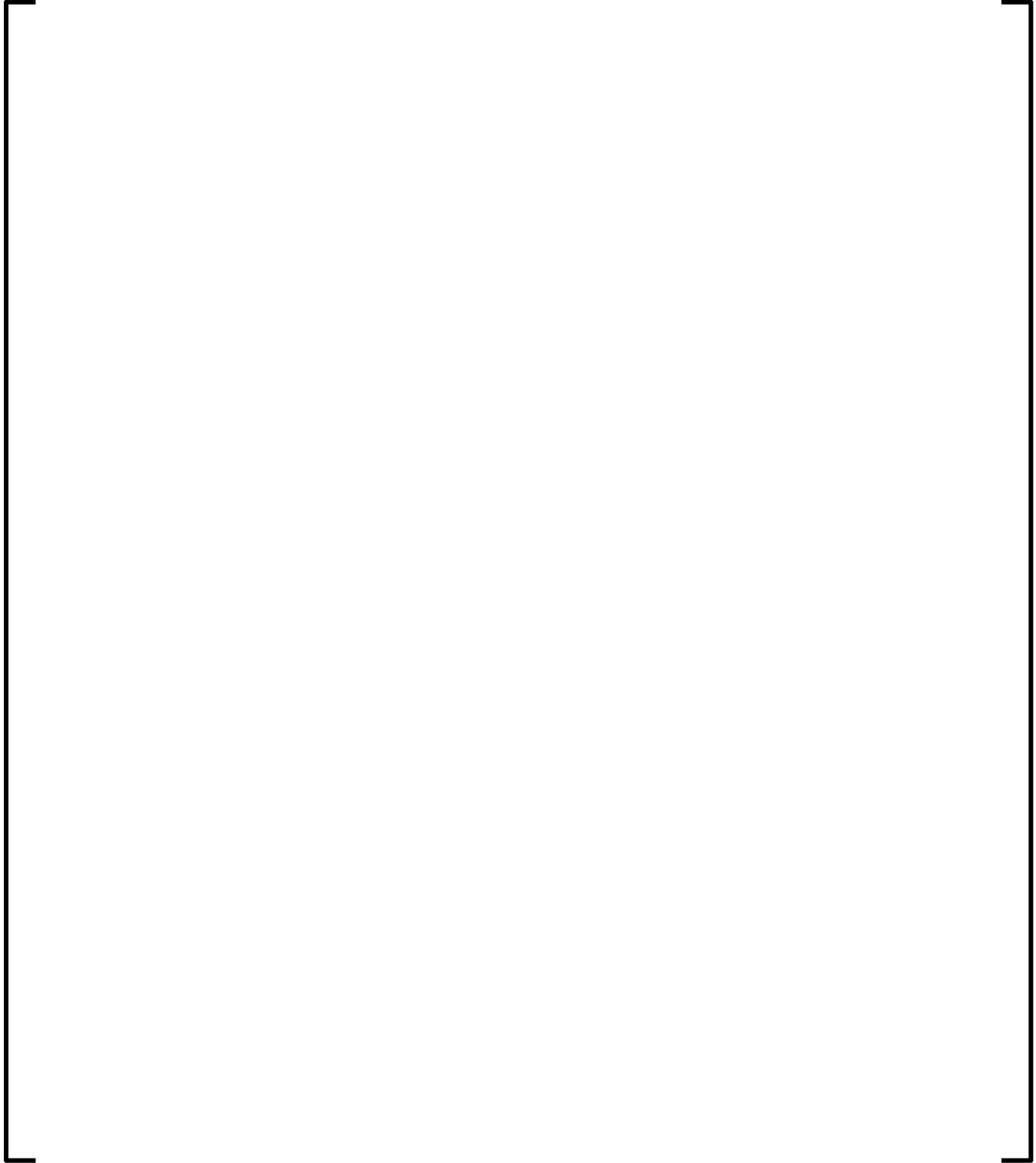


Figure 2.7 Fuel Rod Axial Description

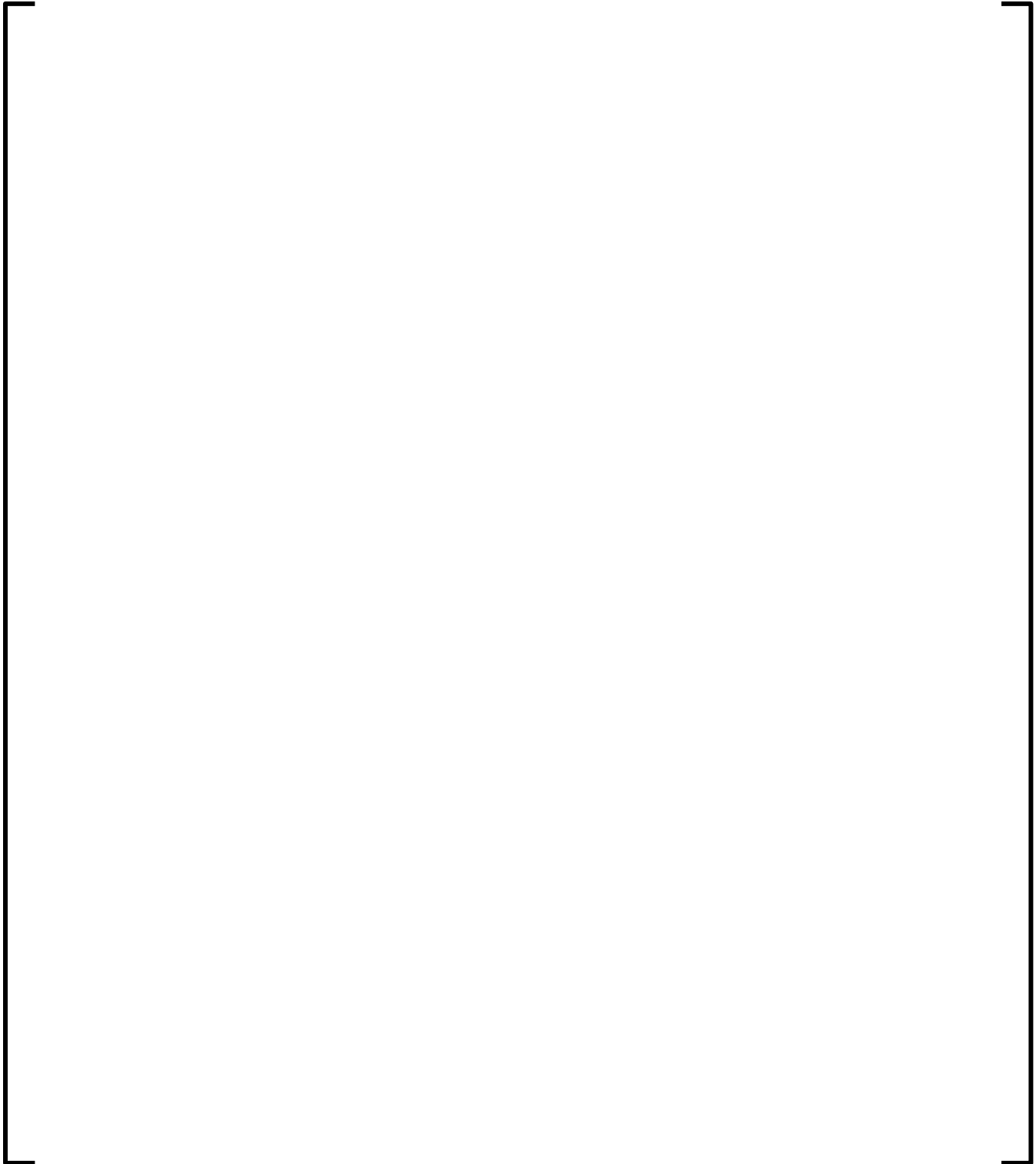


Figure 2.8 Fuel Rod Axial Description

3.0 REFERENCES

1. ANF-89-98(P)(A) Revision 1 and Supplement 1, *Generic Mechanical Design Criteria for BWR Fuel Designs*, Advanced Nuclear Fuels Corporation, May 1995.
2. EMF-2158(P)(A), Revision 0, *Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2*, Siemens Power Corporation, October 1999.
3. ANP-3764P, Revision 0, *Susquehanna Steam Electric Station New Fuel Storage Vault Criticality Safety Analysis for ATRIUM 11*
4. ANP-3765P, Revision 0, *Susquehanna Steam Electric Station Spent Fuel Storage Pool Criticality Safety Analysis for ATRIUM 11*
5. "Certificate of Compliance for Radioactive Material Packages", Certificate Number 9372 Revision 2, NRC Docket Number 71-9372, Package Identification Number USA/9372/B(U)F-96

Framatome Inc.

ANP-3825NP

Revision 0

Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel
Nuclear Fuel Design Report

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Appendix A Enriched Lattice Hot Uncontrolled Reactivity and LPF Plots

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Figure A.1 [] Hot Uncontrolled k_{∞}

Figure A.2 [] Hot Uncontrolled LPF

Figure A.3 [] Hot Uncontrolled k_{∞}

Figure A.4 [] Hot Uncontrolled LPF

Figure A.5 [] Hot Uncontrolled k_{∞}

Figure A.6 [] Hot Uncontrolled LPF

Figure A.7 [] Hot Uncontrolled k_{∞}

Figure A.8 [] Hot Uncontrolled LPF

Figure A.9 [] Hot Uncontrolled k_{∞}

Figure A.10 [] Hot Uncontrolled LPF

Figure A.11 [] Hot Uncontrolled k_{∞}

Figure A.12 [] Hot Uncontrolled LPF

Figure A.13 [] Hot Uncontrolled k_{∞}

Figure A.14 [] Hot Uncontrolled LPF

Figure A.15 [] Hot Uncontrolled k_{∞}

Figure A.16 [] Hot Uncontrolled LPF

Figure A.17 [] Hot Uncontrolled k_{∞}

Figure A.18 [] Hot Uncontrolled LPF

Figure A.19 [] Hot Uncontrolled k_{∞}

Figure A.20 [] Hot Uncontrolled LPF

Figure A.21 [] Hot Uncontrolled k_{∞}

Figure A.22 [] Hot Uncontrolled LPF

Figure A.23 [] Hot Uncontrolled k_{∞}

Figure A.24 [] Hot Uncontrolled LPF

Figure A.25 [] Hot Uncontrolled k_{∞}

Figure A.26 [] Hot Uncontrolled LPF

Figure A.27 [] Hot Uncontrolled k_{∞}

Figure A.28 [] Hot Uncontrolled LPF

Figure A.29 [] Hot Uncontrolled k_{∞}

Figure A.30 [] Hot Uncontrolled LPF

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ANP-3825NP

Revision 0

Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel
Nuclear Fuel Design Report

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Appendix B Enriched Lattice Hot Uncontrolled Reactivity and LPF Tables

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Table B.1 [] Hot Uncontrolled k_{∞}

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Sl. No.	Name of the Candidate	Grade	Score	Remarks
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Case No.	Case Name	Case Type	Case Status	Case Date	Case Location	Case Description	Case Details	Case Notes	Case Comments	Case Actions
1	John Doe	Case 1	Open	2023-01-01	New York	Case 1 Description	Case 1 Details	Case 1 Notes	Case 1 Comments	Case 1 Actions
2	Jane Smith	Case 2	Closed	2023-01-02	California	Case 2 Description	Case 2 Details	Case 2 Notes	Case 2 Comments	Case 2 Actions
3	Bob Johnson	Case 3	Pending	2023-01-03	Texas	Case 3 Description	Case 3 Details	Case 3 Notes	Case 3 Comments	Case 3 Actions
4	Alice Brown	Case 4	Open	2023-01-04	Florida	Case 4 Description	Case 4 Details	Case 4 Notes	Case 4 Comments	Case 4 Actions
5	Charlie White	Case 5	Closed	2023-01-05	Illinois	Case 5 Description	Case 5 Details	Case 5 Notes	Case 5 Comments	Case 5 Actions
6	Diana Green	Case 6	Pending	2023-01-06	Ohio	Case 6 Description	Case 6 Details	Case 6 Notes	Case 6 Comments	Case 6 Actions
7	Frank Black	Case 7	Open	2023-01-07	Georgia	Case 7 Description	Case 7 Details	Case 7 Notes	Case 7 Comments	Case 7 Actions
8	Grace King	Case 8	Closed	2023-01-08	Arizona	Case 8 Description	Case 8 Details	Case 8 Notes	Case 8 Comments	Case 8 Actions
9	Henry Lee	Case 9	Pending	2023-01-09	Colorado	Case 9 Description	Case 9 Details	Case 9 Notes	Case 9 Comments	Case 9 Actions
10	Ivy Hall	Case 10	Open	2023-01-10	Connecticut	Case 10 Description	Case 10 Details	Case 10 Notes	Case 10 Comments	Case 10 Actions
11	Jack Adams	Case 11	Closed	2023-01-11	Delaware	Case 11 Description	Case 11 Details	Case 11 Notes	Case 11 Comments	Case 11 Actions
12	Karen Baker	Case 12	Pending	2023-01-12	Idaho	Case 12 Description	Case 12 Details	Case 12 Notes	Case 12 Comments	Case 12 Actions
13	Leo Clark	Case 13	Open	2023-01-13	Indiana	Case 13 Description	Case 13 Details	Case 13 Notes	Case 13 Comments	Case 13 Actions
14	Mia Evans	Case 14	Closed	2023-01-14	Iowa	Case 14 Description	Case 14 Details	Case 14 Notes	Case 14 Comments	Case 14 Actions
15	Noah Foster	Case 15	Pending	2023-01-15	Kansas	Case 15 Description	Case 15 Details	Case 15 Notes	Case 15 Comments	Case 15 Actions
16	Olivia Gibson	Case 16	Open	2023-01-16	Kentucky	Case 16 Description	Case 16 Details	Case 16 Notes	Case 16 Comments	Case 16 Actions
17	Peter Hall	Case 17	Closed	2023-01-17	Louisiana	Case 17 Description	Case 17 Details	Case 17 Notes	Case 17 Comments	Case 17 Actions
18	Quinn Ives	Case 18	Pending	2023-01-18	Maine	Case 18 Description	Case 18 Details	Case 18 Notes	Case 18 Comments	Case 18 Actions
19	Rachel King	Case 19	Open	2023-01-19	Maryland	Case 19 Description	Case 19 Details	Case 19 Notes	Case 19 Comments	Case 19 Actions
20	Samuel Lee	Case 20	Closed	2023-01-20	Massachusetts	Case 20 Description	Case 20 Details	Case 20 Notes	Case 20 Comments	Case 20 Actions
21	Tina Miller	Case 21	Pending	2023-01-21	Michigan	Case 21 Description	Case 21 Details	Case 21 Notes	Case 21 Comments	Case 21 Actions
22	Uma Nunez	Case 22	Open	2023-01-22	Minnesota	Case 22 Description	Case 22 Details	Case 22 Notes	Case 22 Comments	Case 22 Actions
23	Victor Ortiz	Case 23	Closed	2023-01-23	Mississippi	Case 23 Description	Case 23 Details	Case 23 Notes	Case 23 Comments	Case 23 Actions
24	Wendy Parker	Case 24	Pending	2023-01-24	Montana	Case 24 Description	Case 24 Details	Case 24 Notes	Case 24 Comments	Case 24 Actions
25	Xavier Quinn	Case 25	Open	2023-01-25	Nebraska	Case 25 Description	Case 25 Details	Case 25 Notes	Case 25 Comments	Case 25 Actions
26	Yara Ramirez	Case 26	Closed	2023-01-26	Nevada	Case 26 Description	Case 26 Details	Case 26 Notes	Case 26 Comments	Case 26 Actions
27	Zoe Roberts	Case 27	Pending	2023-01-27	New Hampshire	Case 27 Description	Case 27 Details	Case 27 Notes	Case 27 Comments	Case 27 Actions
28	Adam Scott	Case 28	Open	2023-01-28	New Jersey	Case 28 Description	Case 28 Details	Case 28 Notes	Case 28 Comments	Case 28 Actions
29	Bella Taylor	Case 29	Closed	2023-01-29	New Mexico	Case 29 Description	Case 29 Details	Case 29 Notes	Case 29 Comments	Case 29 Actions
30	Chris White	Case 30	Pending	2023-01-30	New York	Case 30 Description	Case 30 Details	Case 30 Notes	Case 30 Comments	Case 30 Actions
31	Diana Young	Case 31	Open	2023-01-31	North Carolina	Case 31 Description	Case 31 Details	Case 31 Notes	Case 31 Comments	Case 31 Actions
32	Ethan Green	Case 32	Closed	2023-02-01	North Dakota	Case 32 Description	Case 32 Details	Case 32 Notes	Case 32 Comments	Case 32 Actions
33	Fiona Hall	Case 33	Pending	2023-02-02	Ohio	Case 33 Description	Case 33 Details	Case 33 Notes	Case 33 Comments	Case 33 Actions
34	Gavin King	Case 34	Open	2023-02-03	Oklahoma	Case 34 Description	Case 34 Details	Case 34 Notes	Case 34 Comments	Case 34 Actions
35	Hannah Lee	Case 35	Closed	2023-02-04	Oregon	Case 35 Description	Case 35 Details	Case 35 Notes	Case 35 Comments	Case 35 Actions
36	Ian Miller	Case 36	Pending	2023-02-05	Pennsylvania	Case 36 Description	Case 36 Details	Case 36 Notes	Case 36 Comments	Case 36 Actions
37	Jessica Nunez	Case 37	Open	2023-02-06	Rhode Island	Case 37 Description	Case 37 Details	Case 37 Notes	Case 37 Comments	Case 37 Actions
38	Kyle Ortiz	Case 38	Closed	2023-02-07	South Carolina	Case 38 Description	Case 38 Details	Case 38 Notes	Case 38 Comments	Case 38 Actions
39	Laura Parker	Case 39	Pending	2023-02-08	South Dakota	Case 3				



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Sl. No.	Name of the Candidate	Grade	Score	Remarks
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Case No.	Case Name	Case Type	Case Status	Case Date	Case Location	Case Description	Case Details	Case Notes	Case Comments
1	John Doe	Case 1	Open	2023-01-01	New York	Case 1 Description	Case 1 Details	Case 1 Notes	Case 1 Comments
2	Jane Smith	Case 2	Closed	2023-01-02	California	Case 2 Description	Case 2 Details	Case 2 Notes	Case 2 Comments
3	Bob Johnson	Case 3	Pending	2023-01-03	Texas	Case 3 Description	Case 3 Details	Case 3 Notes	Case 3 Comments
4	Alice Brown	Case 4	Open	2023-01-04	Florida	Case 4 Description	Case 4 Details	Case 4 Notes	Case 4 Comments
5	Charlie Davis	Case 5	Closed	2023-01-05	Illinois	Case 5 Description	Case 5 Details	Case 5 Notes	Case 5 Comments
6	Diana Prince	Case 6	Pending	2023-01-06	Washington	Case 6 Description	Case 6 Details	Case 6 Notes	Case 6 Comments
7	Ethan Hunt	Case 7	Open	2023-01-07	Virginia	Case 7 Description	Case 7 Details	Case 7 Notes	Case 7 Comments
8	Fiona Glenanne	Case 8	Closed	2023-01-08	Massachusetts	Case 8 Description	Case 8 Details	Case 8 Notes	Case 8 Comments
9	Greg Kinnear	Case 9	Pending	2023-01-09	Colorado	Case 9 Description	Case 9 Details	Case 9 Notes	Case 9 Comments
10	Hannah Montana	Case 10	Open	2023-01-10	Idaho	Case 10 Description	Case 10 Details	Case 10 Notes	Case 10 Comments
11	Ian Somerhalder	Case 11	Closed	2023-01-11	Mississippi	Case 11 Description	Case 11 Details	Case 11 Notes	Case 11 Comments
12	Jessie James	Case 12	Pending	2023-01-12	Missouri	Case 12 Description	Case 12 Details	Case 12 Notes	Case 12 Comments
13	Kate Winslet	Case 13	Open	2023-01-13	England	Case 13 Description	Case 13 Details	Case 13 Notes	Case 13 Comments
14	Liam Neeson	Case 14	Closed	2023-01-14	Ireland	Case 14 Description	Case 14 Details	Case 14 Notes	Case 14 Comments
15	Mia Farrow	Case 15	Pending	2023-01-15	Hawaii	Case 15 Description	Case 15 Details	Case 15 Notes	Case 15 Comments
16	Nicole Kidman	Case 16	Open	2023-01-16	Australia	Case 16 Description	Case 16 Details	Case 16 Notes	Case 16 Comments
17	Orlando Bloom	Case 17	Closed	2023-01-17	Spain	Case 17 Description	Case 17 Details	Case 17 Notes	Case 17 Comments
18	Peter Dinklage	Case 18	Pending	2023-01-18	South Africa	Case 18 Description	Case 18 Details	Case 18 Notes	Case 18 Comments
19	Quentin Tarantino	Case 19	Open	2023-01-19	California	Case 19 Description	Case 19 Details	Case 19 Notes	Case 19 Comments
20	Rachel Watson	Case 20	Closed	2023-01-20	Canada	Case 20 Description	Case 20 Details	Case 20 Notes	Case 20 Comments
21	Samuel L. Jackson	Case 21	Pending	2023-01-21	Georgia	Case 21 Description	Case 21 Details	Case 21 Notes	Case 21 Comments
22	Tina Turner	Case 22	Open	2023-01-22	Germany	Case 22 Description	Case 22 Details	Case 22 Notes	Case 22 Comments
23	Uma Thurman	Case 23	Closed	2023-01-23	France	Case 23 Description	Case 23 Details	Case 23 Notes	Case 23 Comments
24	Vince Vaughn	Case 24	Pending	2023-01-24	Florida	Case 24 Description	Case 24 Details	Case 24 Notes	Case 24 Comments
25	Wendie Renner	Case 25	Open	2023-01-25	France	Case 25 Description	Case 25 Details	Case 25 Notes	Case 25 Comments
26	Xosha Roquemore	Case 26	Closed	2023-01-26	California	Case 26 Description	Case 26 Details	Case 26 Notes	Case 26 Comments
27	Yara Shahidi	Case 27	Pending	2023-01-27	India	Case 27 Description	Case 27 Details	Case 27 Notes	Case 27 Comments
28	Zoe Lister-Jones	Case 28	Open	2023-01-28	California	Case 28 Description	Case 28 Details	Case 28 Notes	Case 28 Comments
29	Adam Sandler	Case 29	Closed	2023-01-29	New York	Case 29 Description	Case 29 Details	Case 29 Notes	Case 29 Comments
30	Ben Stiller	Case 30	Pending	2023-01-30	California	Case 30 Description	Case 30 Details	Case 30 Notes	Case 30 Comments
31	Cameron Diaz	Case 31	Open	2023-01-31	California	Case 31 Description	Case 31 Details	Case 31 Notes	Case 31 Comments
32	Drew Barrymore	Case 32	Closed	2023-02-01	California	Case 32 Description	Case 32 Details	Case 32 Notes	Case 32 Comments
33	Ewan McGregor	Case 33	Pending	2023-02-02	Scotland	Case 33 Description	Case 33 Details	Case 33 Notes	Case 33 Comments
34	Faye Dunaway	Case 34	Open	2023-02-03	California	Case 34 Description	Case 34 Details	Case 34 Notes	Case 34 Comments
35	Gary Oldman	Case 35	Closed	2023-02-04	England	Case 35 Description	Case 35 Details	Case 35 Notes	Case 35 Comments
36	Halle Berry	Case 36	Pending	2023-02-05	California	Case 36 Description	Case 36 Details	Case 36 Notes	Case 36 Comments
37	Ian McKellen	Case 37	Open	2023-02-06	England	Case 37 Description	Case 37 Details	Case 37 Notes	Case 37 Comments
38	Jessie J	Case 38	Closed	2023-02-07	Jamaica	Case 38 Description	Case 38 Details	Case 38 Notes	Case 38 Comments
39	Kate Winslet	Case 39	Pending	2023-02-08	England	Case 39 Description	Case 39 Details	Case 39 Notes	Case 39 Comments
40	Liam Neeson	Case 40	Open	2023-02-09	Ireland	Case 40 Description	Case 40 Details	Case 40 Notes	Case 40 Comments
41	Mia Farrow	Case 41	Closed	2023-02-10	Hawaii	Case 41 Description	Case 41 Details	Case 41 Notes	Case 41 Comments
42	Nicole Kidman	Case 42	Pending	2023-02-11	Australia	Case 42 Description	Case 42 Details	Case 42 Notes	Case 42 Comments
43	Orlando Bloom	Case 43	Open	2023-02					

Case No.	Case Name	Case Type	Case Status	Case Date	Case Location	Case Description	Case Details	Case Notes	Case Comments	Case Actions
1	John Doe	Case 1	Open	2023-01-01	New York	Case 1 Description	Case 1 Details	Case 1 Notes	Case 1 Comments	Case 1 Actions
2	Jane Smith	Case 2	Closed	2023-01-02	California	Case 2 Description	Case 2 Details	Case 2 Notes	Case 2 Comments	Case 2 Actions
3	Bob Johnson	Case 3	Pending	2023-01-03	Texas	Case 3 Description	Case 3 Details	Case 3 Notes	Case 3 Comments	Case 3 Actions
4	Alice Brown	Case 4	Open	2023-01-04	Florida	Case 4 Description	Case 4 Details	Case 4 Notes	Case 4 Comments	Case 4 Actions
5	Charlie Davis	Case 5	Closed	2023-01-05	Illinois	Case 5 Description	Case 5 Details	Case 5 Notes	Case 5 Comments	Case 5 Actions
6	Diana Prince	Case 6	Pending	2023-01-06	Washington	Case 6 Description	Case 6 Details	Case 6 Notes	Case 6 Comments	Case 6 Actions
7	Edward Norton	Case 7	Open	2023-01-07	Massachusetts	Case 7 Description	Case 7 Details	Case 7 Notes	Case 7 Comments	Case 7 Actions
8	Fiona Glenanne	Case 8	Closed	2023-01-08	Ontario	Case 8 Description	Case 8 Details	Case 8 Notes	Case 8 Comments	Case 8 Actions
9	George Clooney	Case 9	Pending	2023-01-09	Georgia	Case 9 Description	Case 9 Details	Case 9 Notes	Case 9 Comments	Case 9 Actions
10	Helen Mirren	Case 10	Open	2023-01-10	London	Case 10 Description	Case 10 Details	Case 10 Notes	Case 10 Comments	Case 10 Actions
11	Ian McKellen	Case 11	Closed	2023-01-11	Edinburgh	Case 11 Description	Case 11 Details	Case 11 Notes	Case 11 Comments	Case 11 Actions
12	Jennifer Lawrence	Case 12	Pending	2023-01-12	Indiana	Case 12 Description	Case 12 Details	Case 12 Notes	Case 12 Comments	Case 12 Actions
13	Keanu Reeves	Case 13	Open	2023-01-13	Manitoba	Case 13 Description	Case 13 Details	Case 13 Notes	Case 13 Comments	Case 13 Actions
14	Liam Neeson	Case 14	Closed	2023-01-14	Massachusetts	Case 14 Description	Case 14 Details	Case 14 Notes	Case 14 Comments	Case 14 Actions
15	Mel Gibson	Case 15	Pending	2023-01-15	Queensland	Case 15 Description	Case 15 Details	Case 15 Notes	Case 15 Comments	Case 15 Actions
16	Nicole Kidman	Case 16	Open	2023-01-16	Victoria	Case 16 Description	Case 16 Details	Case 16 Notes	Case 16 Comments	Case 16 Actions
17	Orlando Bloom	Case 17	Closed	2023-01-17	Queensland	Case 17 Description	Case 17 Details	Case 17 Notes	Case 17 Comments	Case 17 Actions
18	Peter Dinklage	Case 18	Pending	2023-01-18	Queensland	Case 18 Description	Case 18 Details	Case 18 Notes	Case 18 Comments	Case 18 Actions
19	Quentin Tarantino	Case 19	Open	2023-01-19	Queensland	Case 19 Description	Case 19 Details	Case 19 Notes	Case 19 Comments	Case 19 Actions
20	Rachel Watson	Case 20	Closed	2023-01-20	Queensland	Case 20 Description	Case 20 Details	Case 20 Notes	Case 20 Comments	Case 20 Actions
21	Samuel L. Jackson	Case 21	Pending	2023-01-21	Queensland	Case 21 Description	Case 21 Details	Case 21 Notes	Case 21 Comments	Case 21 Actions
22	Sarah Michelle Gellar	Case 22	Open	2023-01-22	Queensland	Case 22 Description	Case 22 Details	Case 22 Notes	Case 22 Comments	Case 22 Actions
23	Tom Cruise	Case 23	Closed	2023-01-23	Queensland	Case 23 Description	Case 23 Details	Case 23 Notes	Case 23 Comments	Case 23 Actions
24	Uma Thurman	Case 24	Pending	2023-01-24	Queensland	Case 24 Description	Case 24 Details	Case 24 Notes	Case 24 Comments	Case 24 Actions
25	Will Smith	Case 25	Open	2023-01-25	Queensland	Case 25 Description	Case 25 Details	Case 25 Notes	Case 25 Comments	Case 25 Actions

Table B.12 [

] Hot Uncontrolled LPF



Table B.14 [

] Hot Uncontrolled LPF

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Table B.15 [] Hot Uncontrolled k_{∞}

Table B.16 [] Hot Uncontrolled LPF

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Table B.17 [

] Hot Uncontrolled k_{∞}

Table B.18 [

] Hot Uncontrolled LPF

Sl. No.	Name of the Candidate	Grade	Score	Remarks
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Table B.21 [

] Hot Uncontrolled k_{∞}

Table B.22 [

] Hot Uncontrolled LPF

Sl. No.	Name of the Candidate	Grade	Score	Remarks
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Table B.25 [

] Hot Uncontrolled k_{∞}

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Table B.28 [] Hot Uncontrolled LPF

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[illegible]

Table B.30 [

] Hot Uncontrolled LPF

Appendix C Enriched Lattice Isotopic Data Tables

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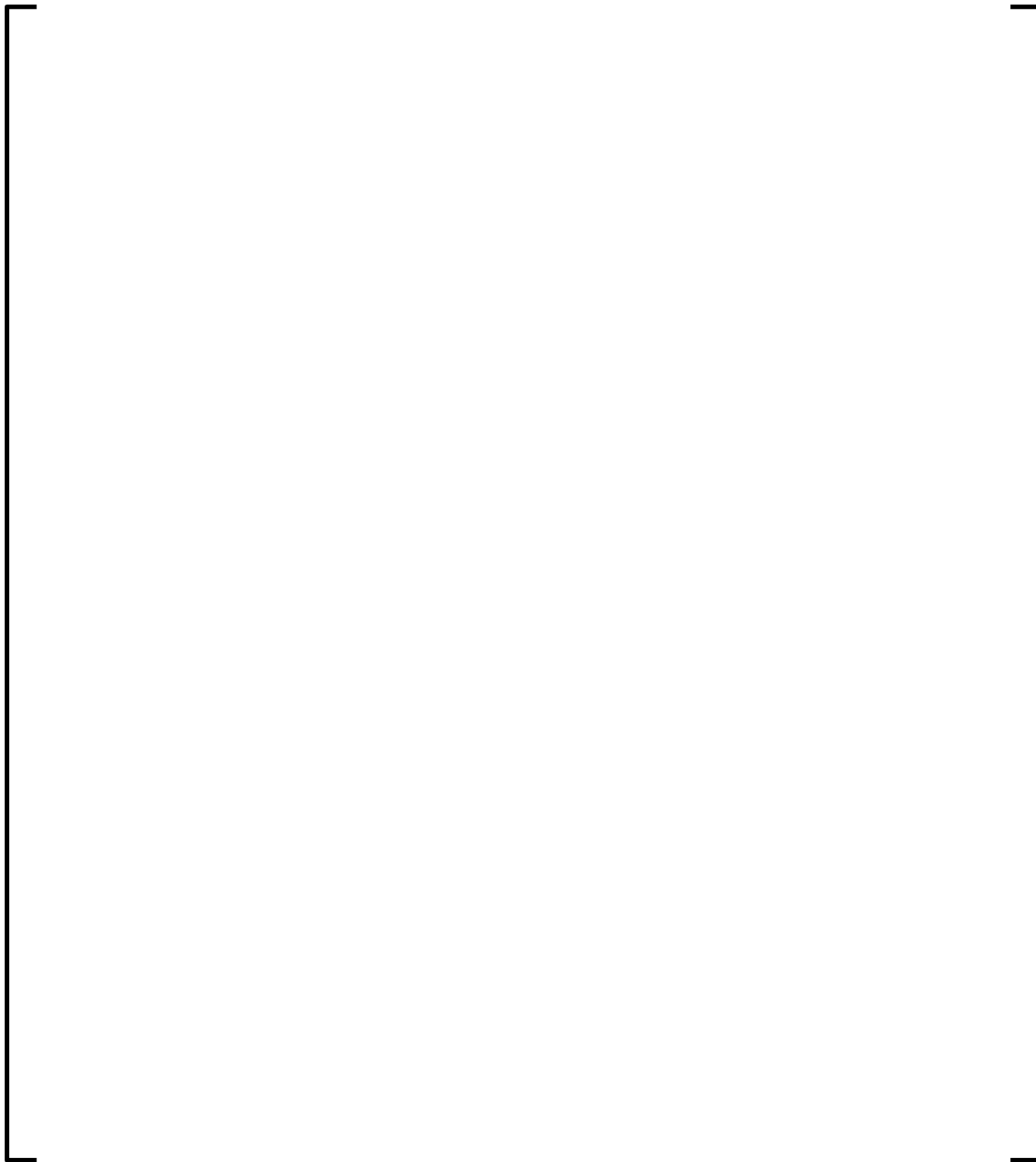
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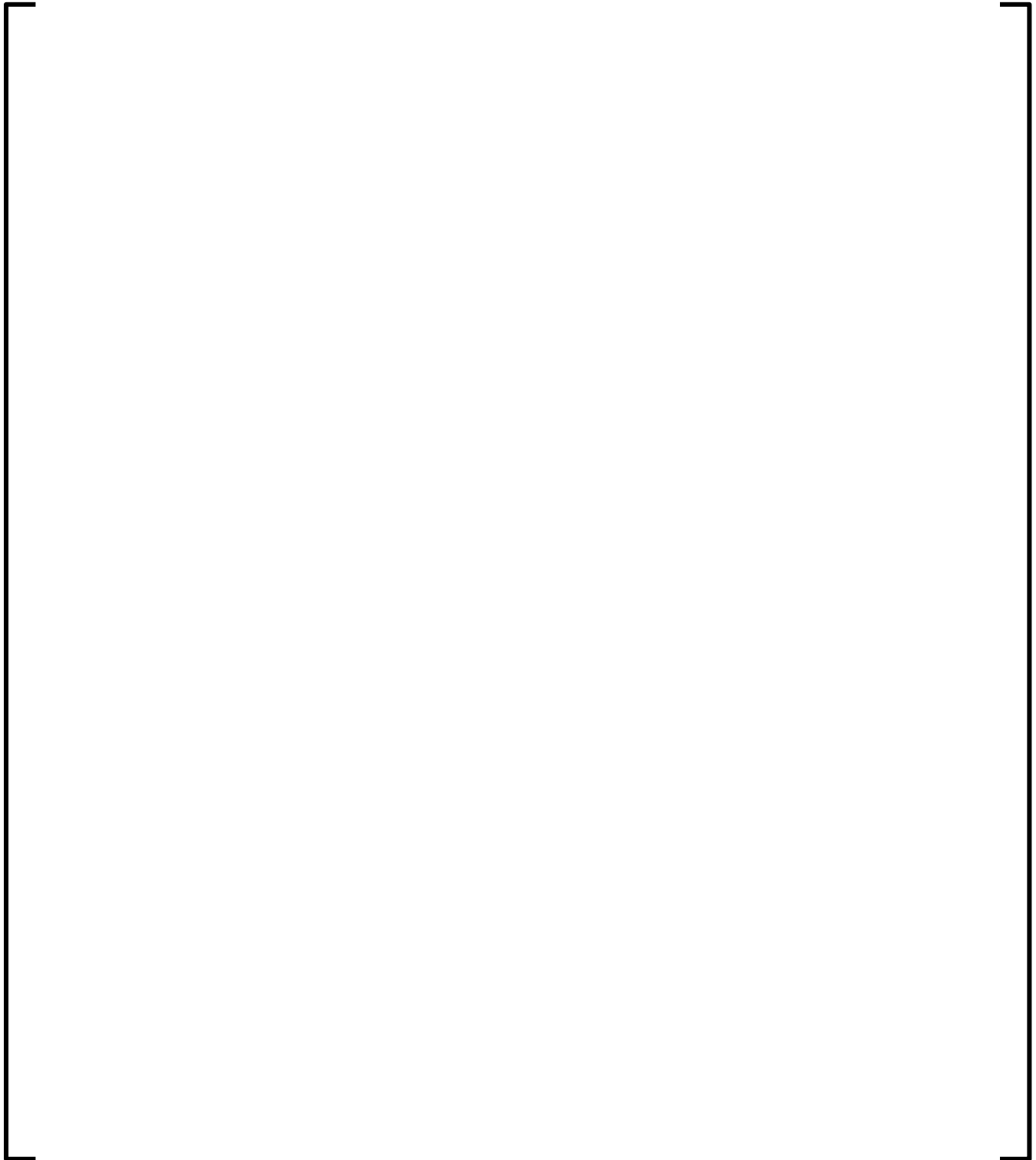
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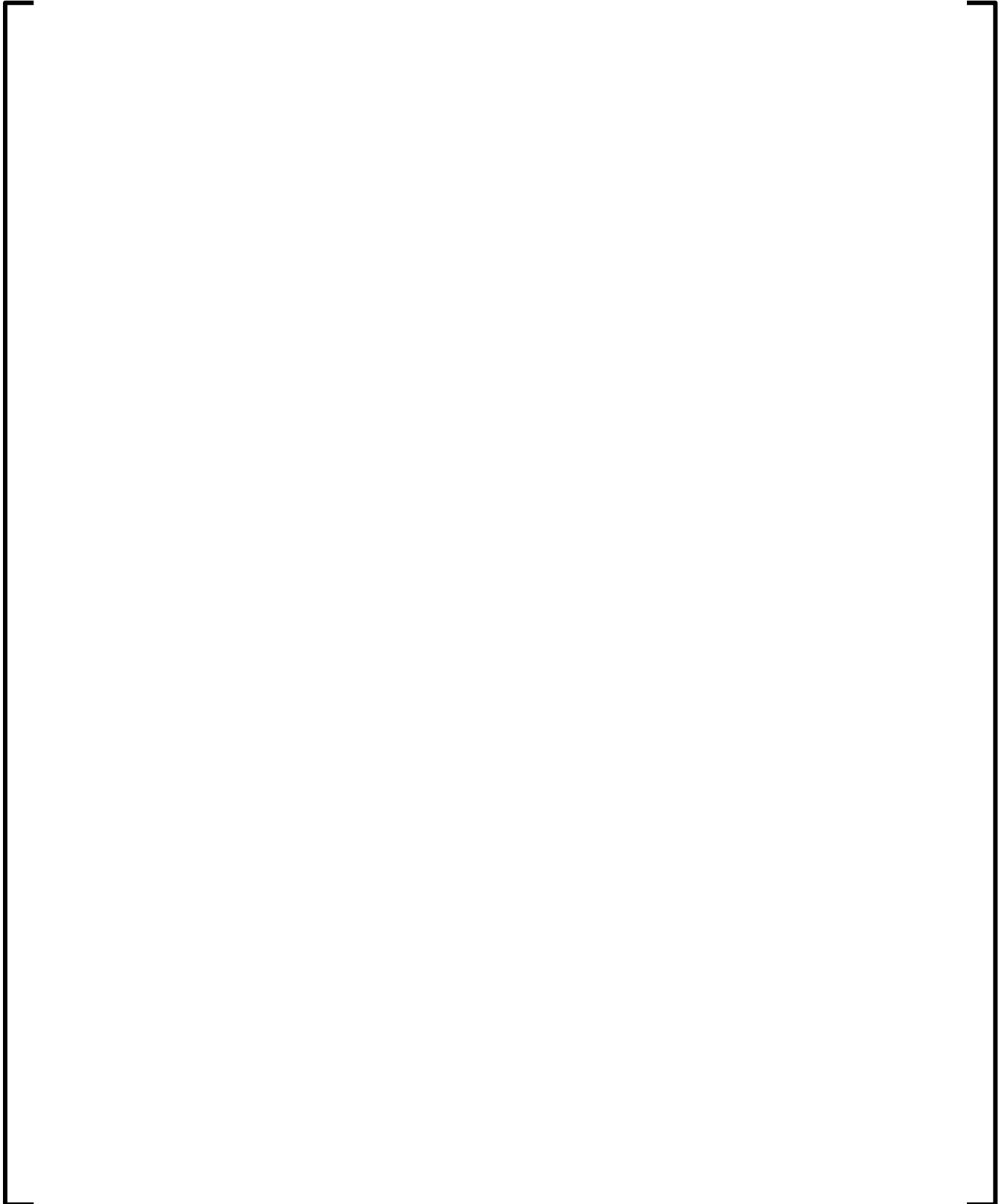
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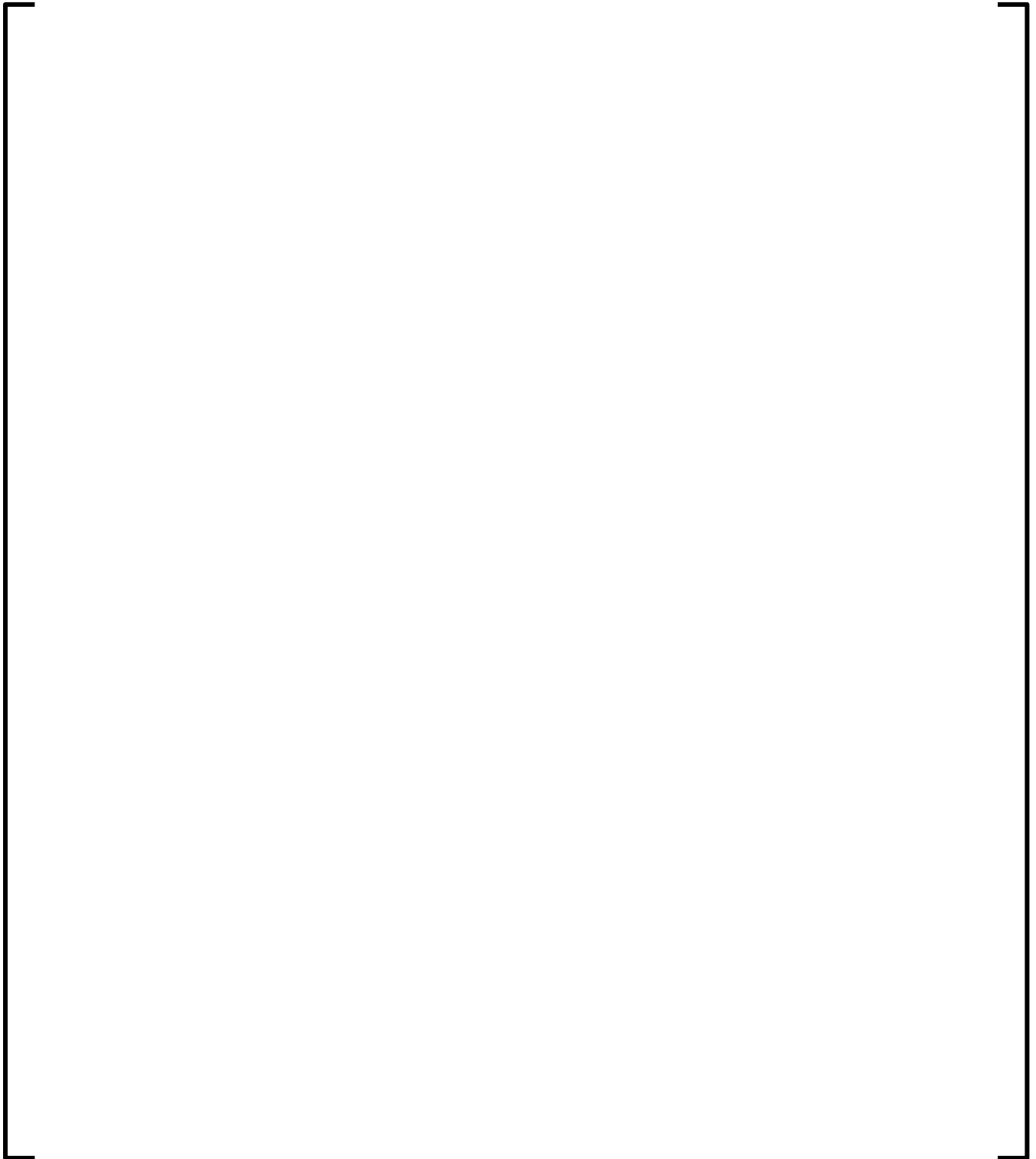
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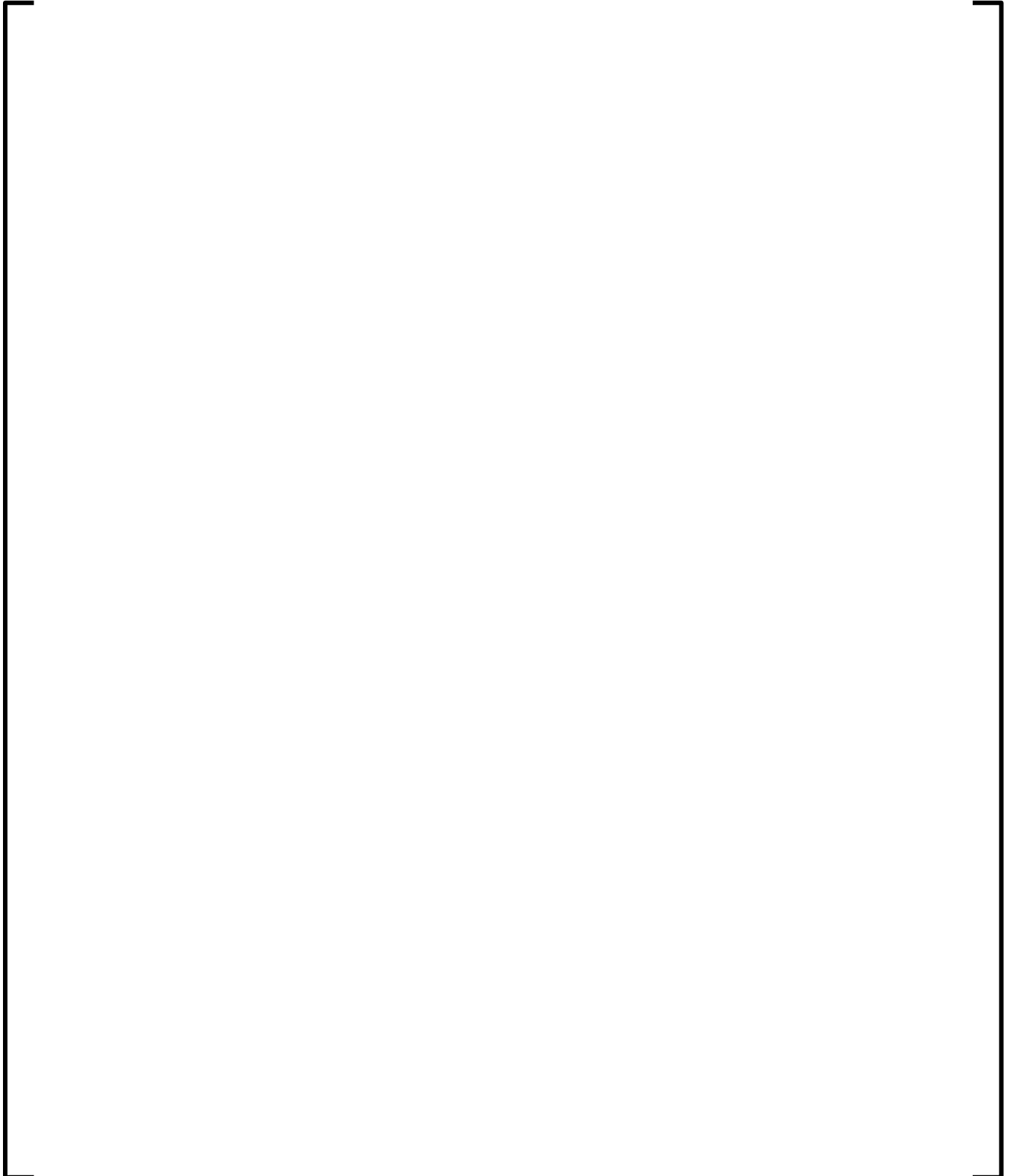
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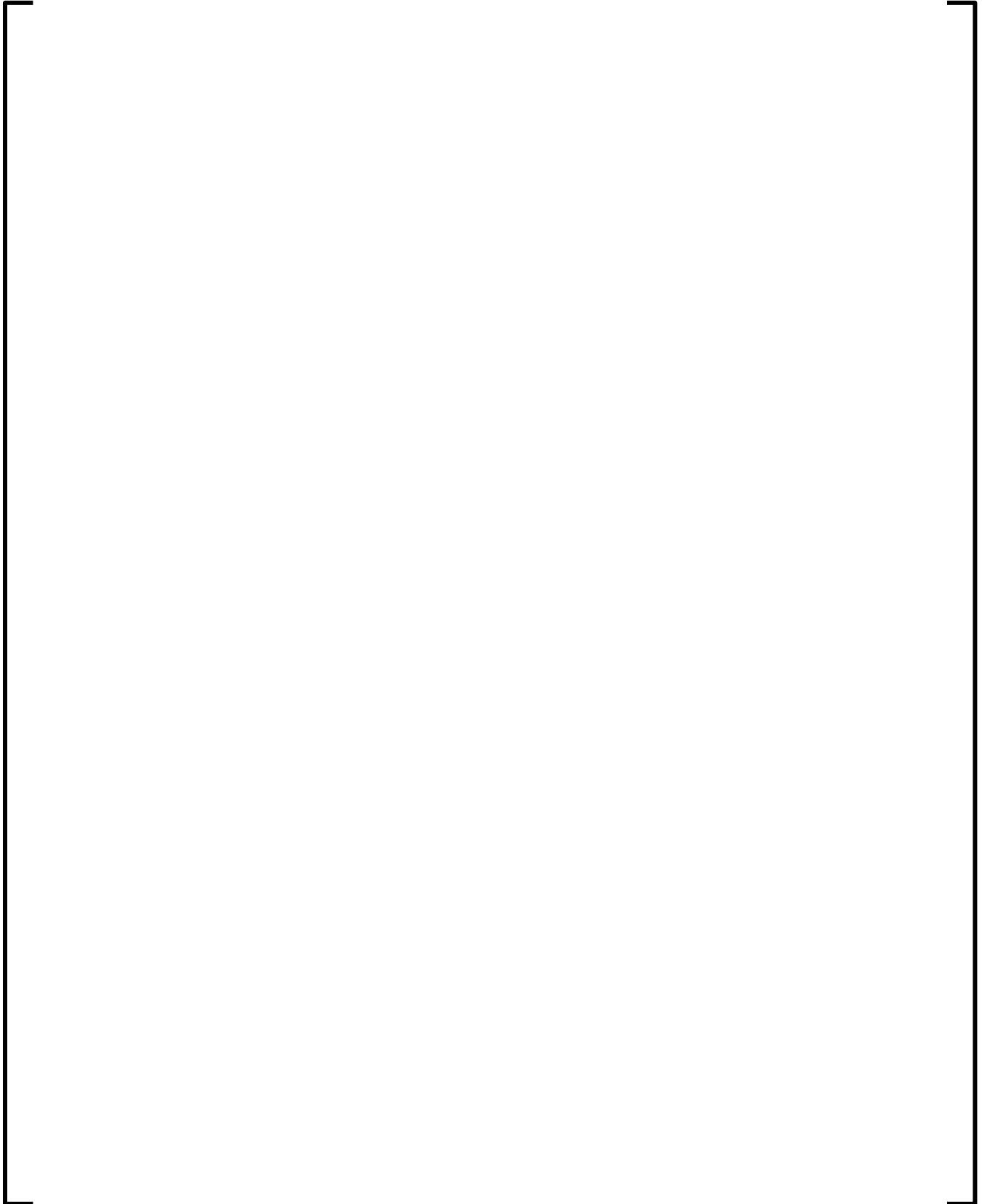
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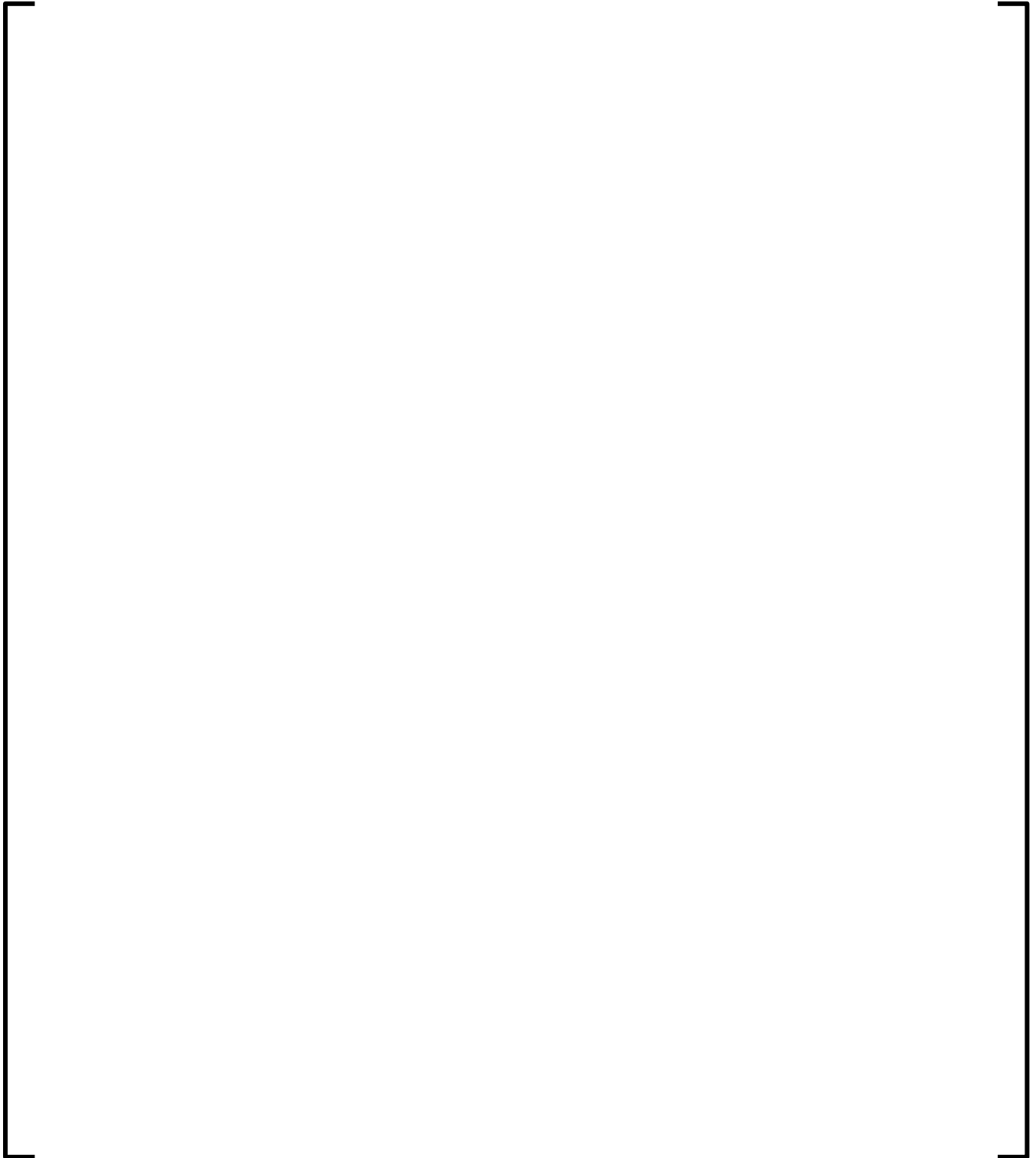
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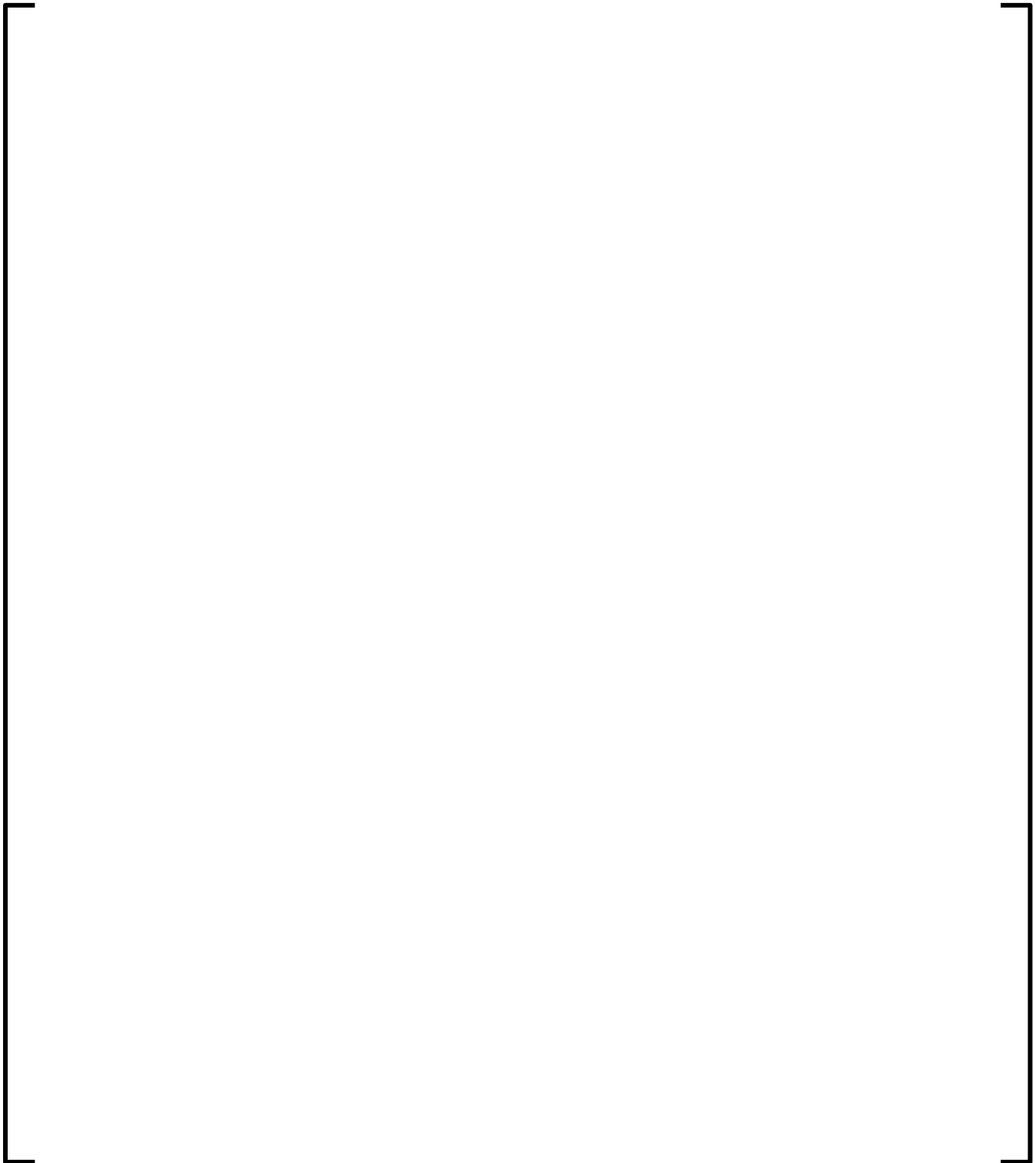
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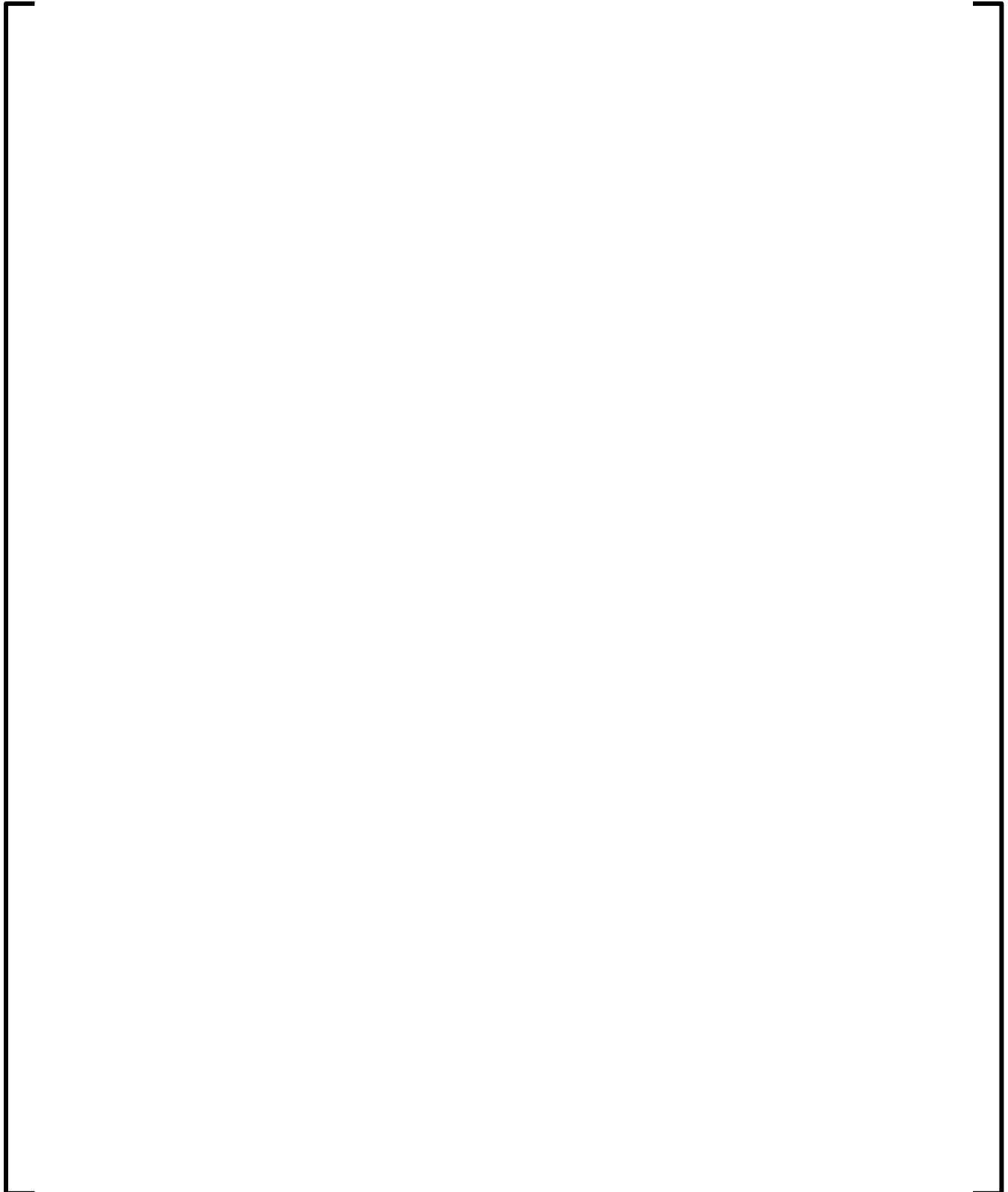
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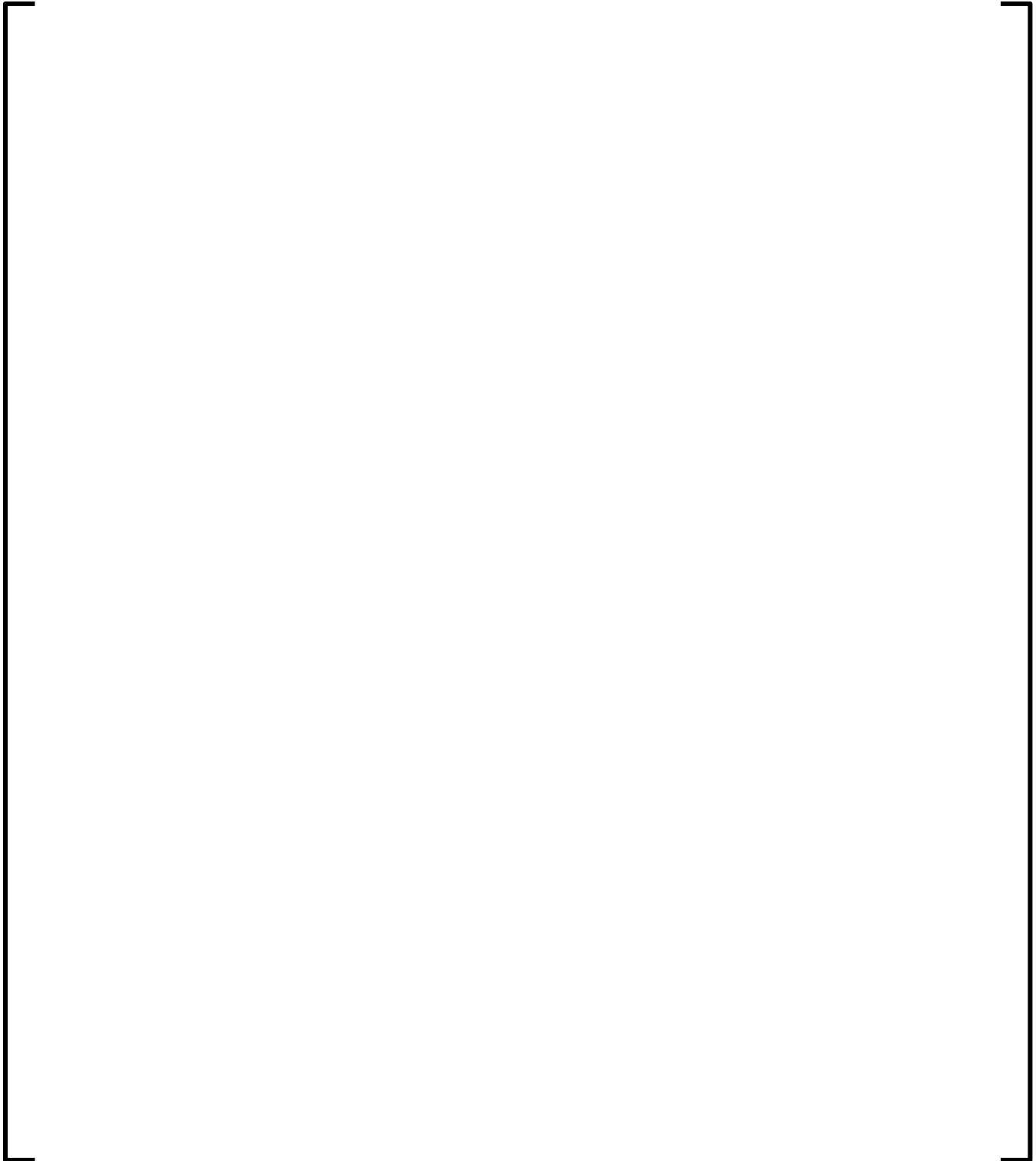
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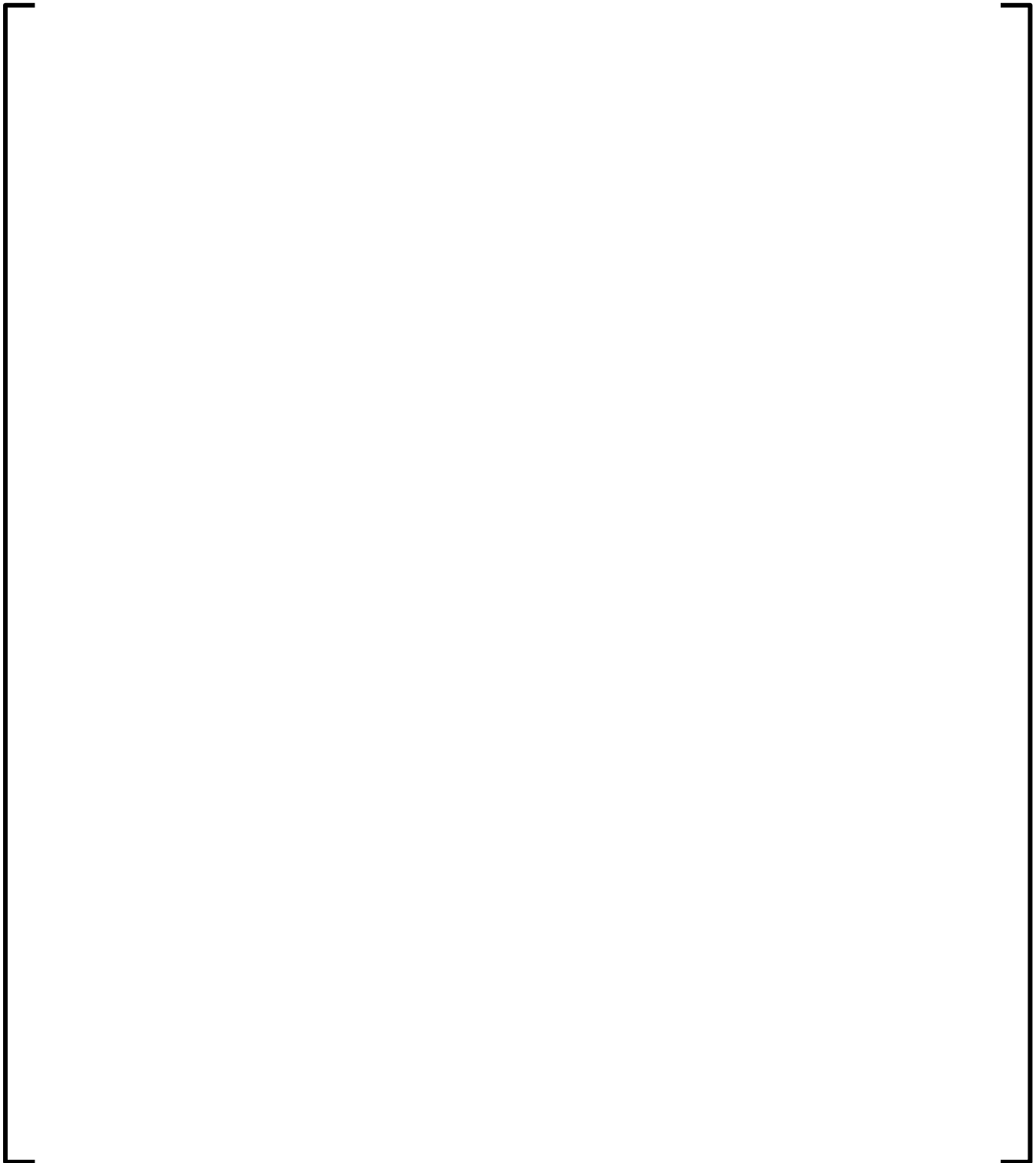
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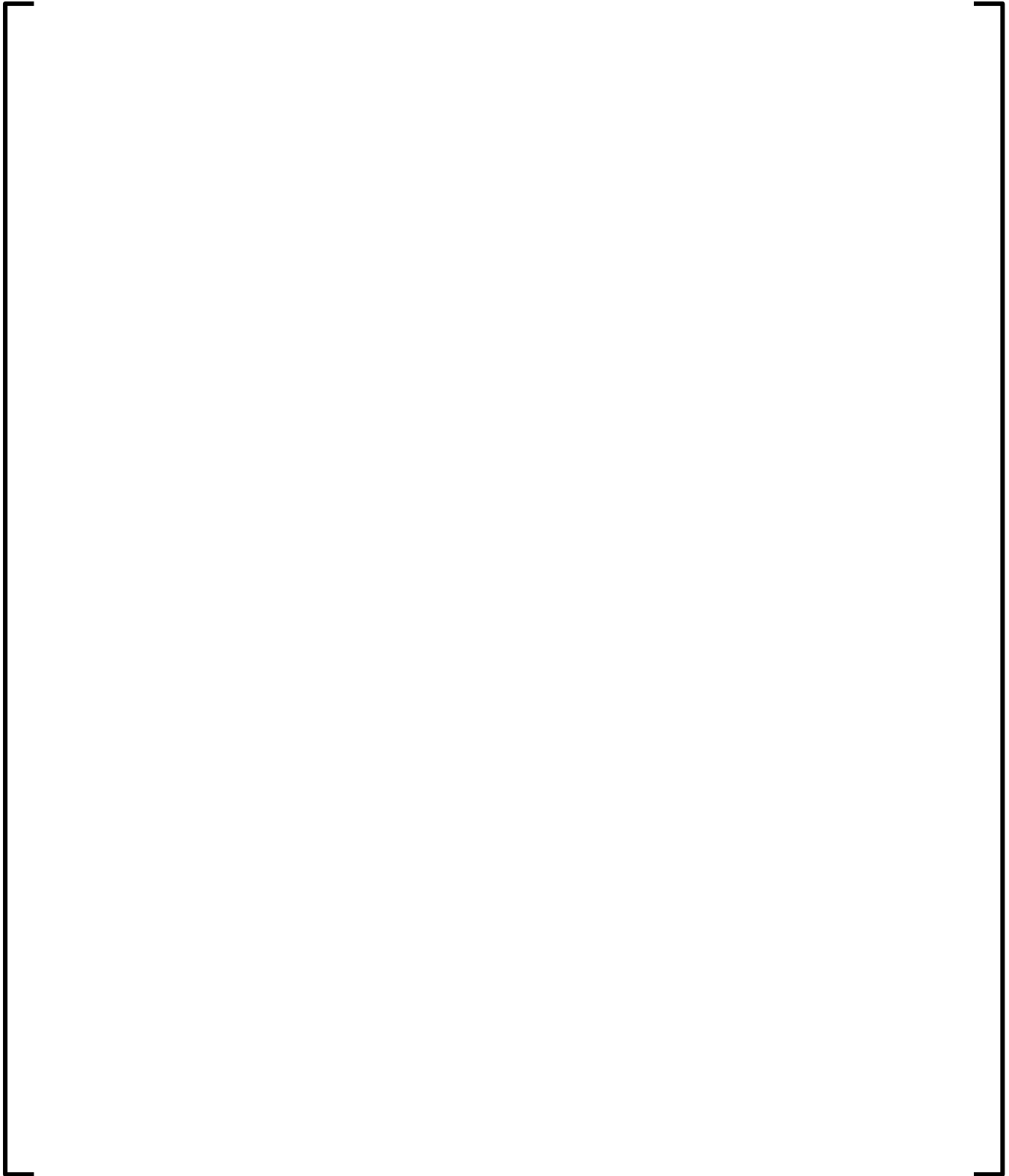
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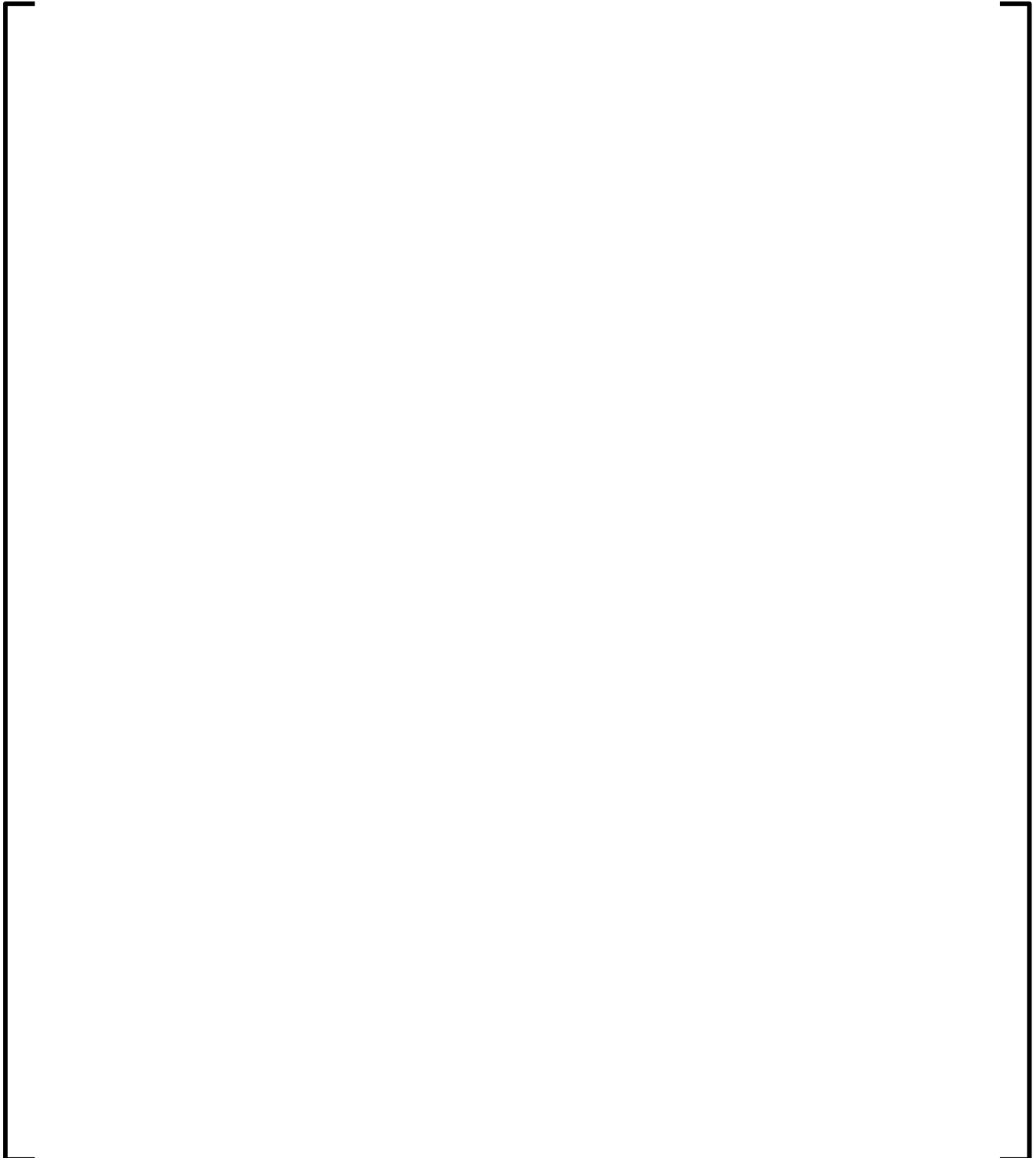
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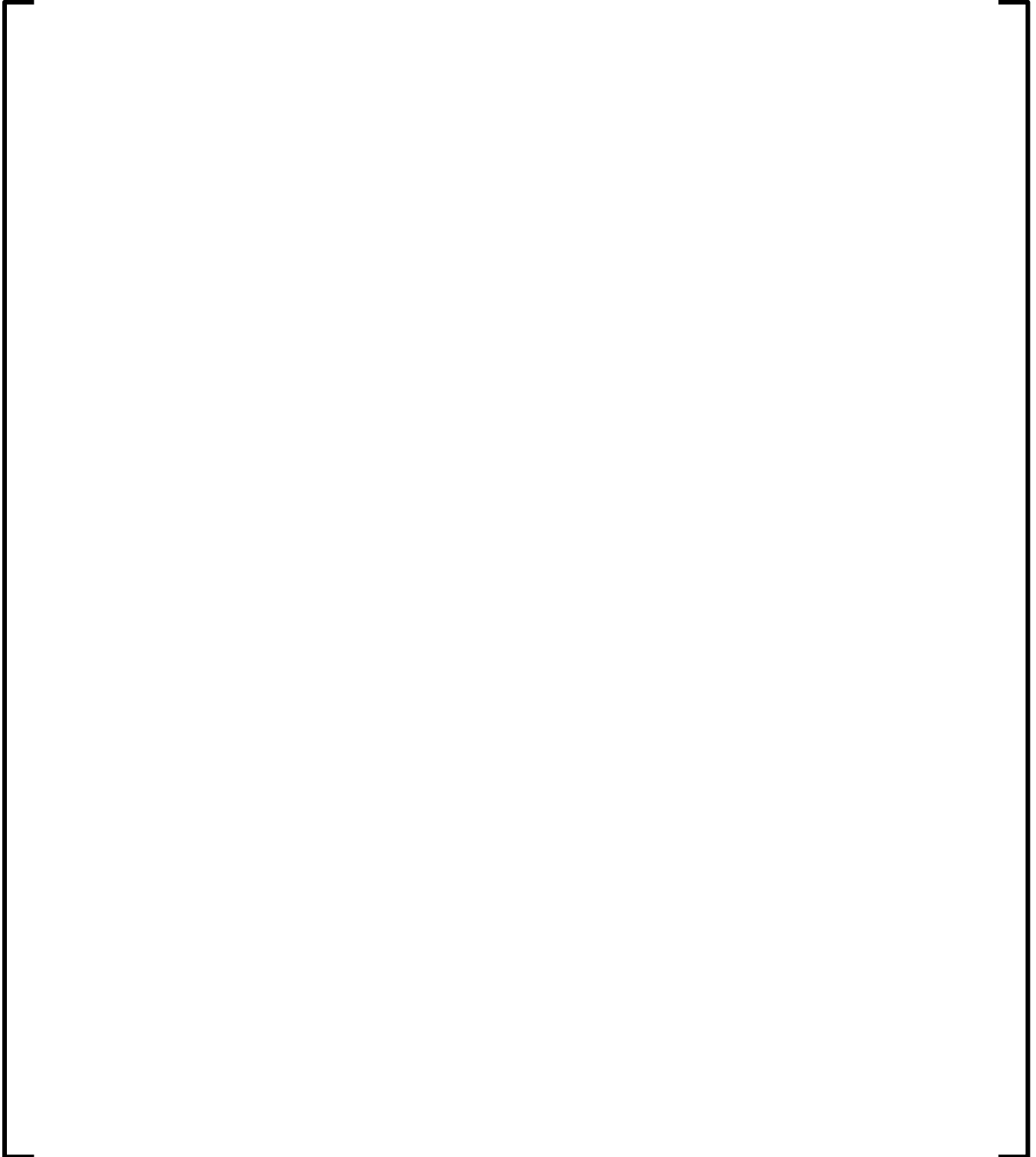
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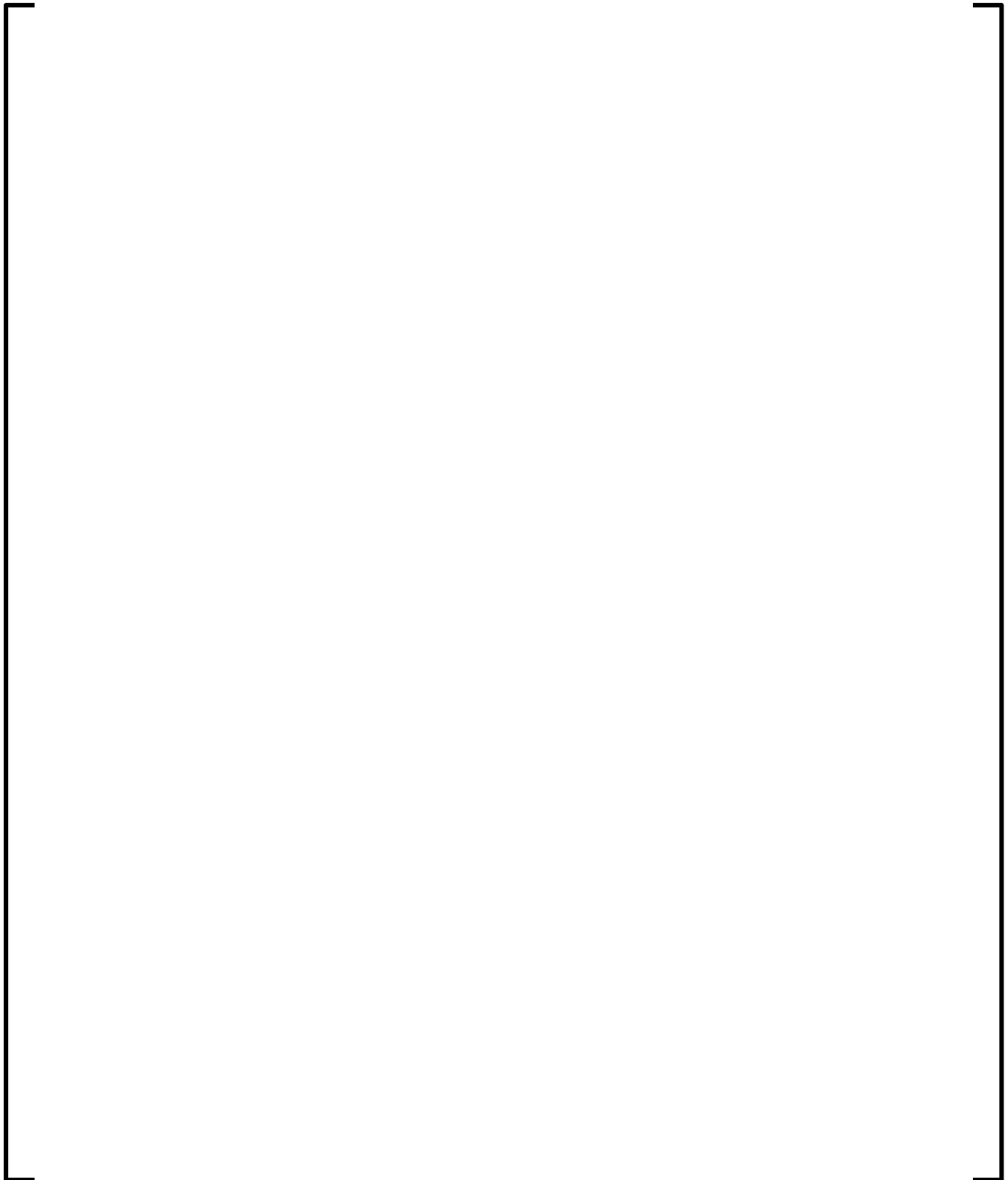
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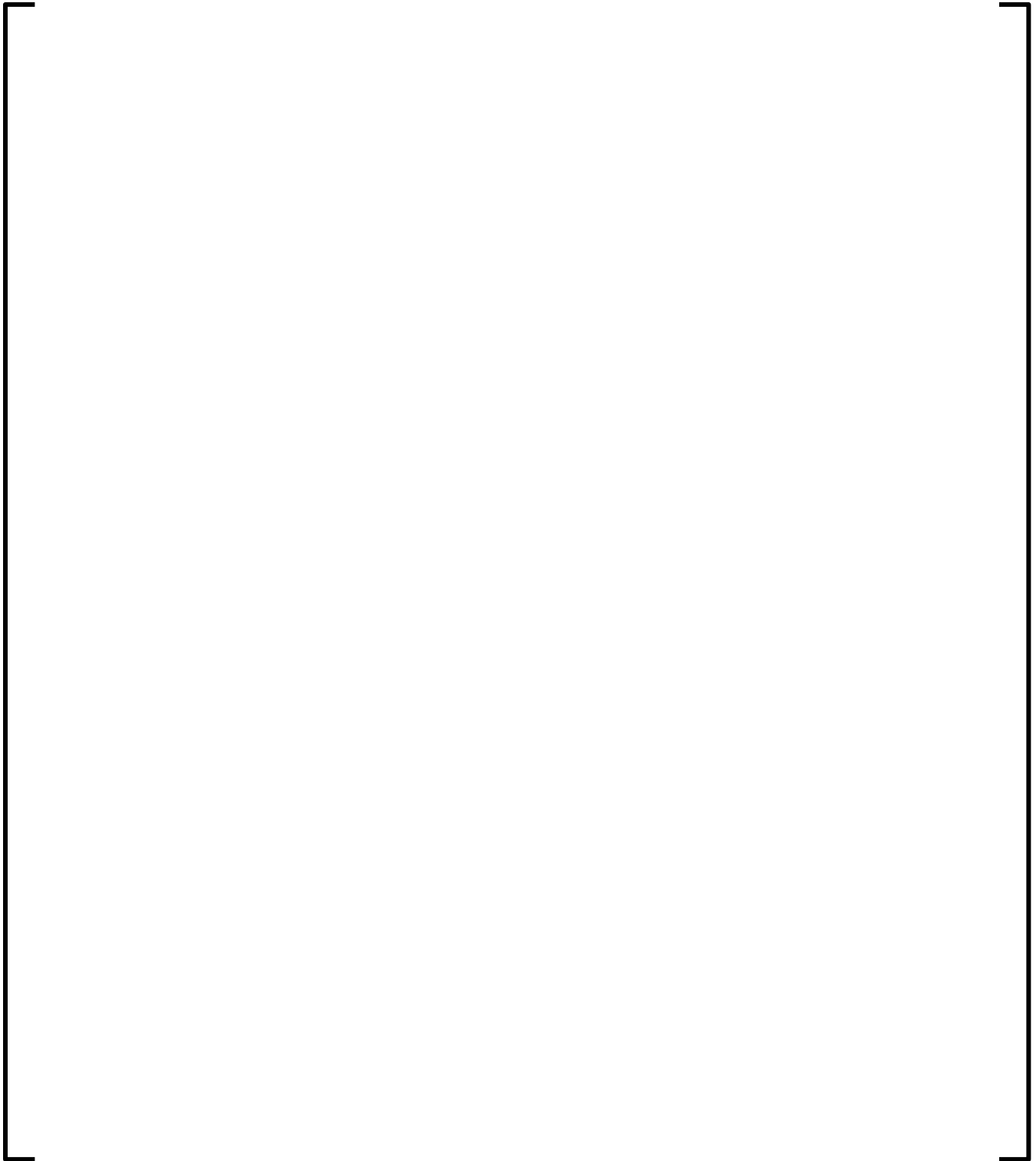
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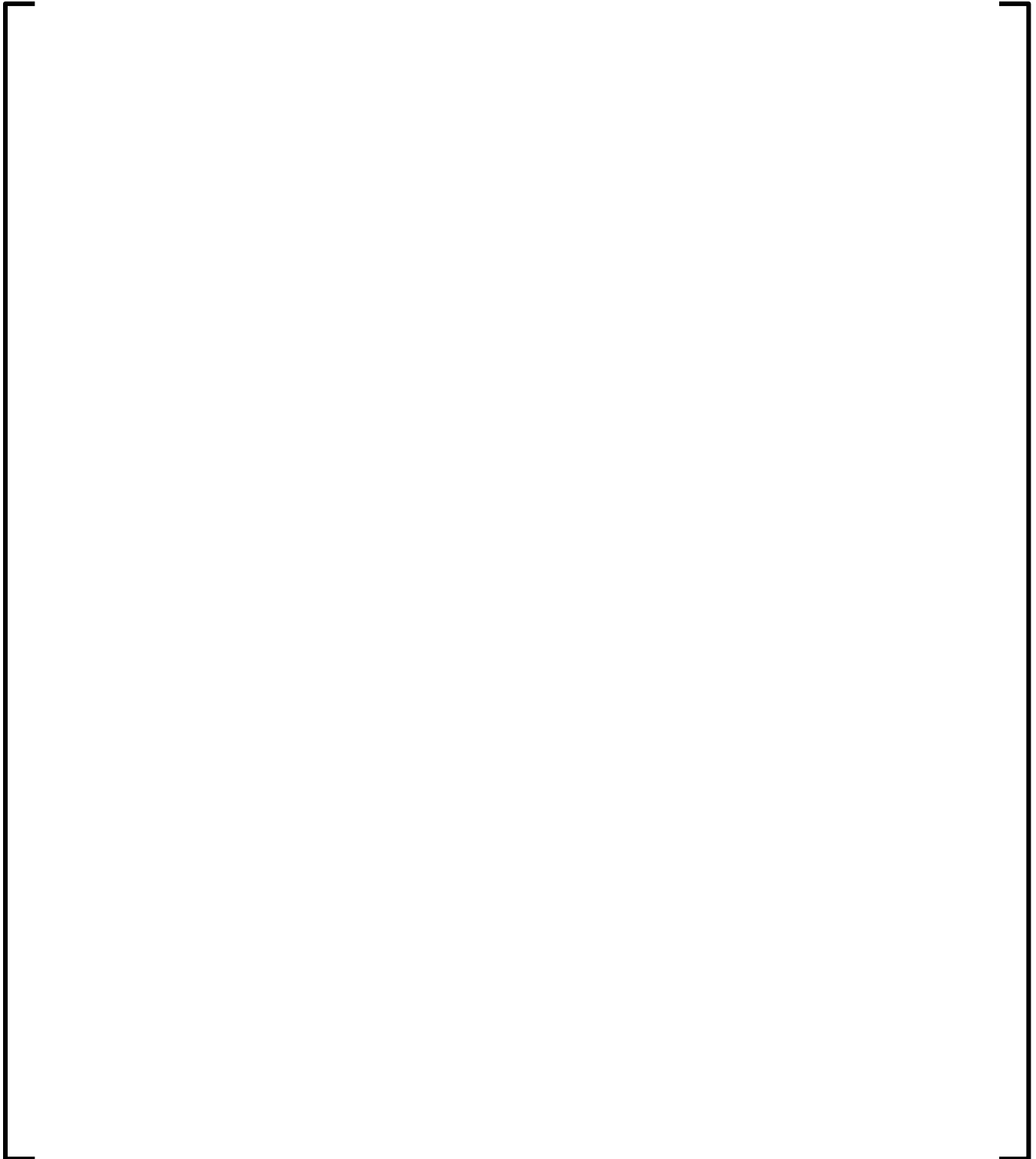
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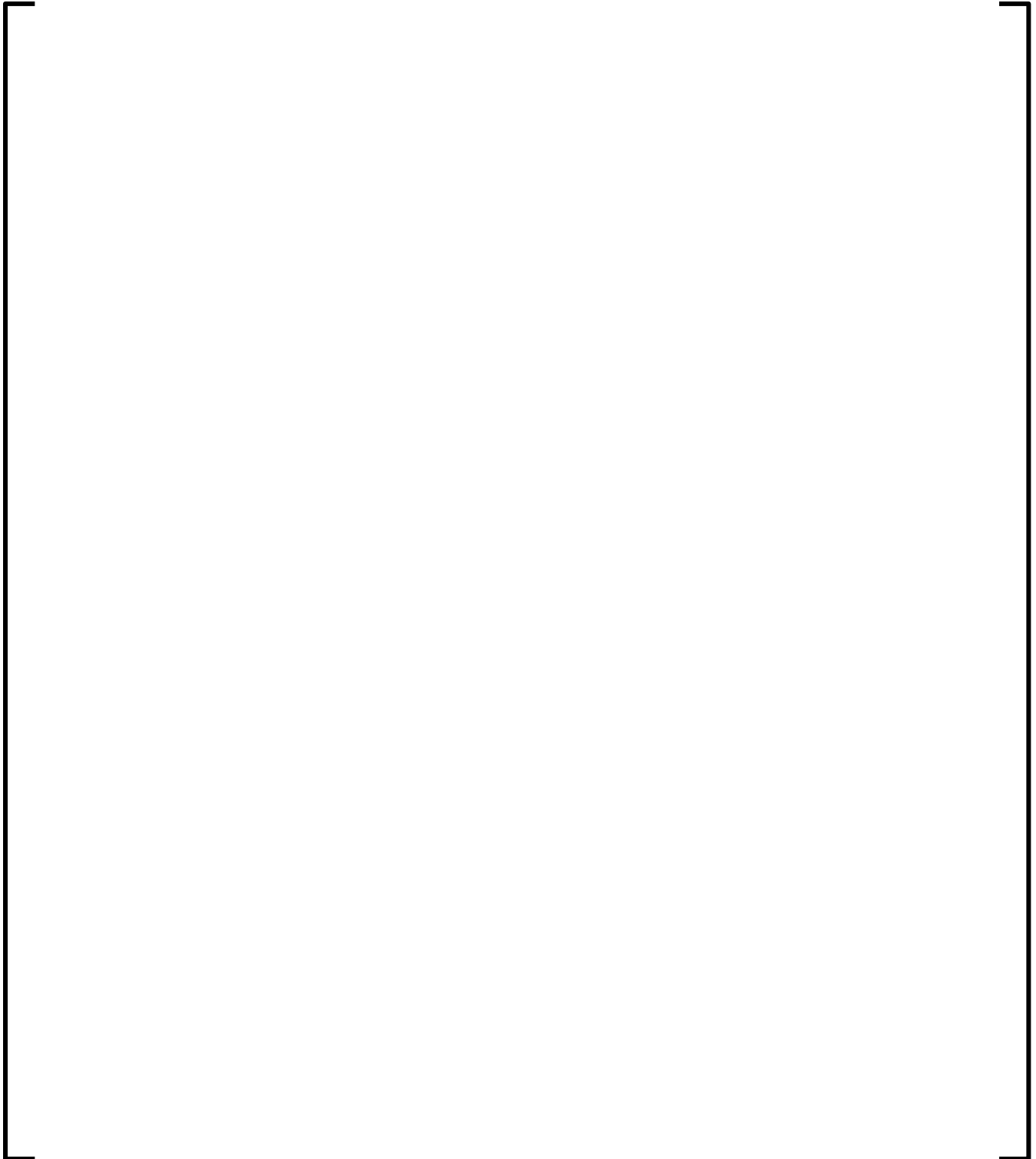
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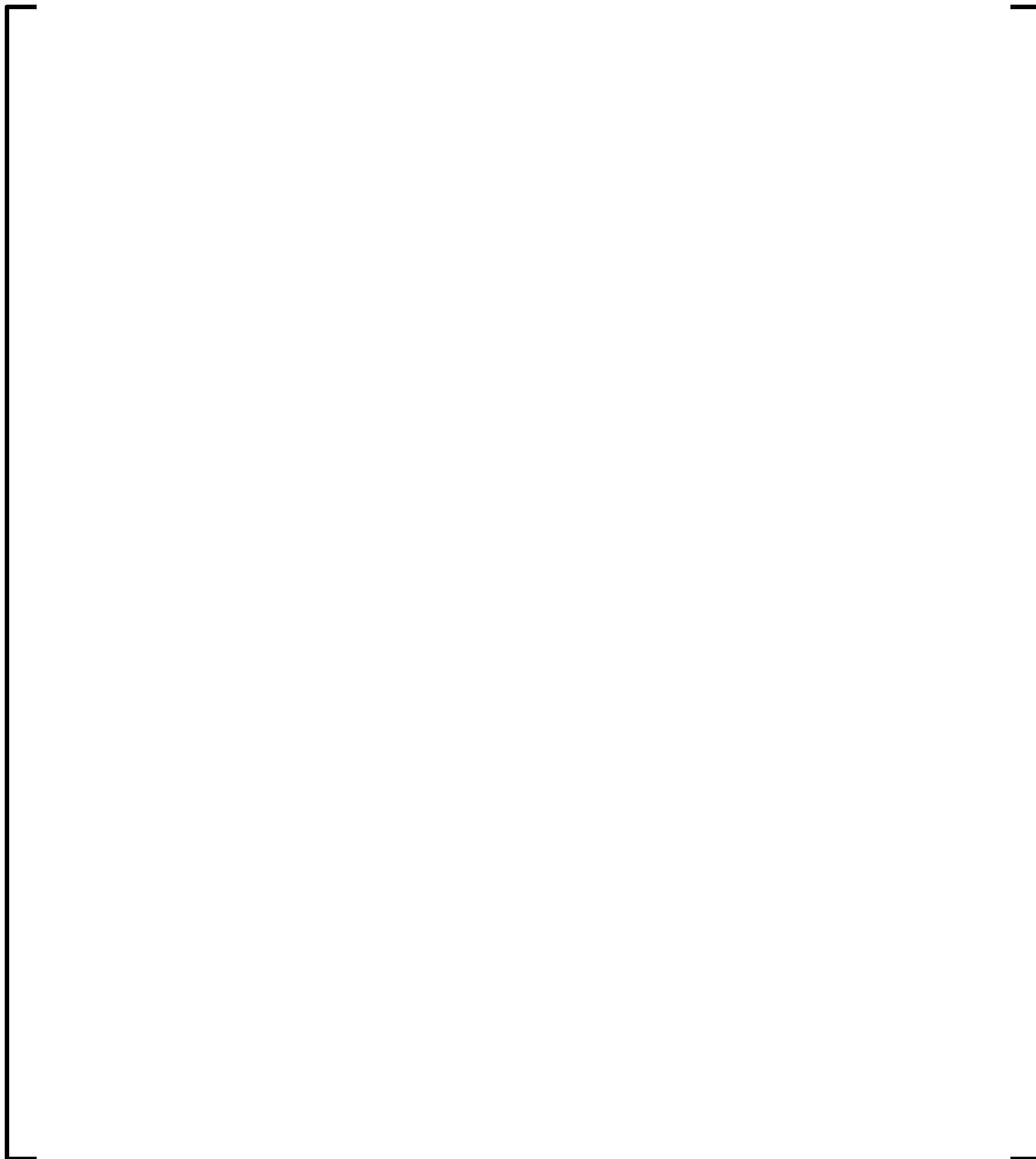


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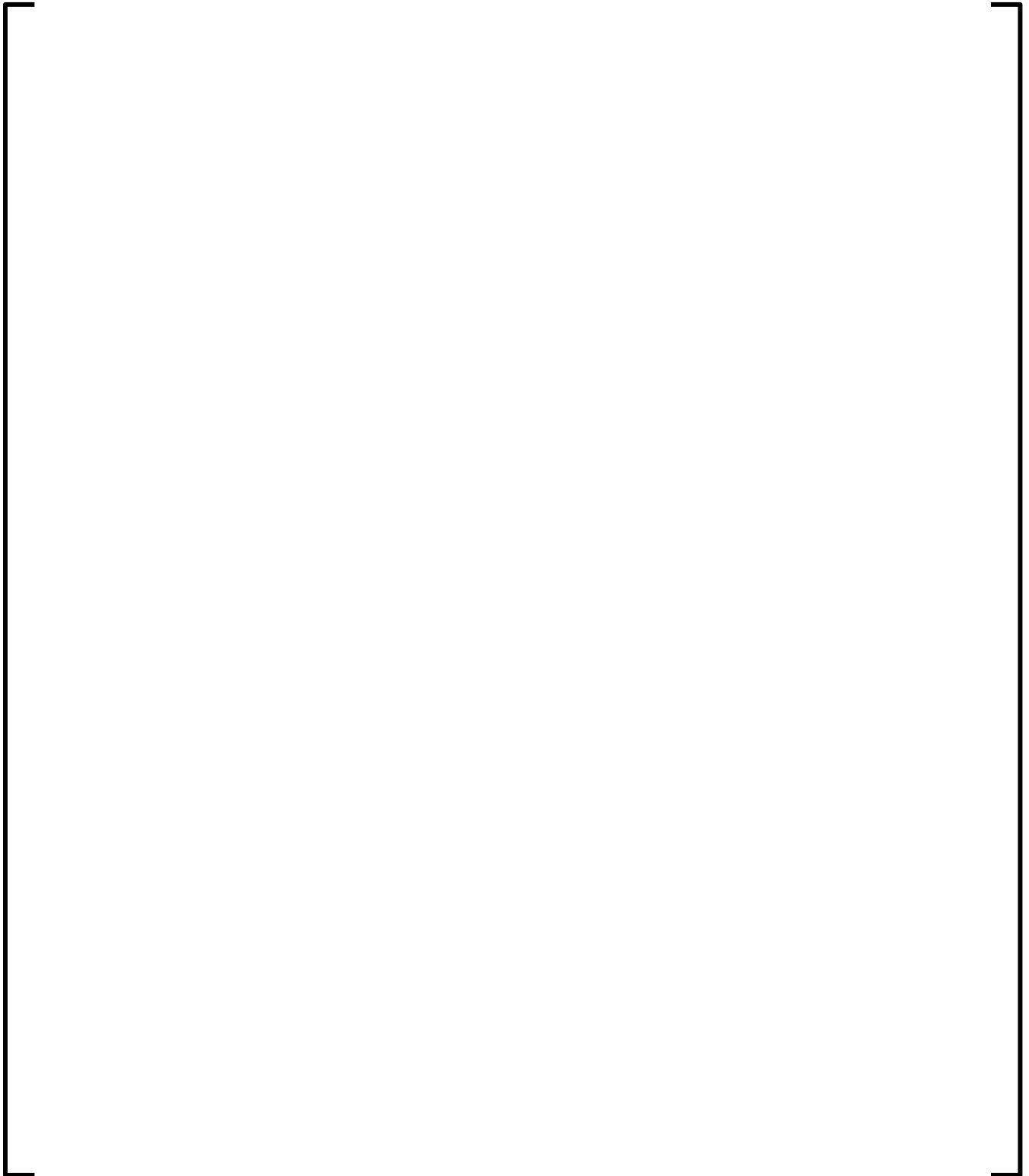
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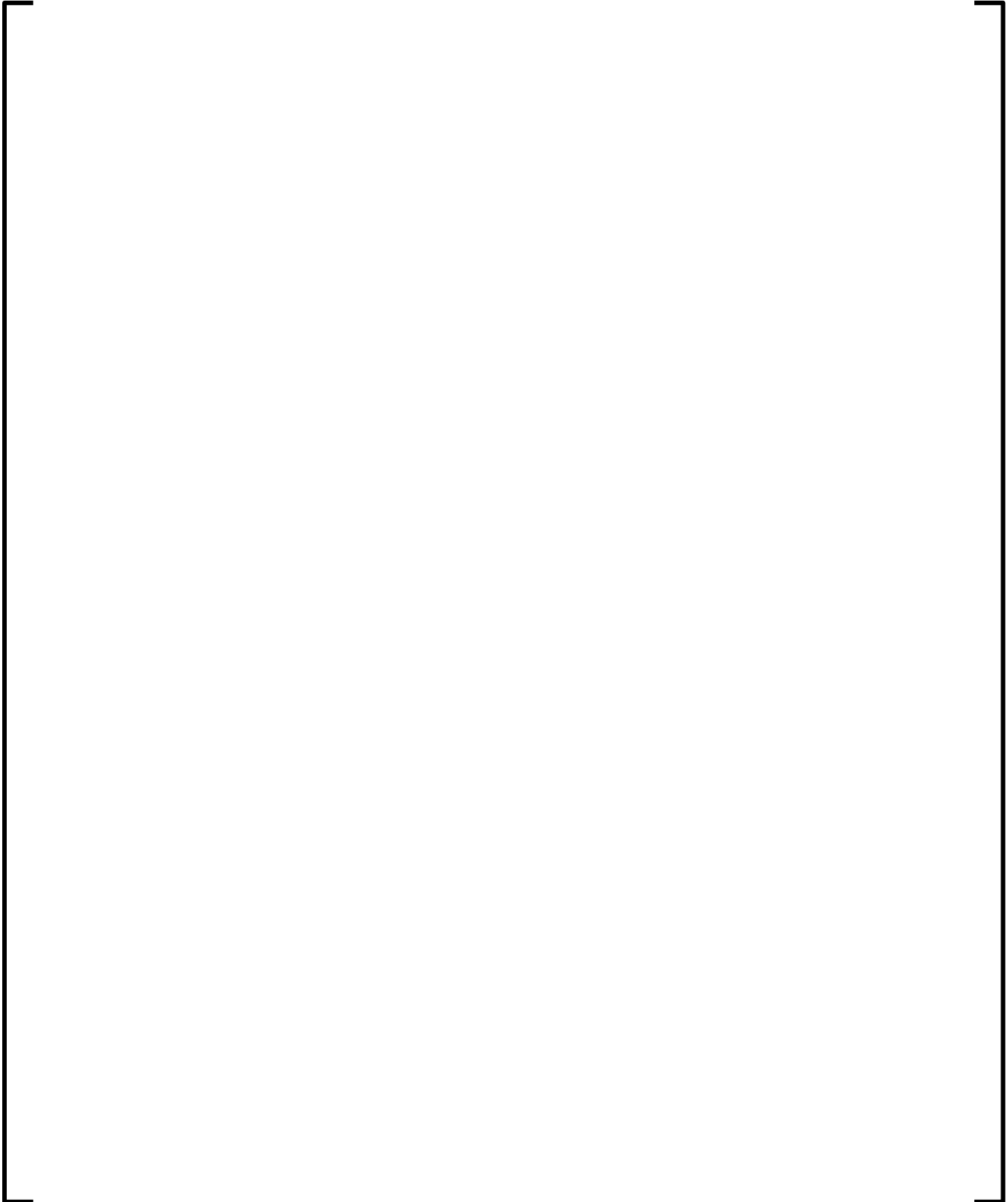
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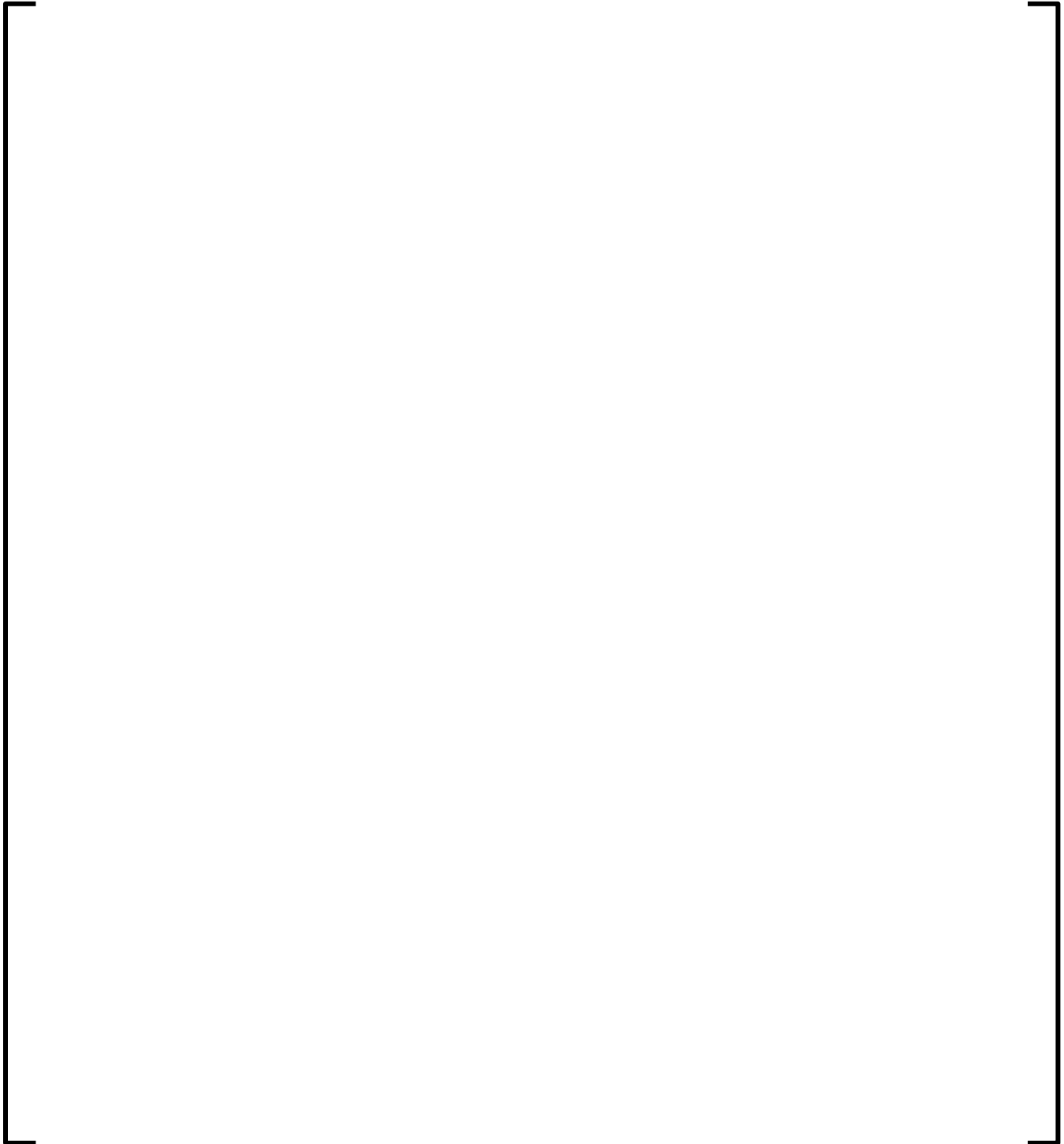
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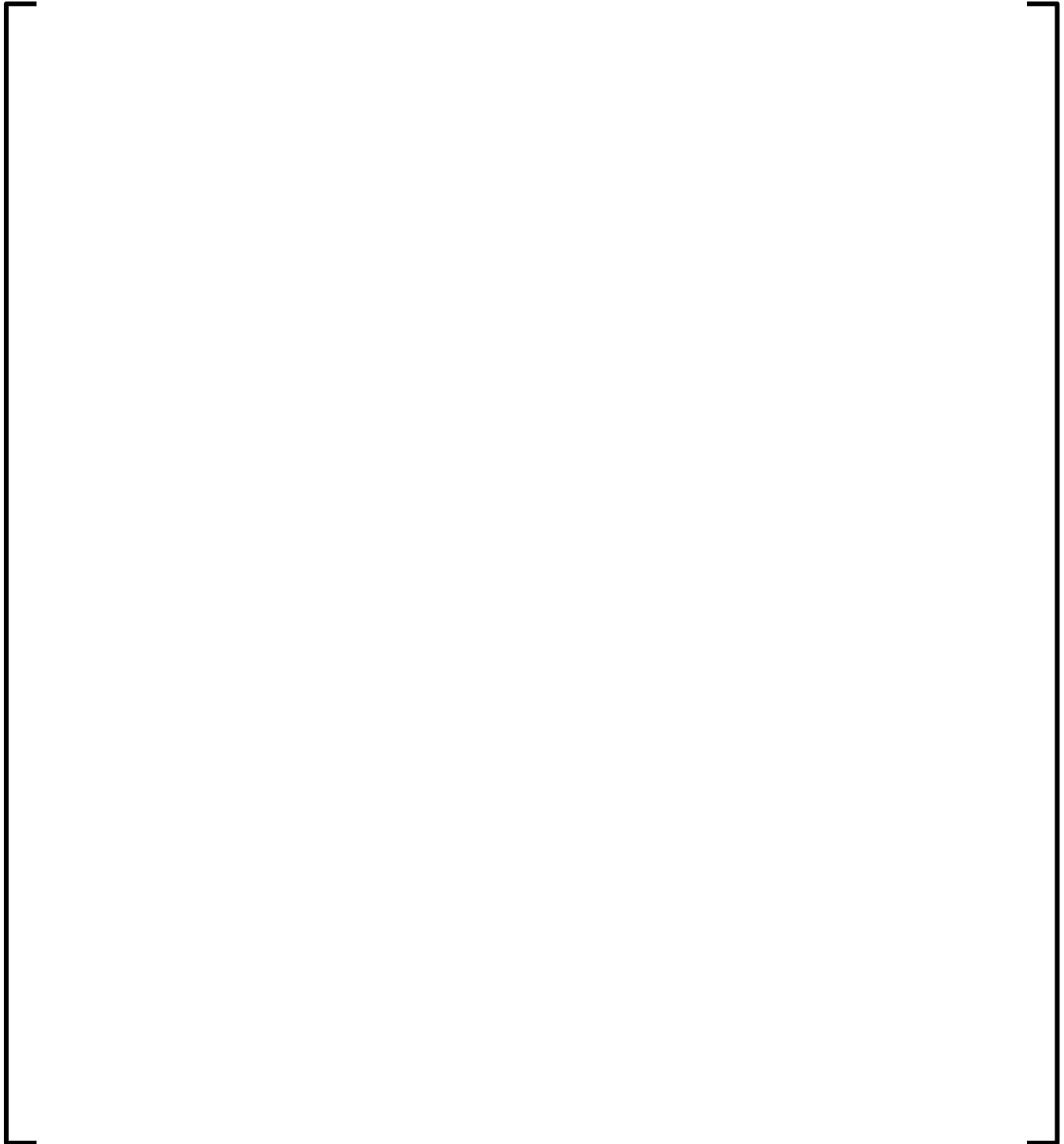
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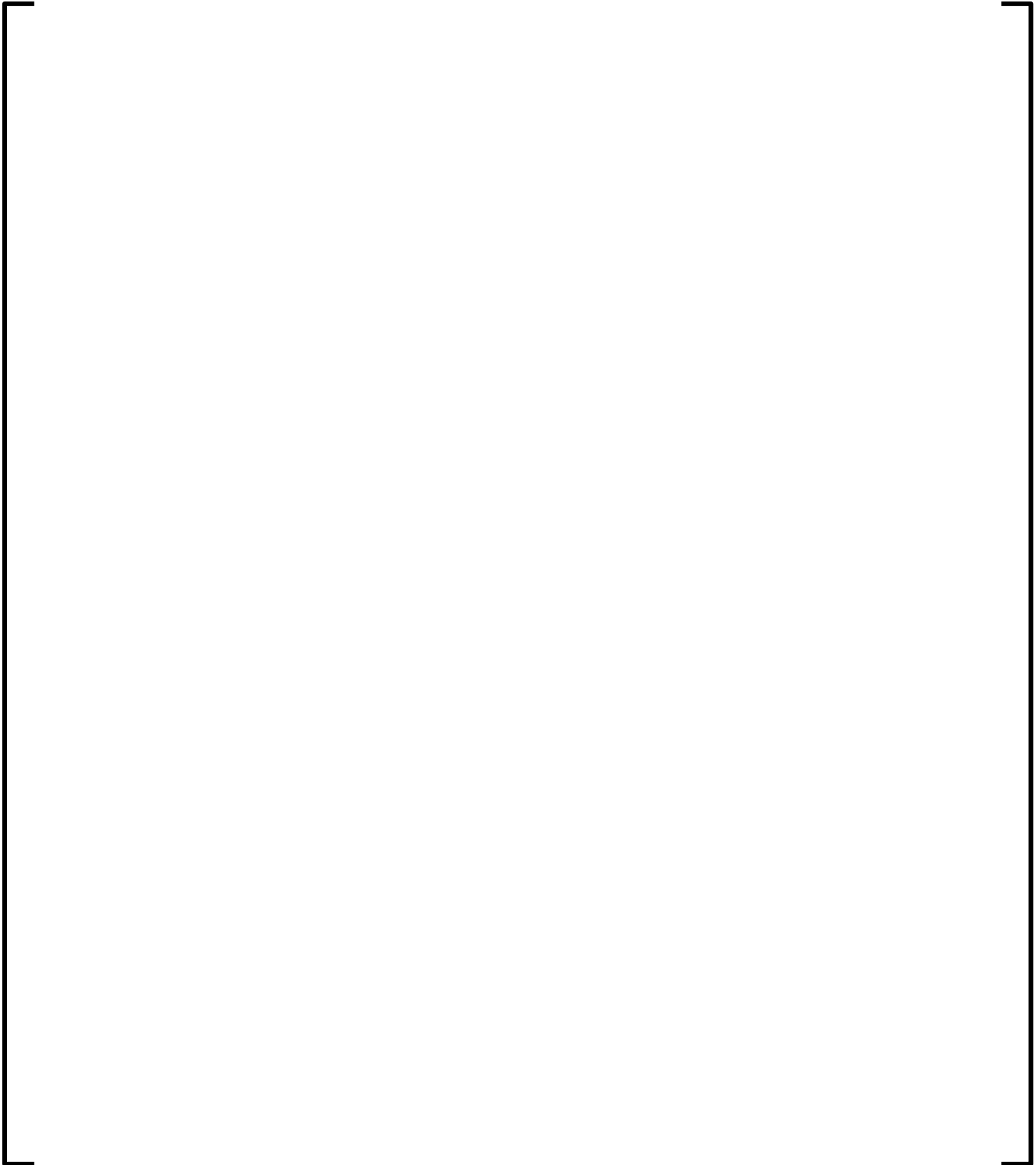
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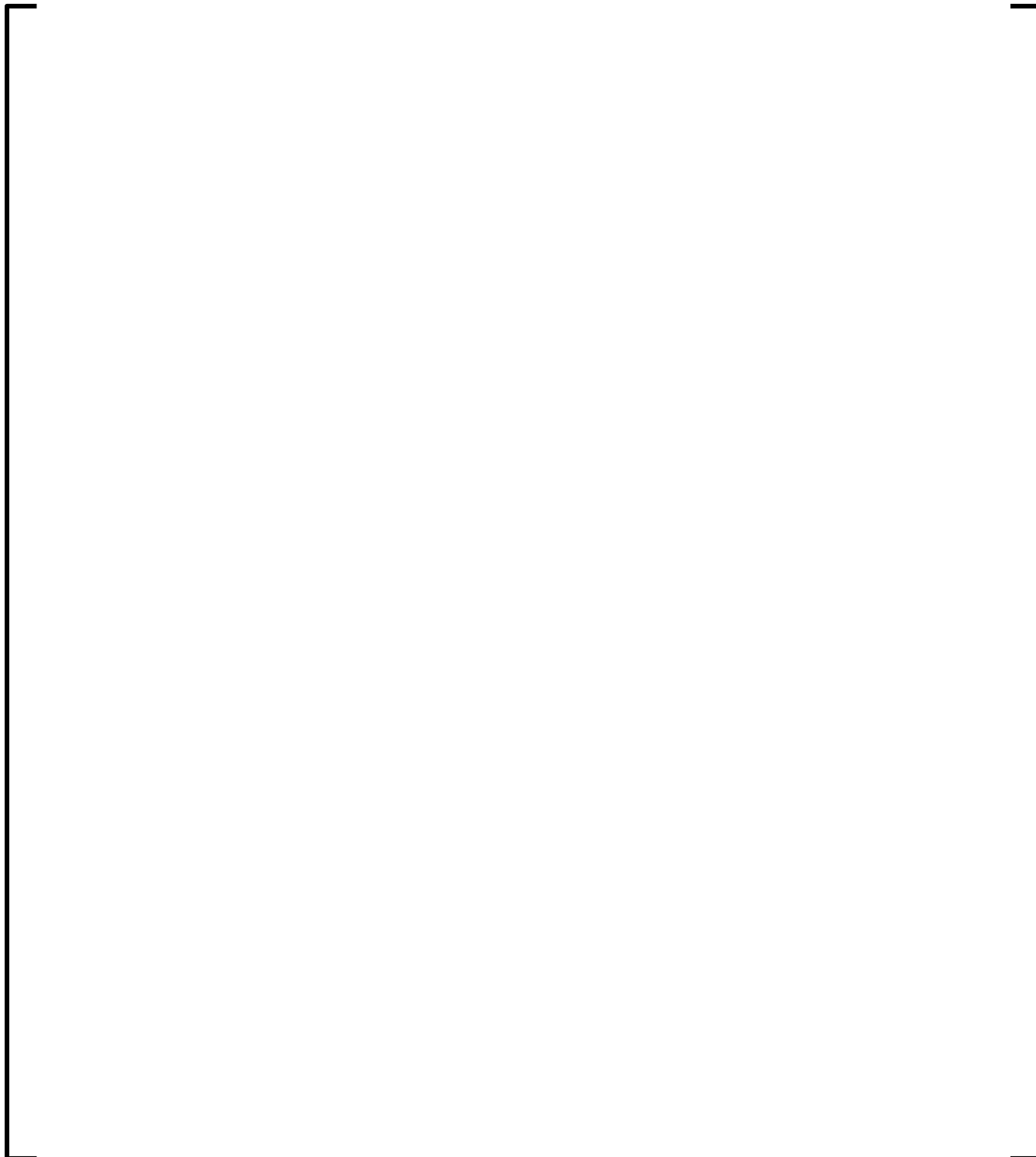


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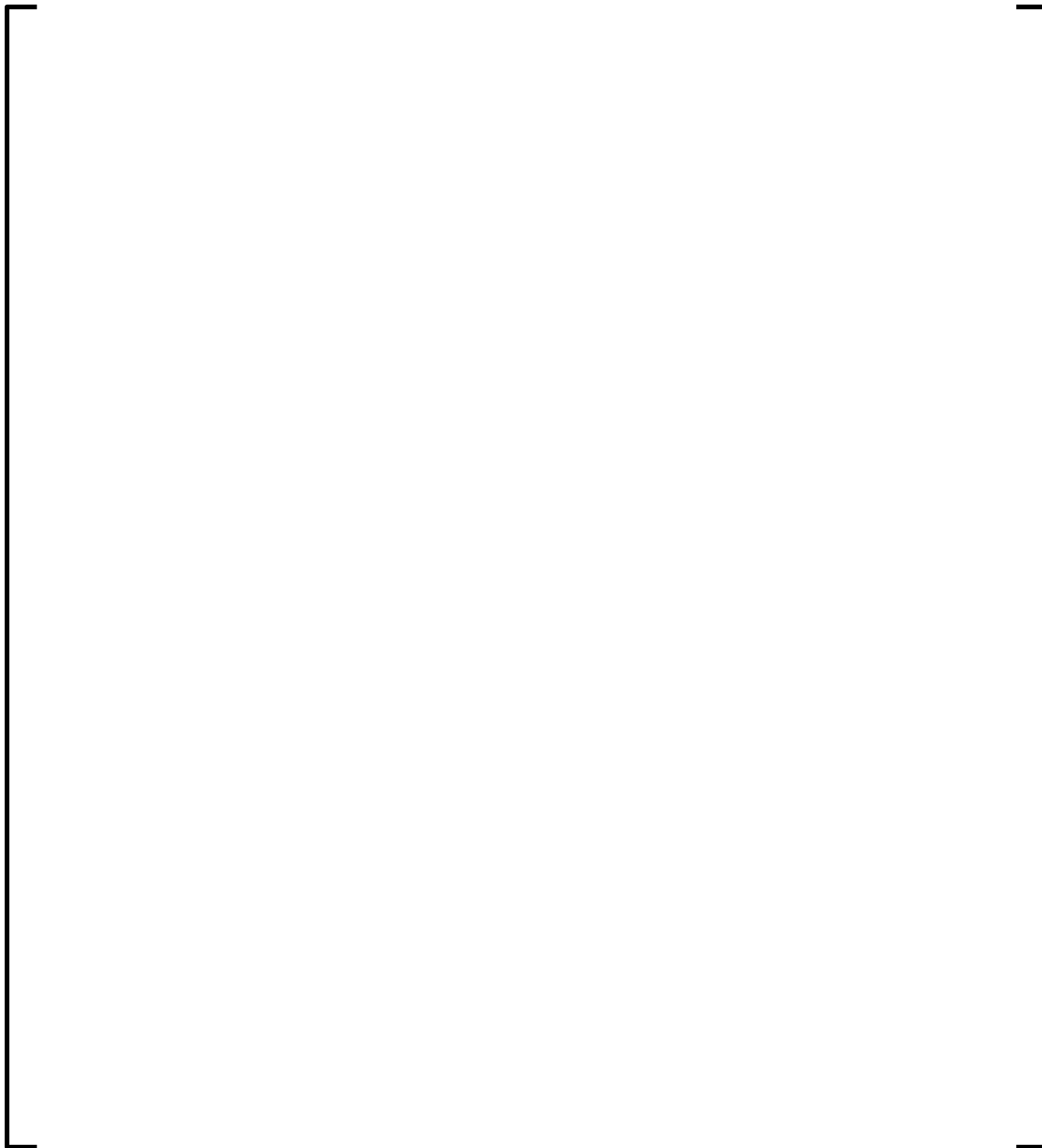


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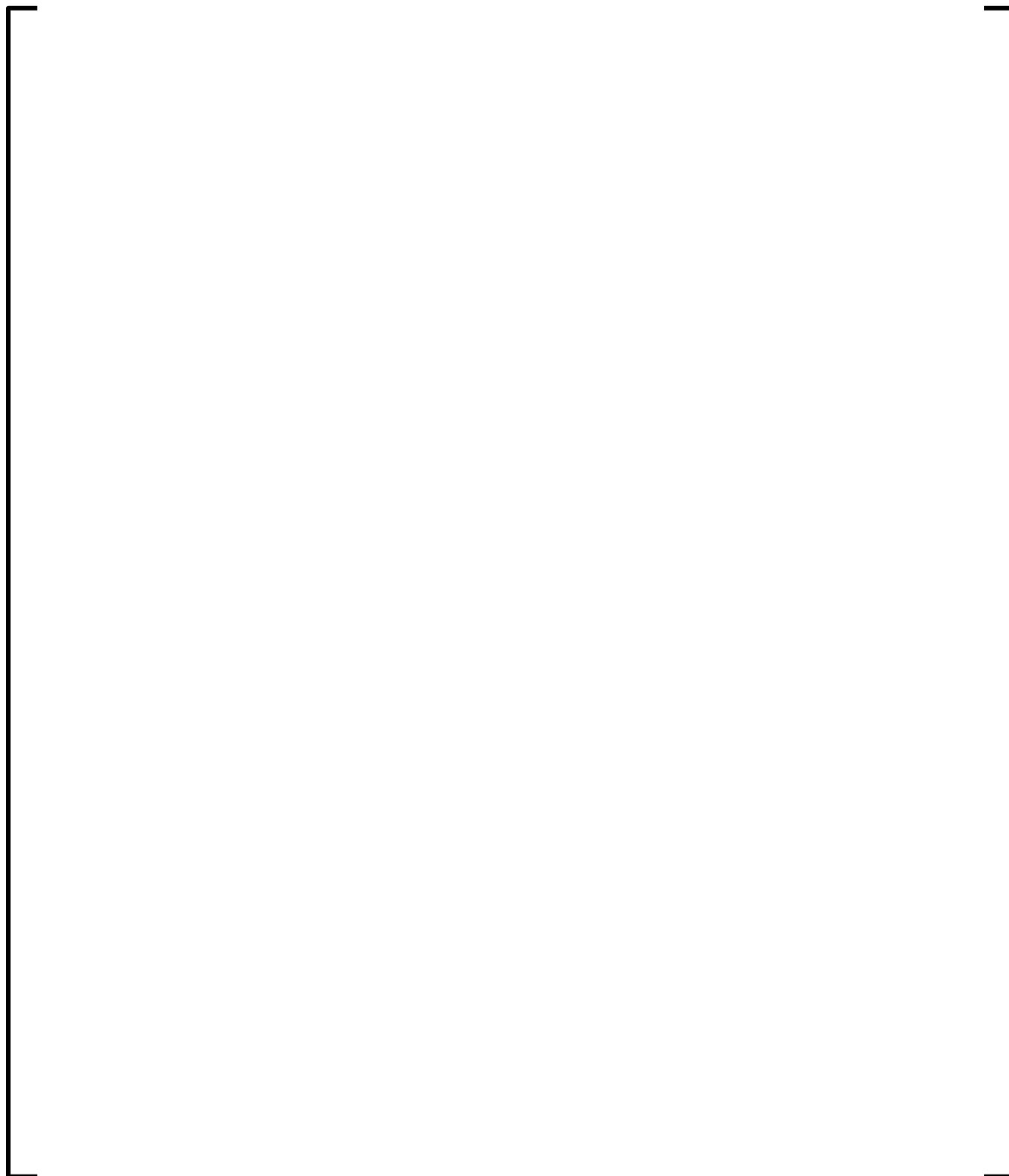


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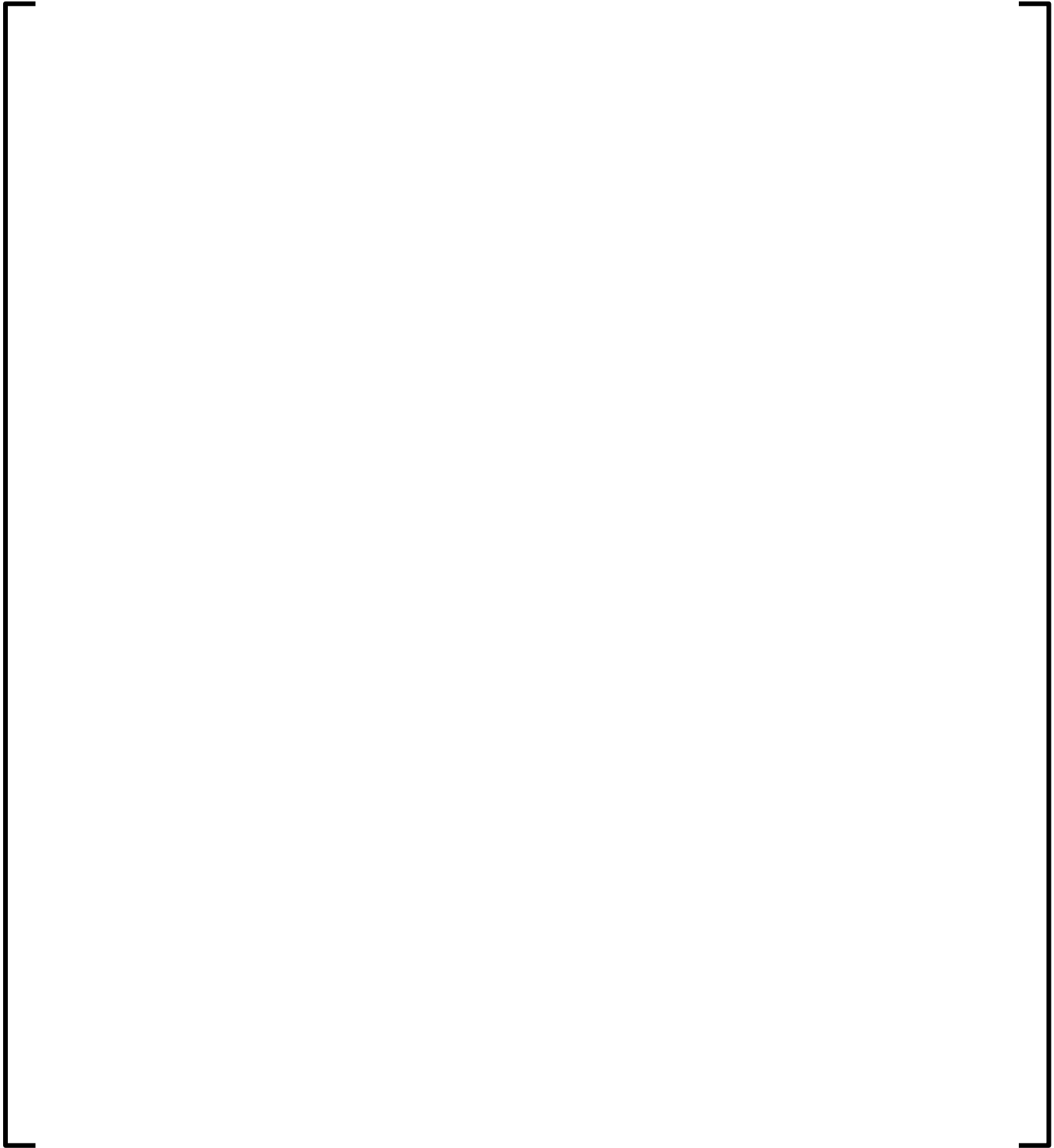
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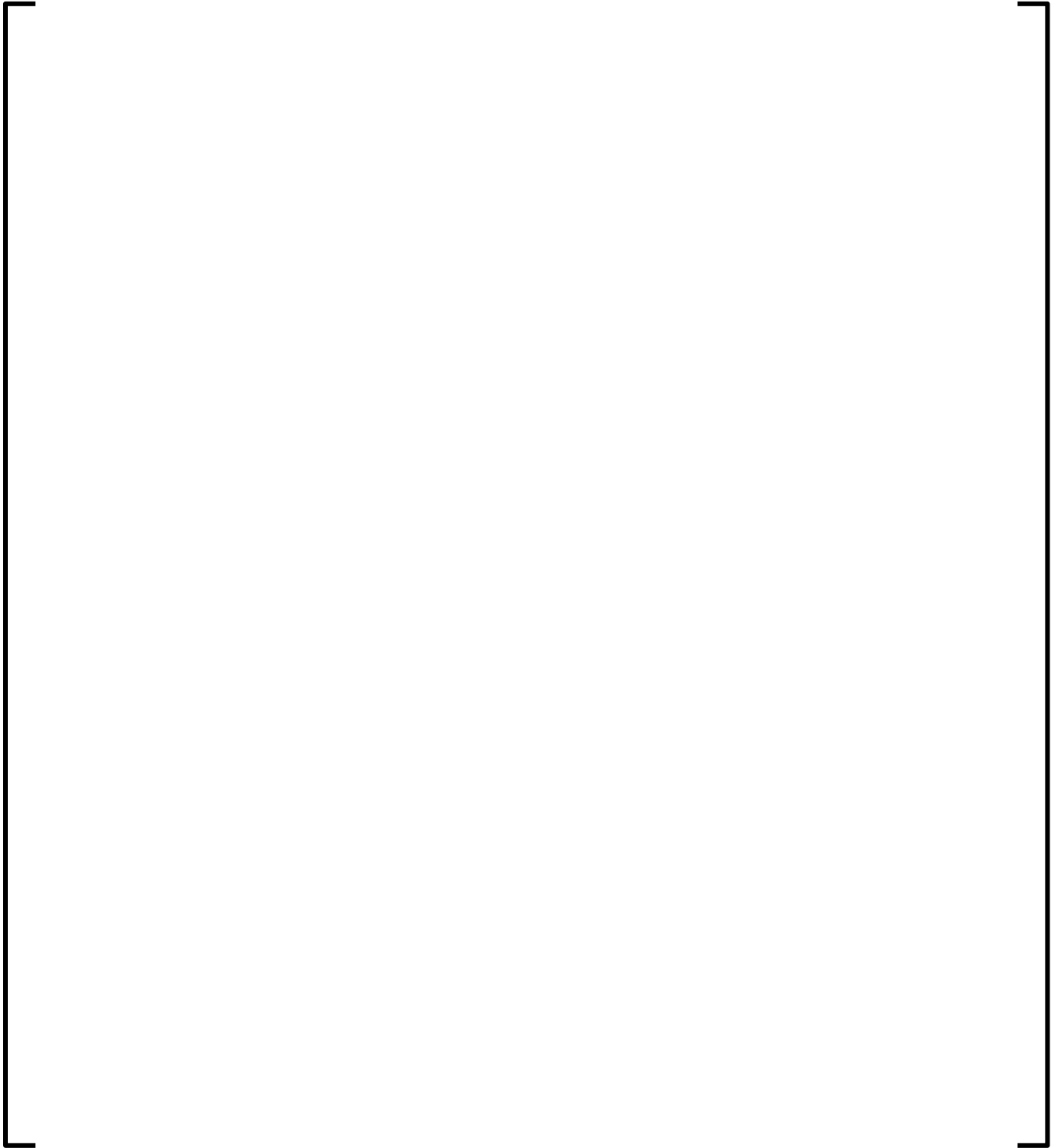
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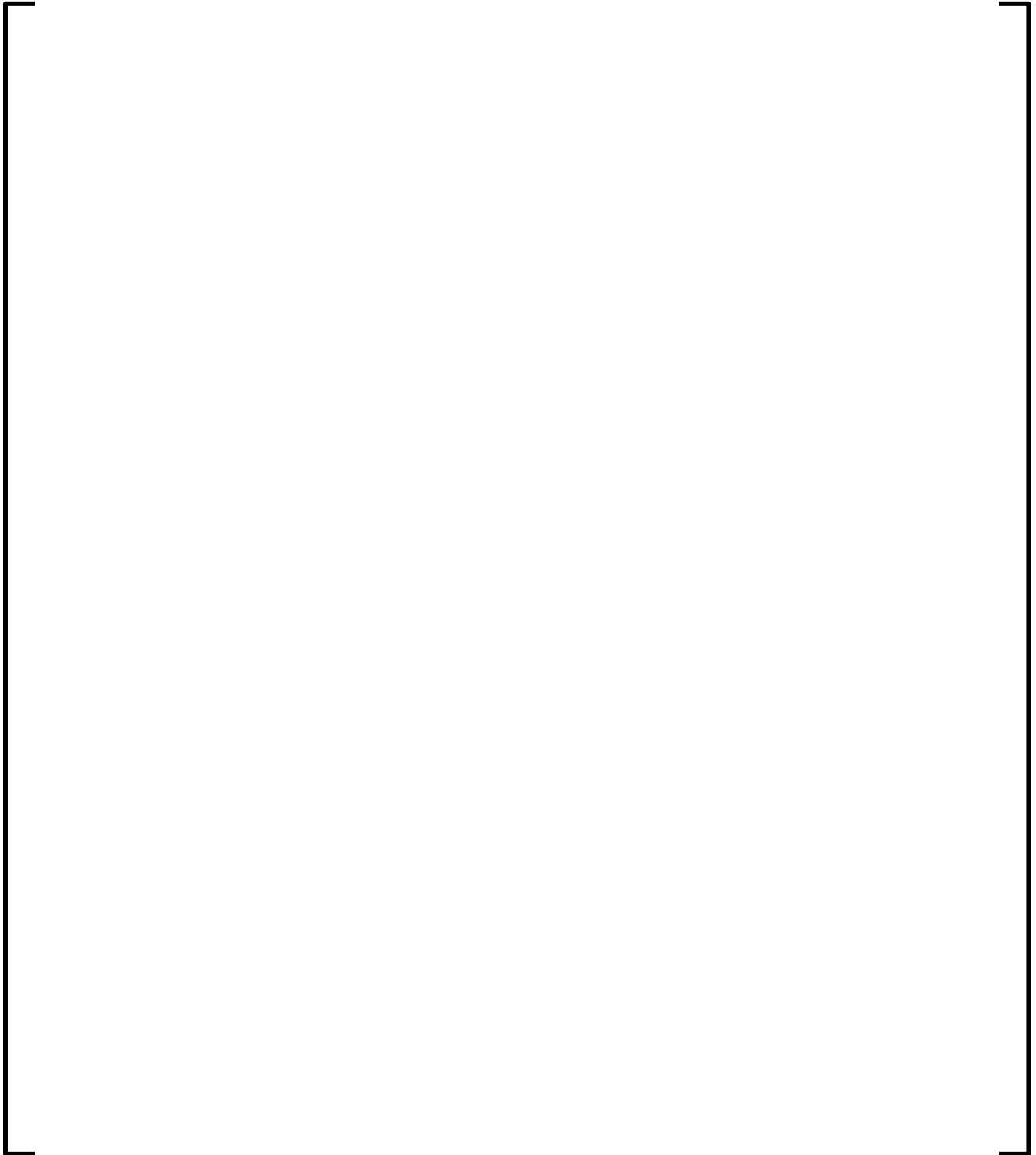
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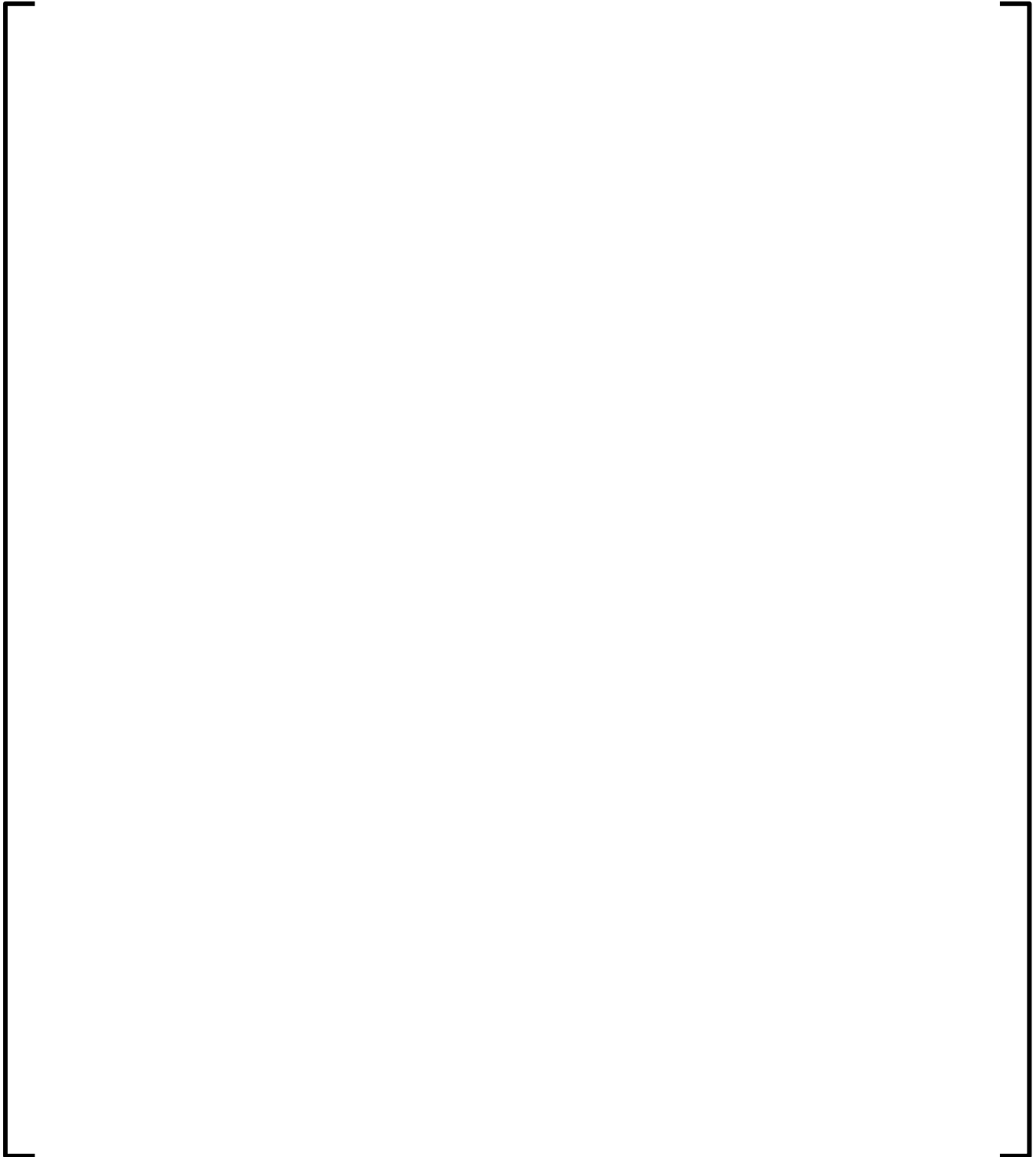
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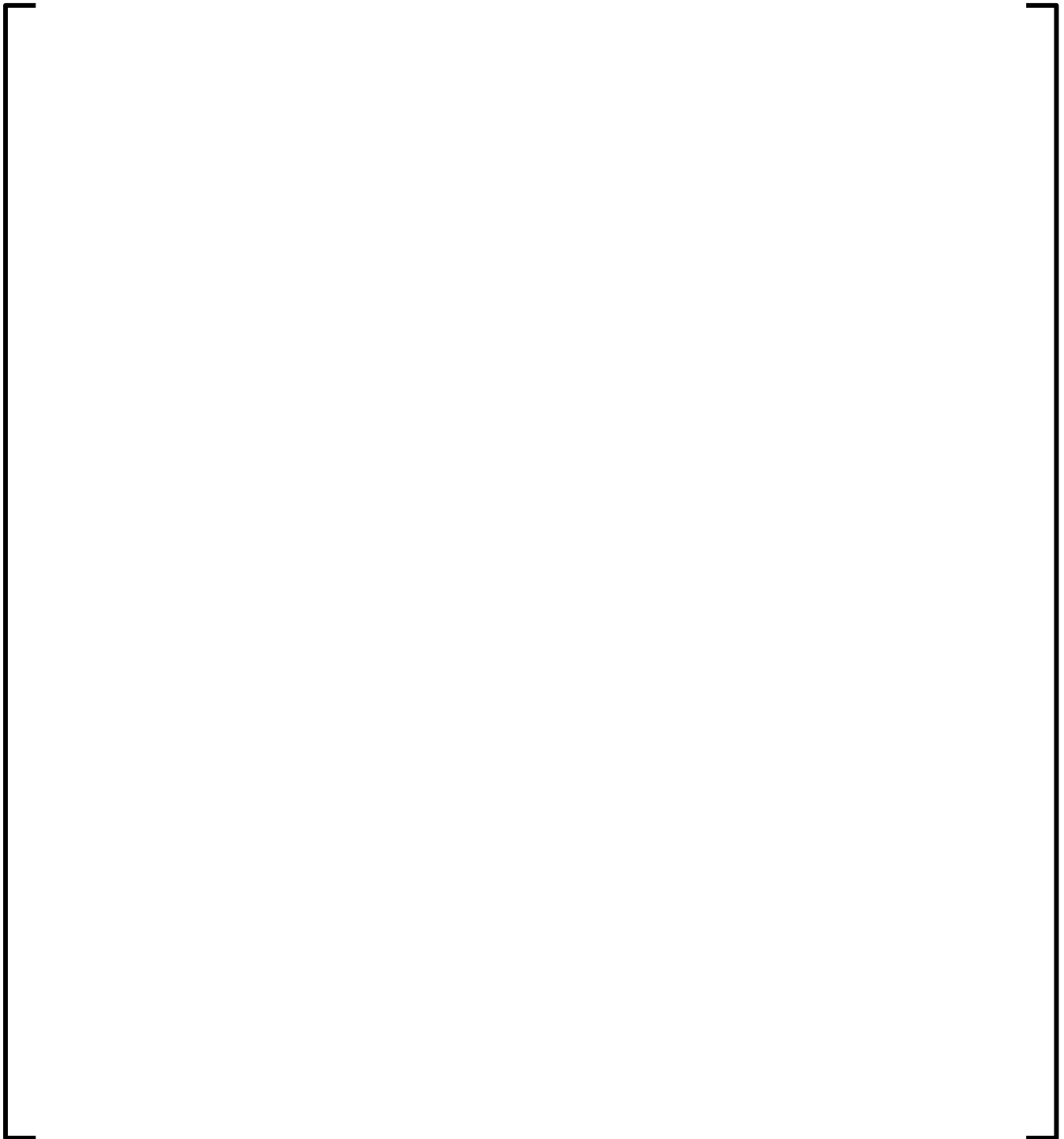
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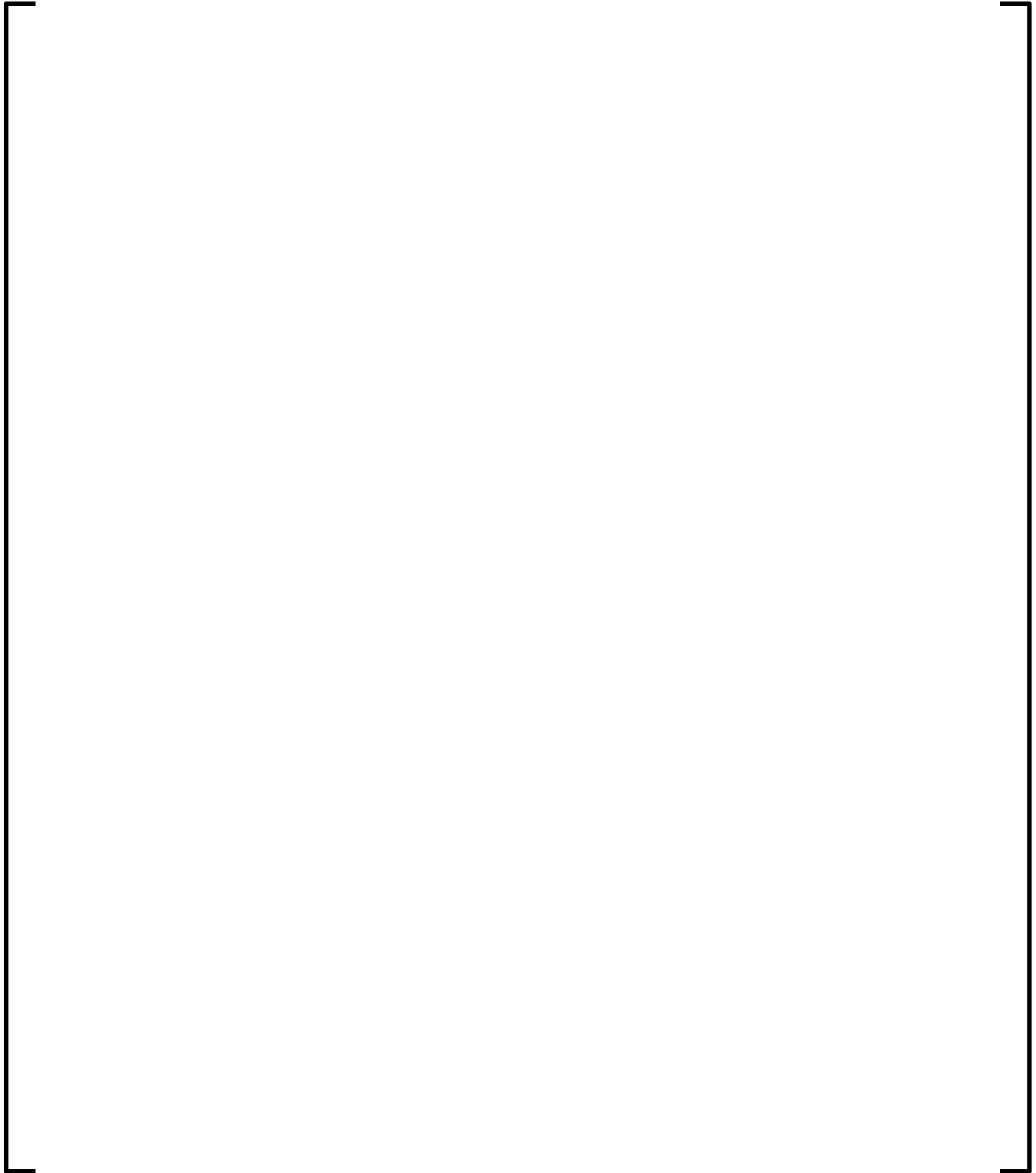
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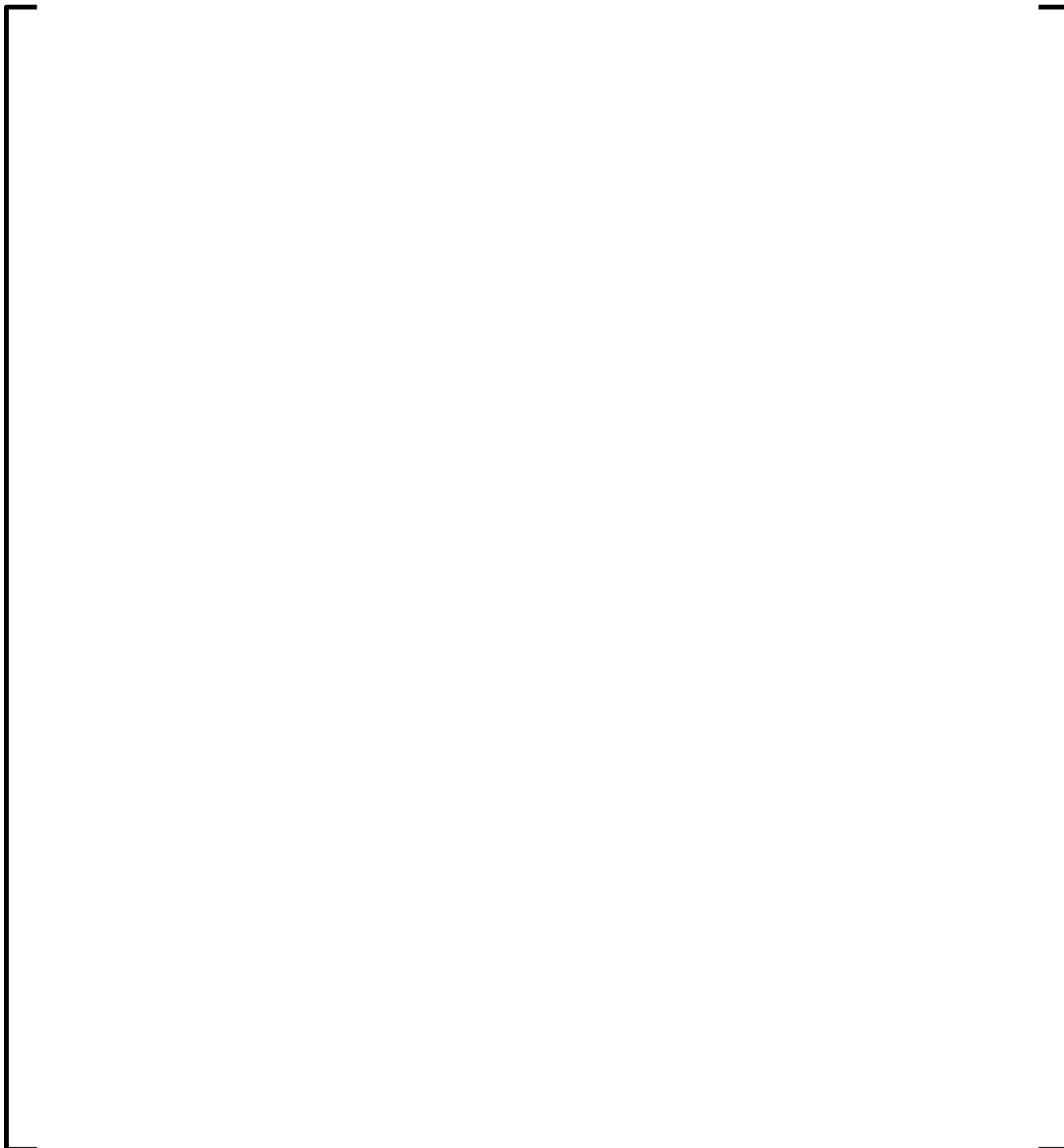


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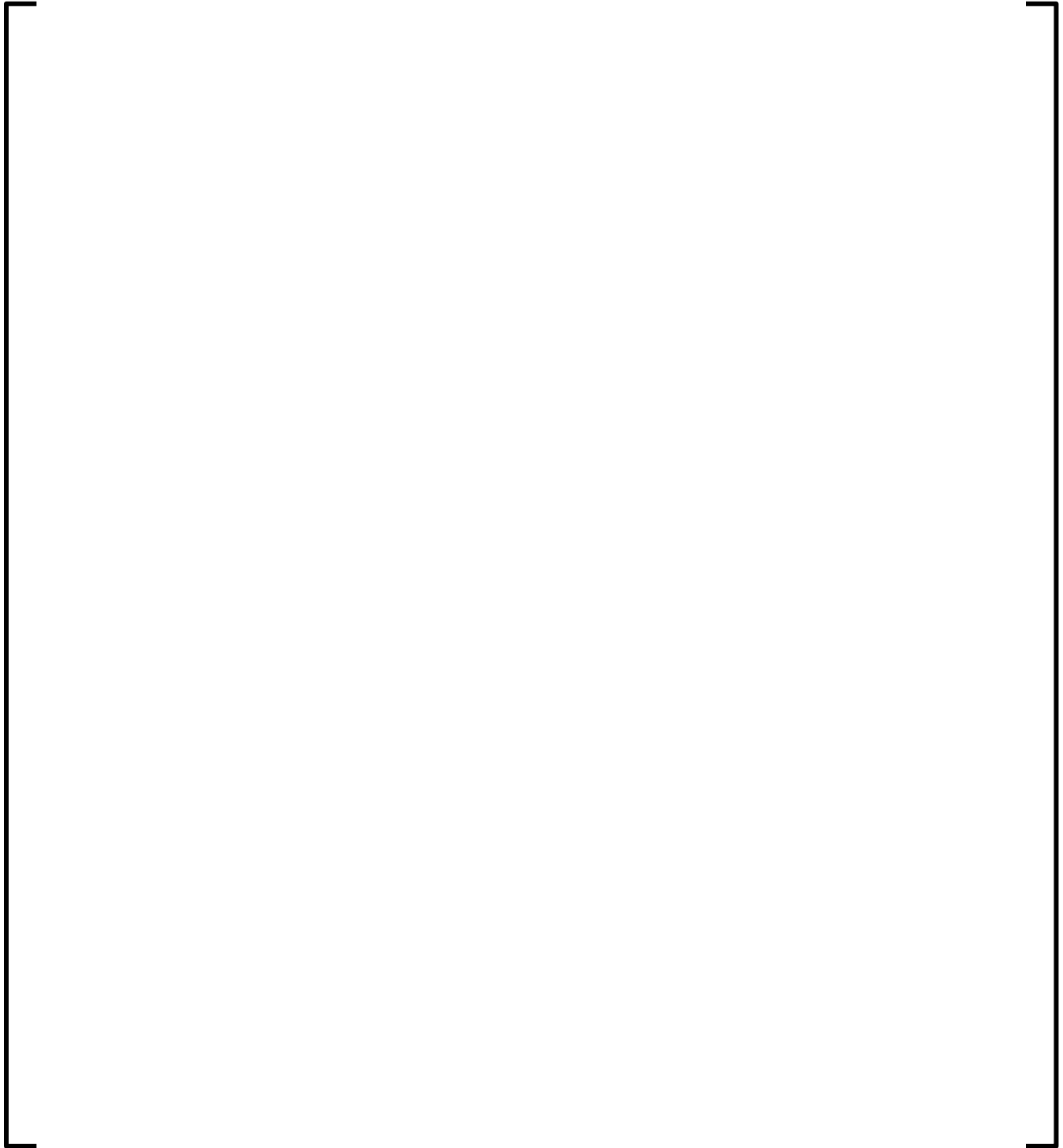
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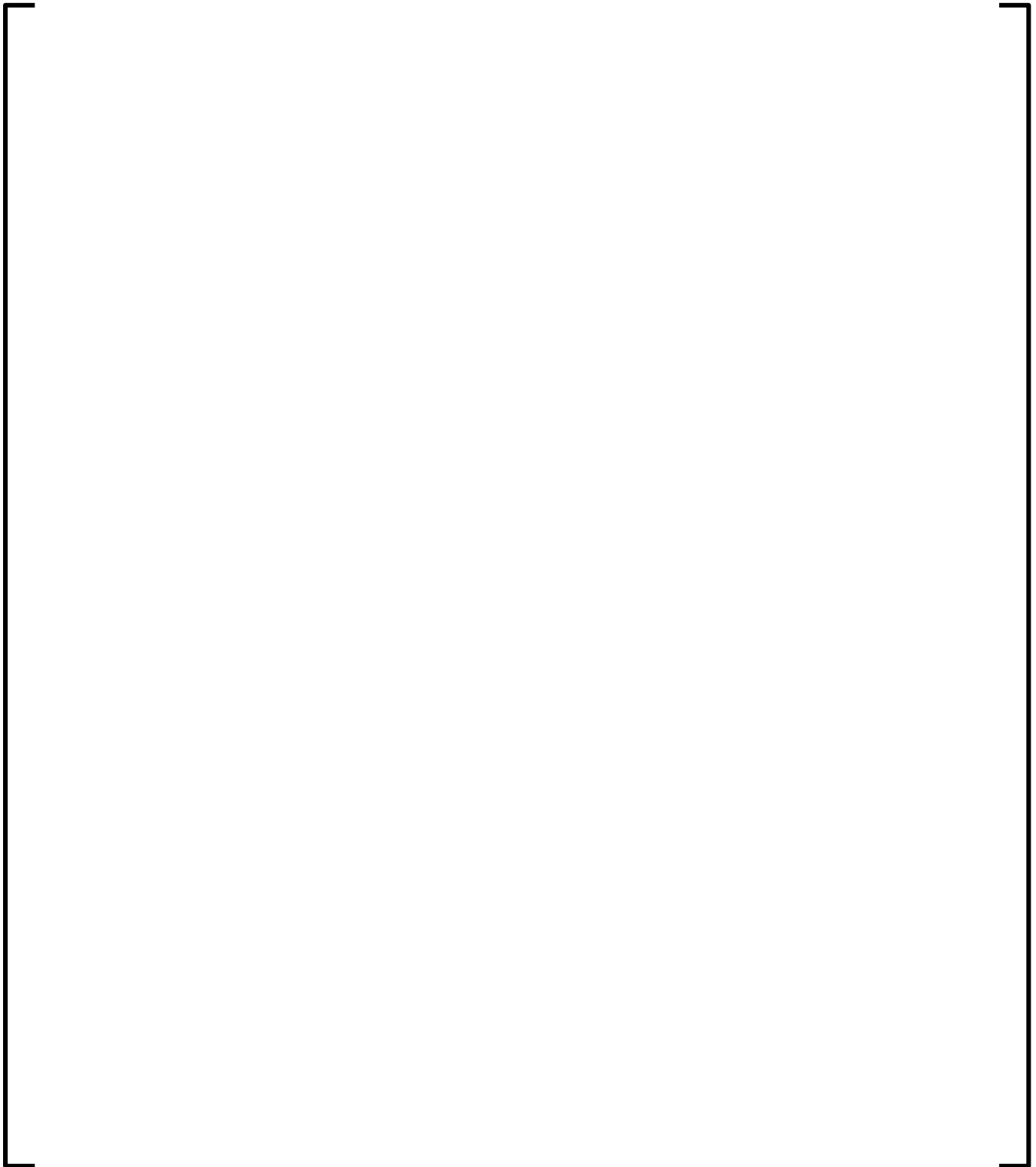
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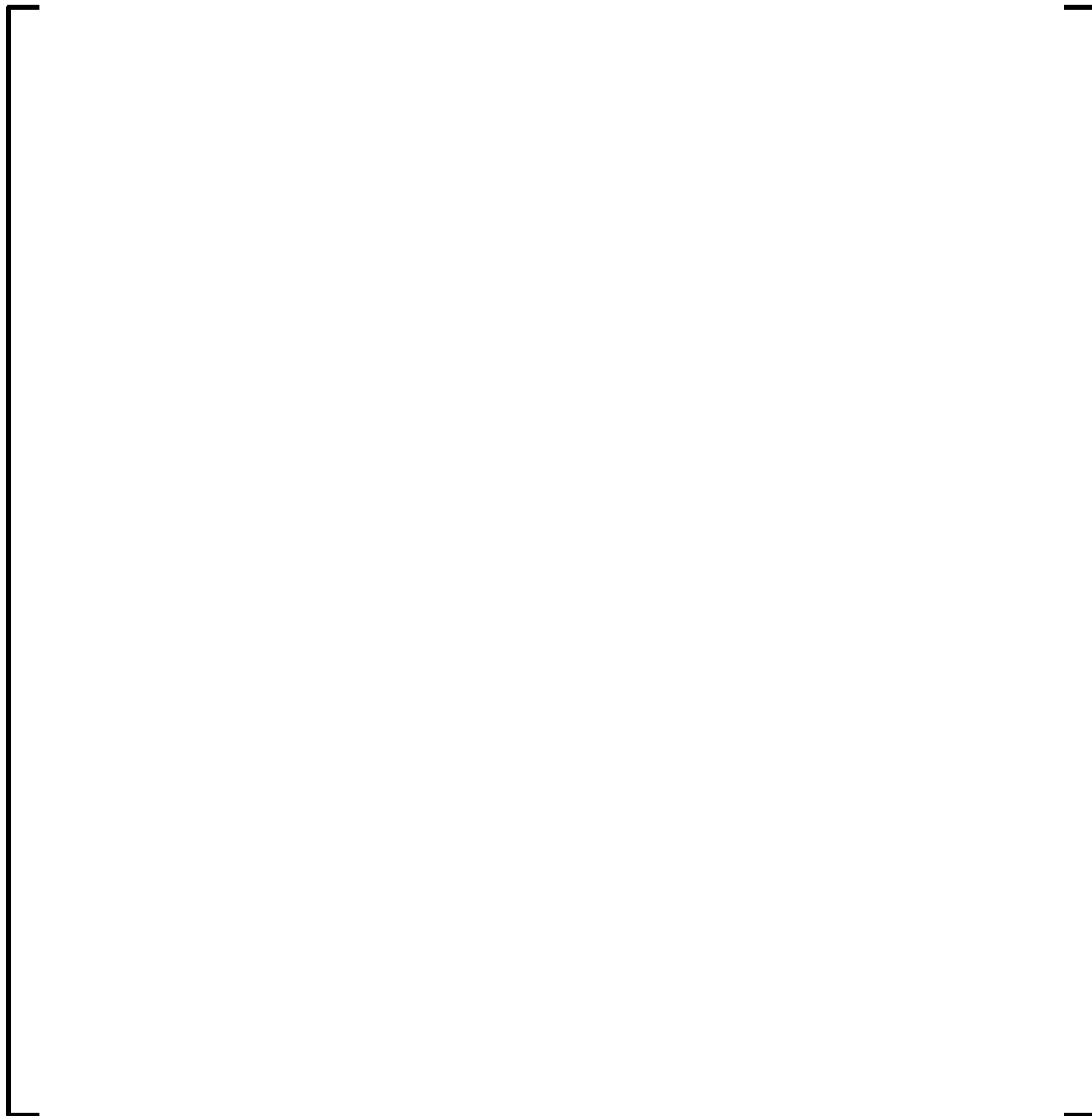


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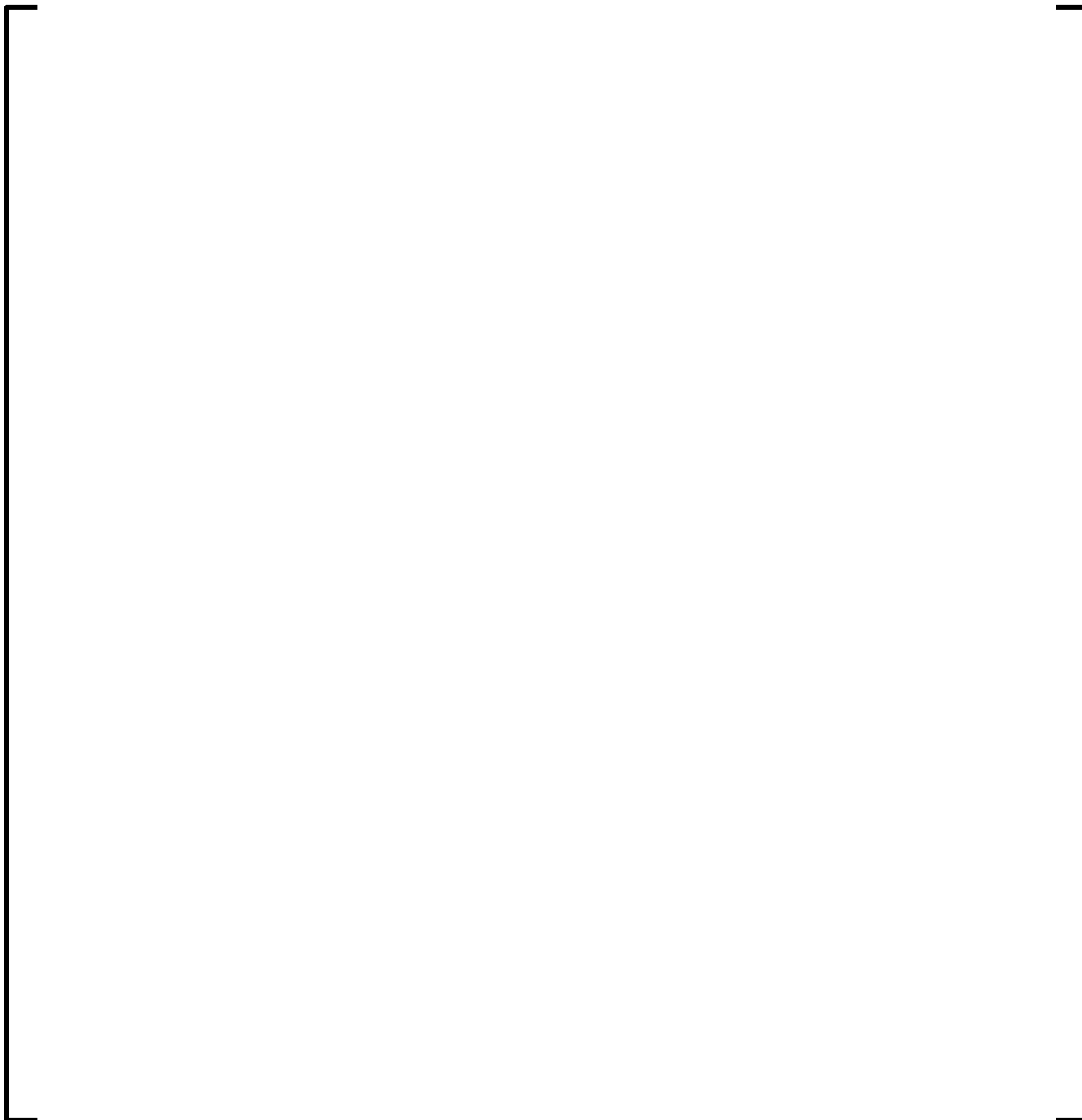


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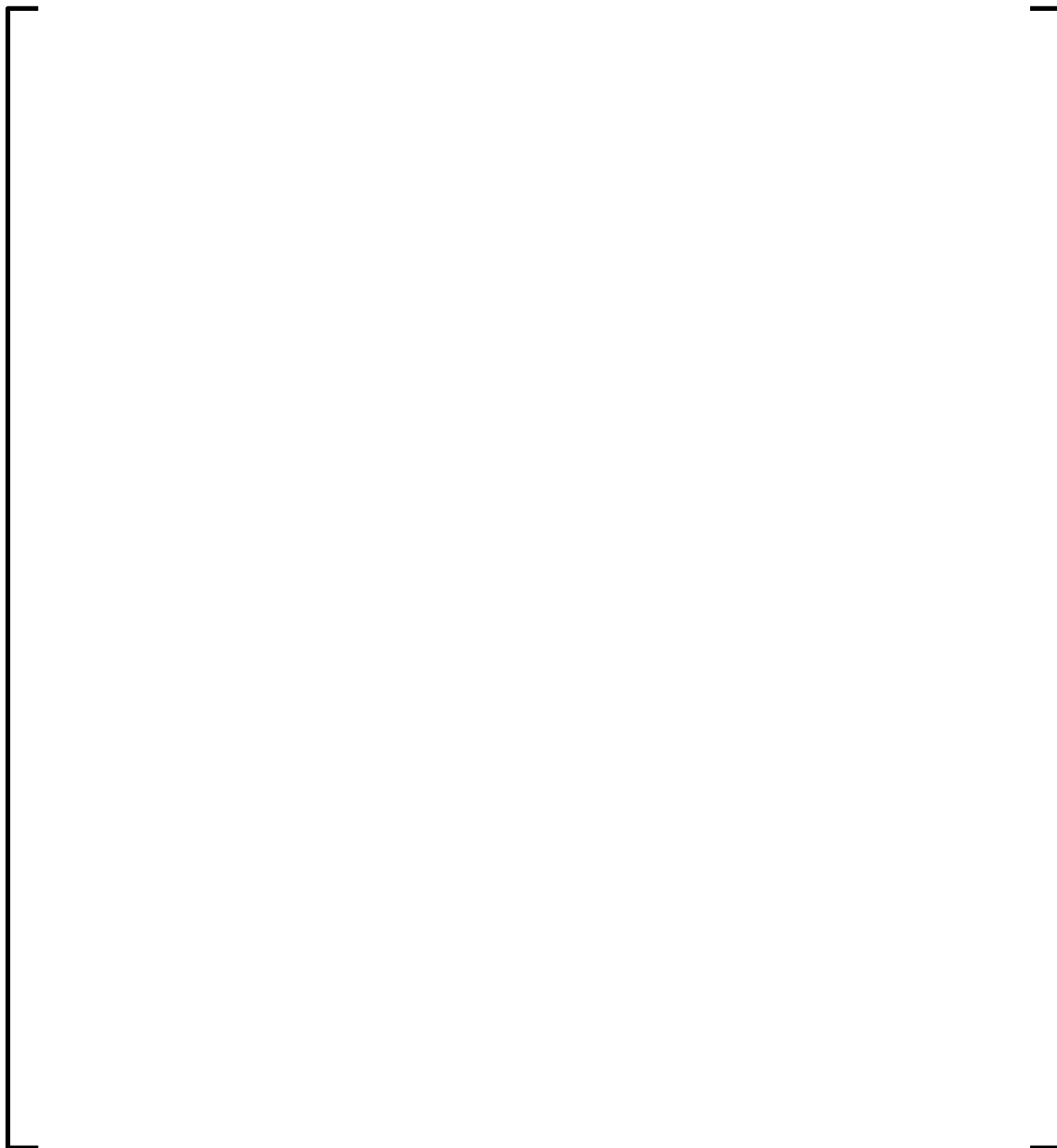


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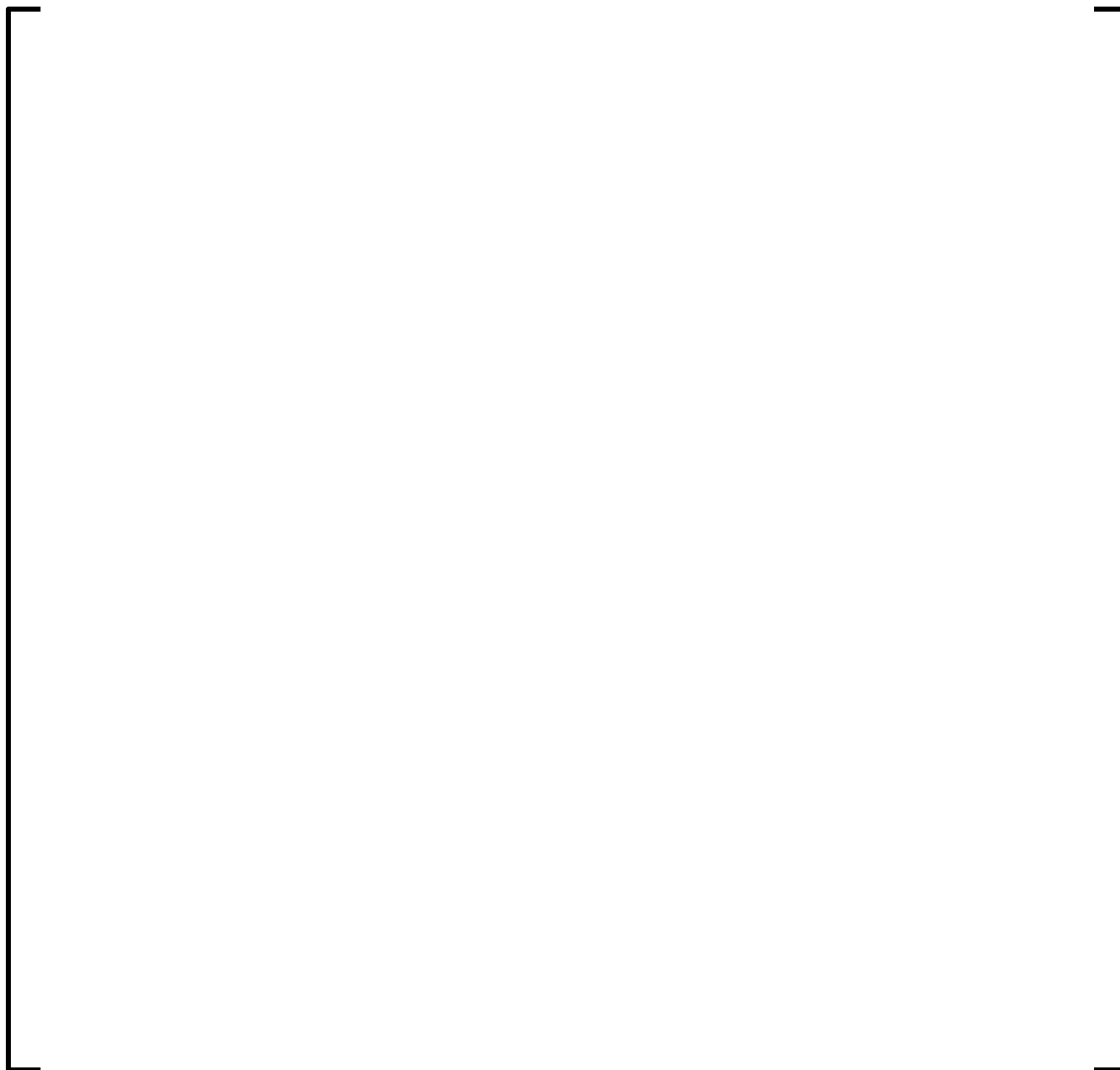


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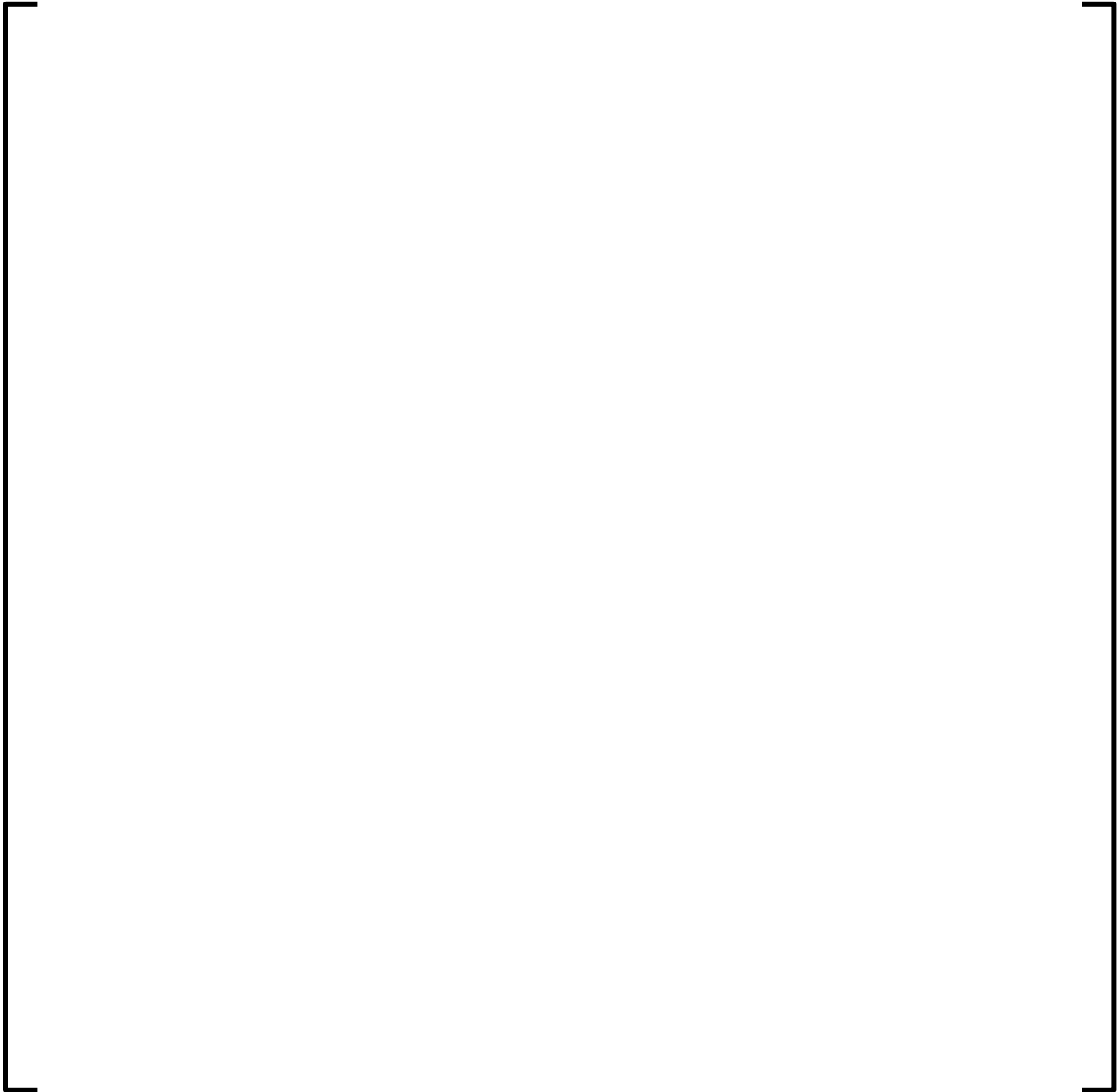
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Appendix D Lattice Enrichment Distribution Maps



Figure D.1 [] Enrichment Distribution



Figure D.2 [] Enrichment Distribution

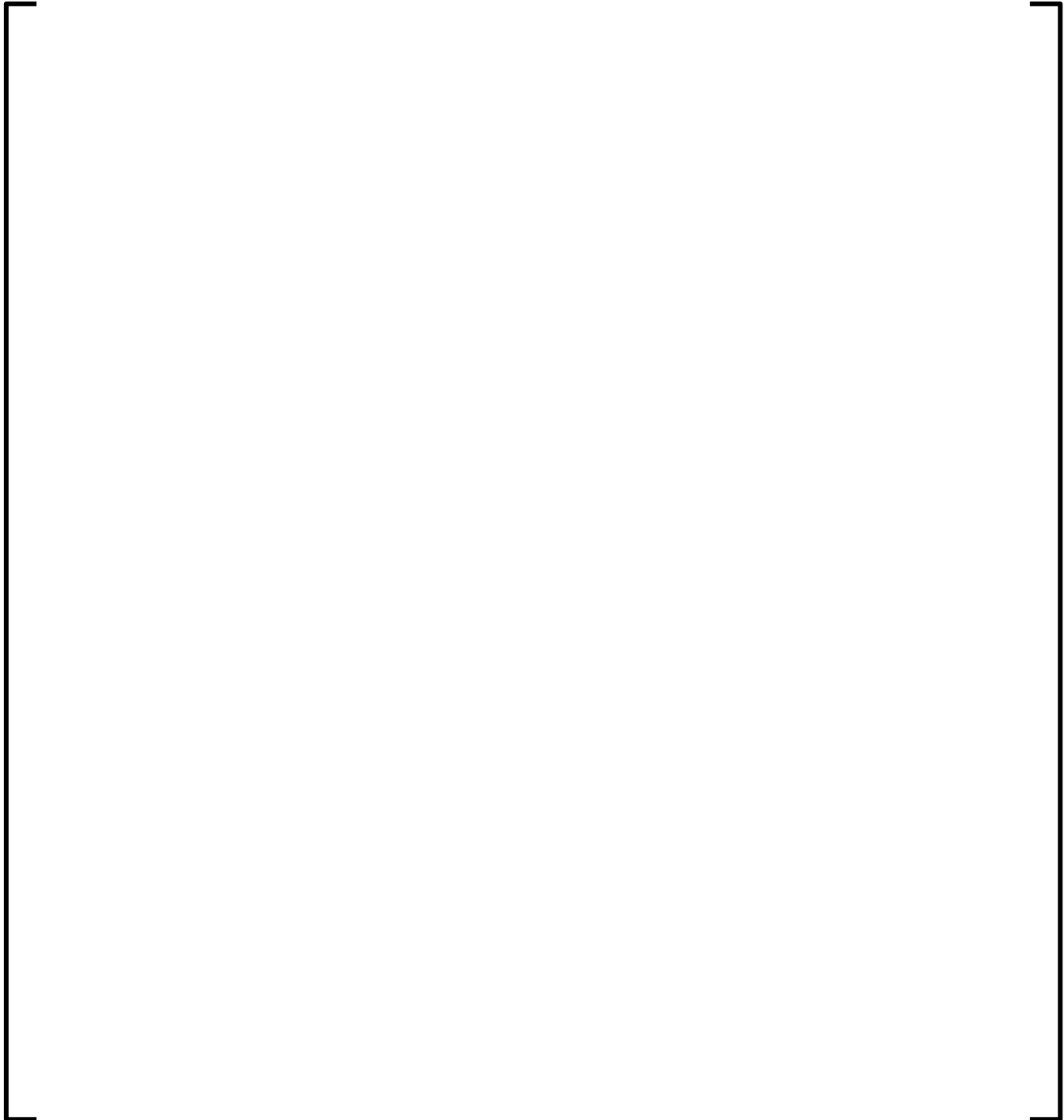


Figure D.3 [] Enrichment Distribution

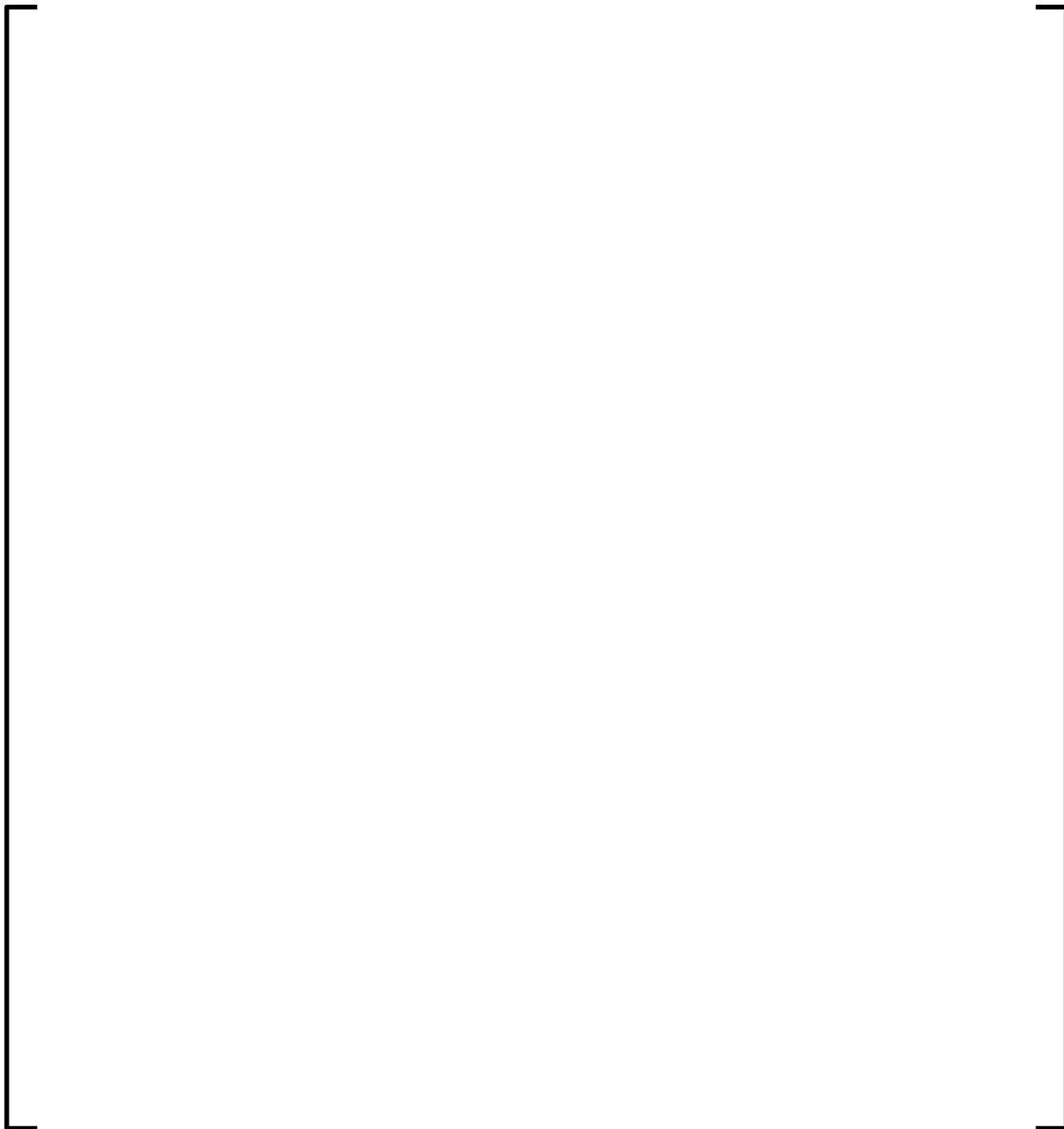


Figure D.4 [] Enrichment Distribution

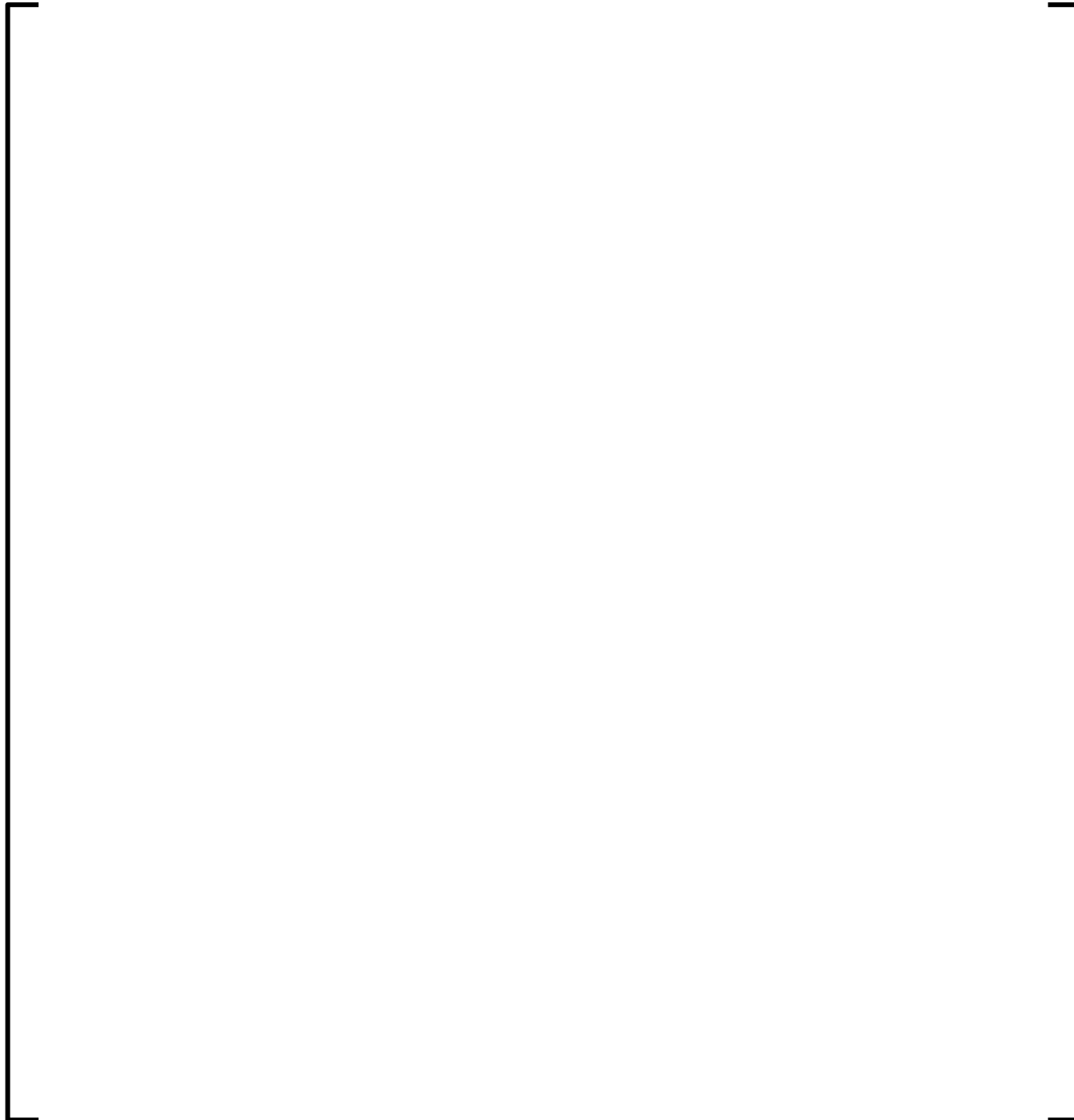


Figure D.5 [] Enrichment Distribution

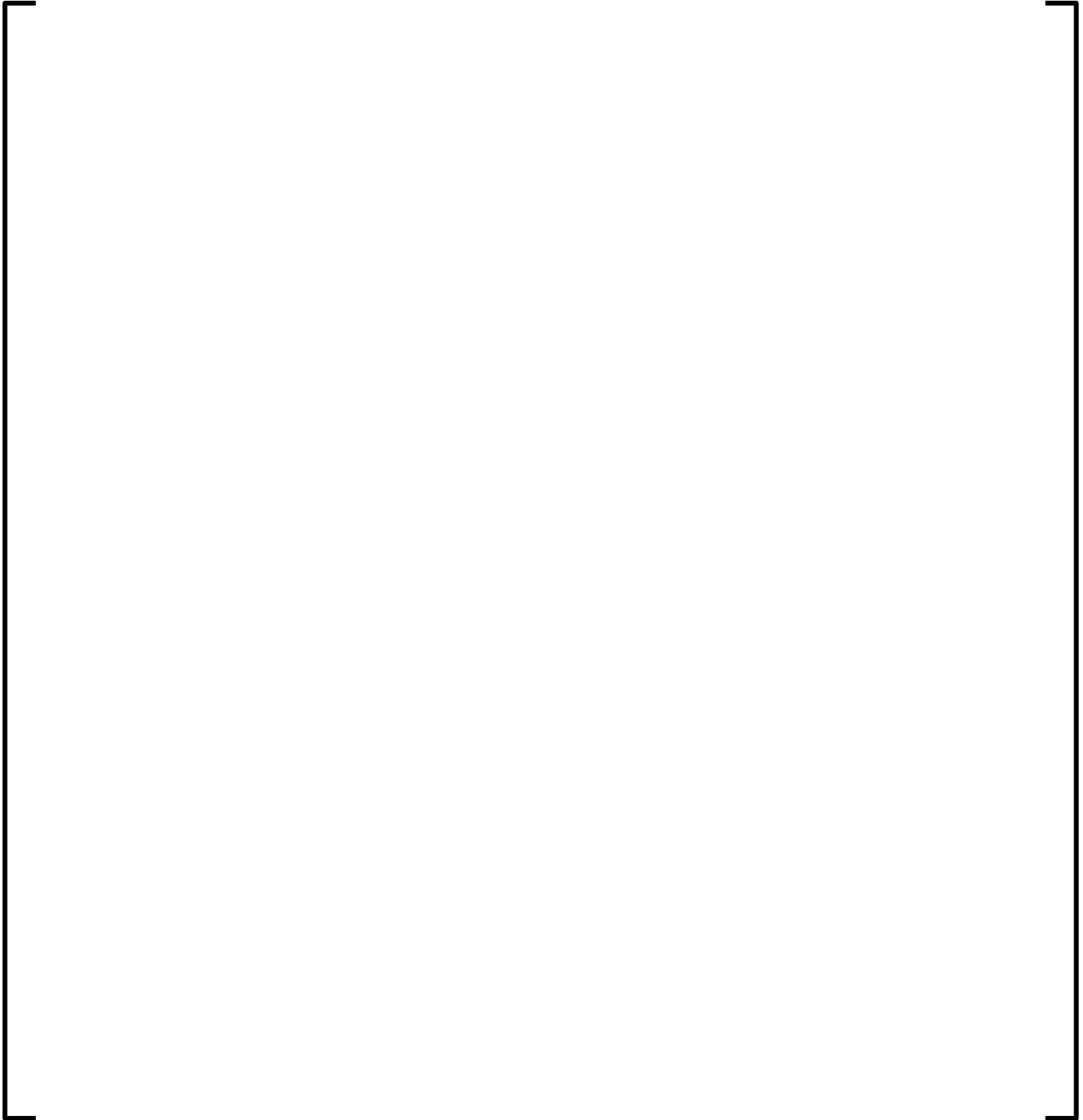


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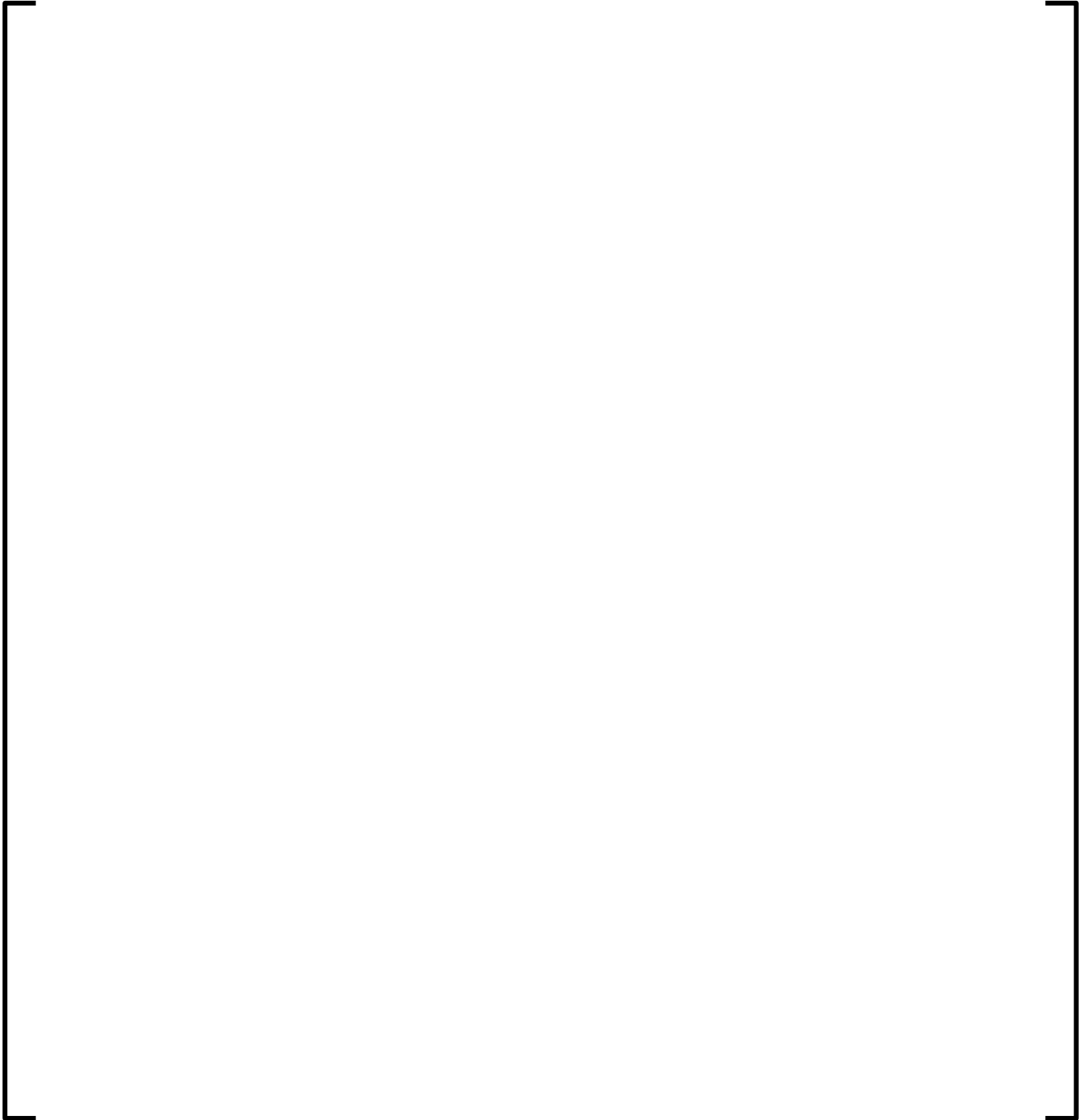


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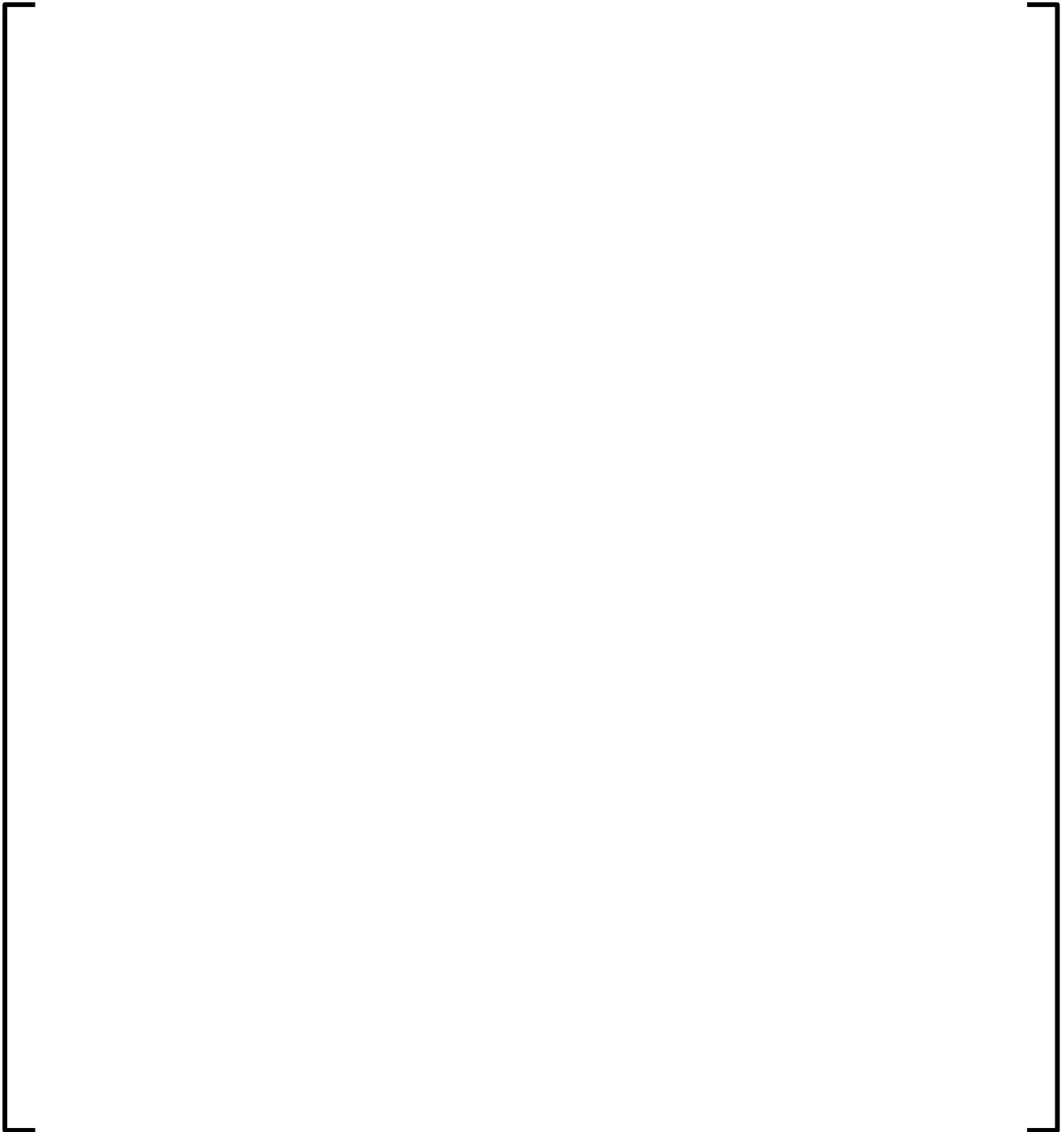


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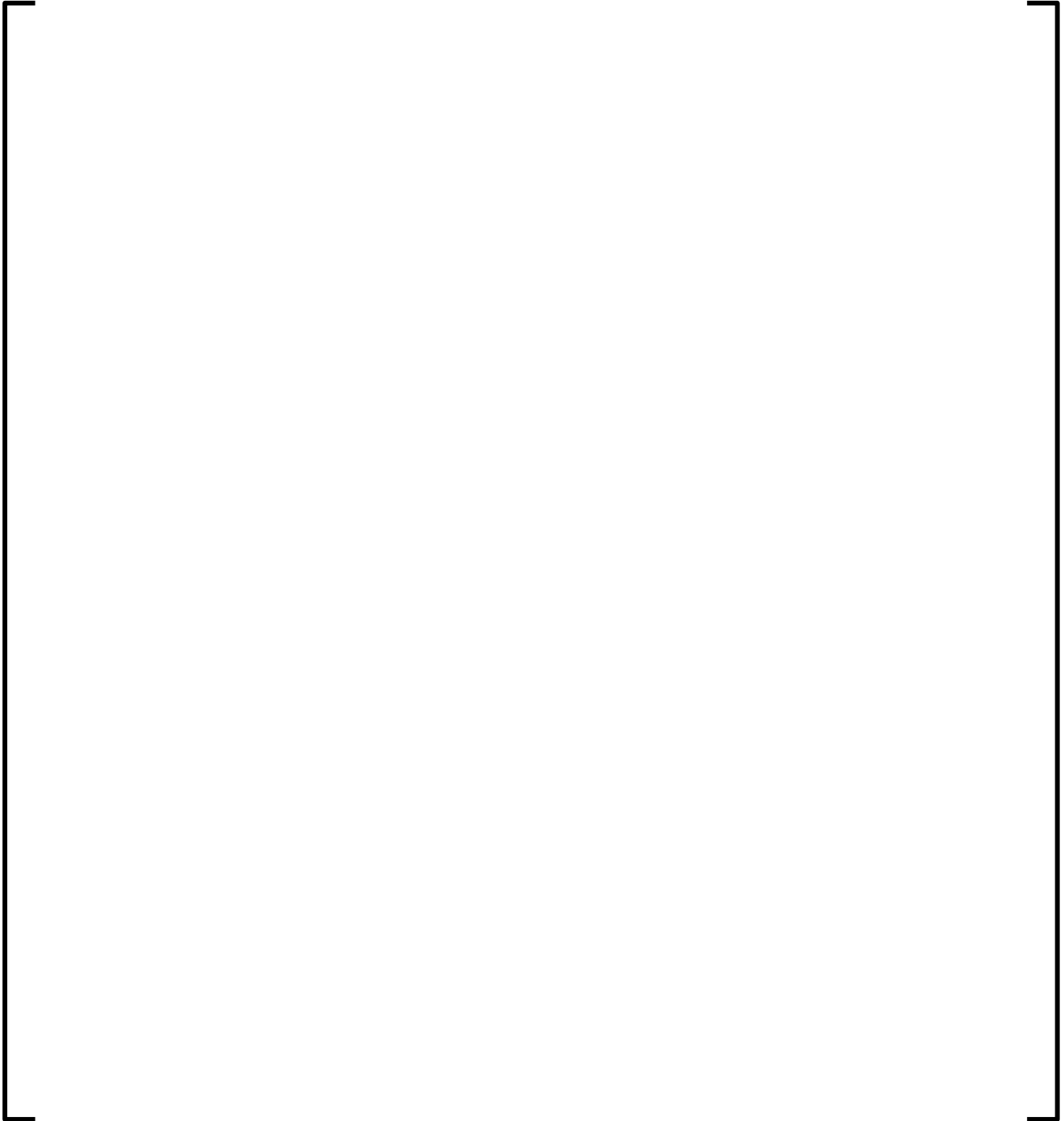


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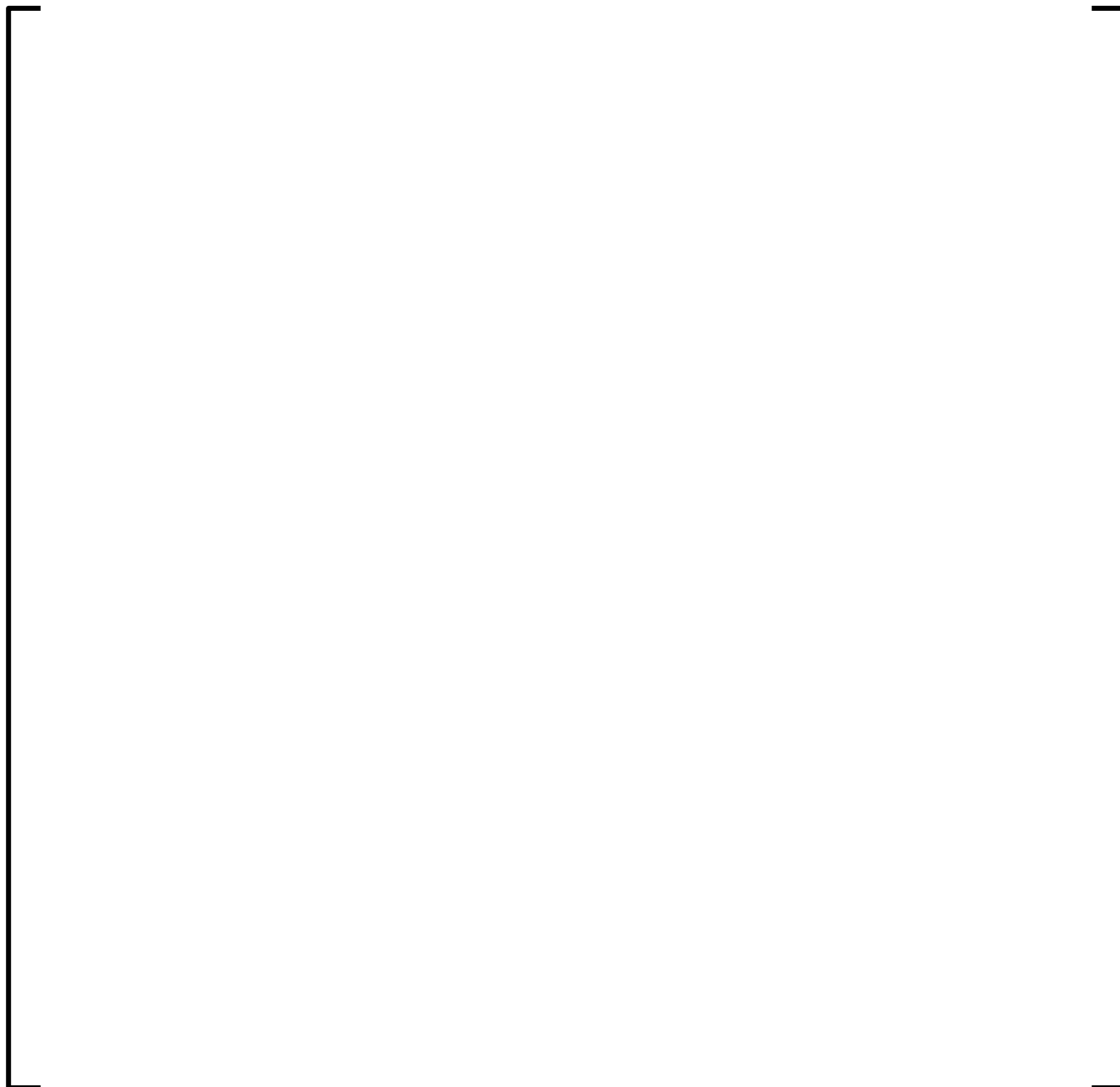


Figure D.10 [] Enrichment Distribution



Figure D.11 [] Enrichment Distribution



Figure D.12 [] Enrichment Distribution

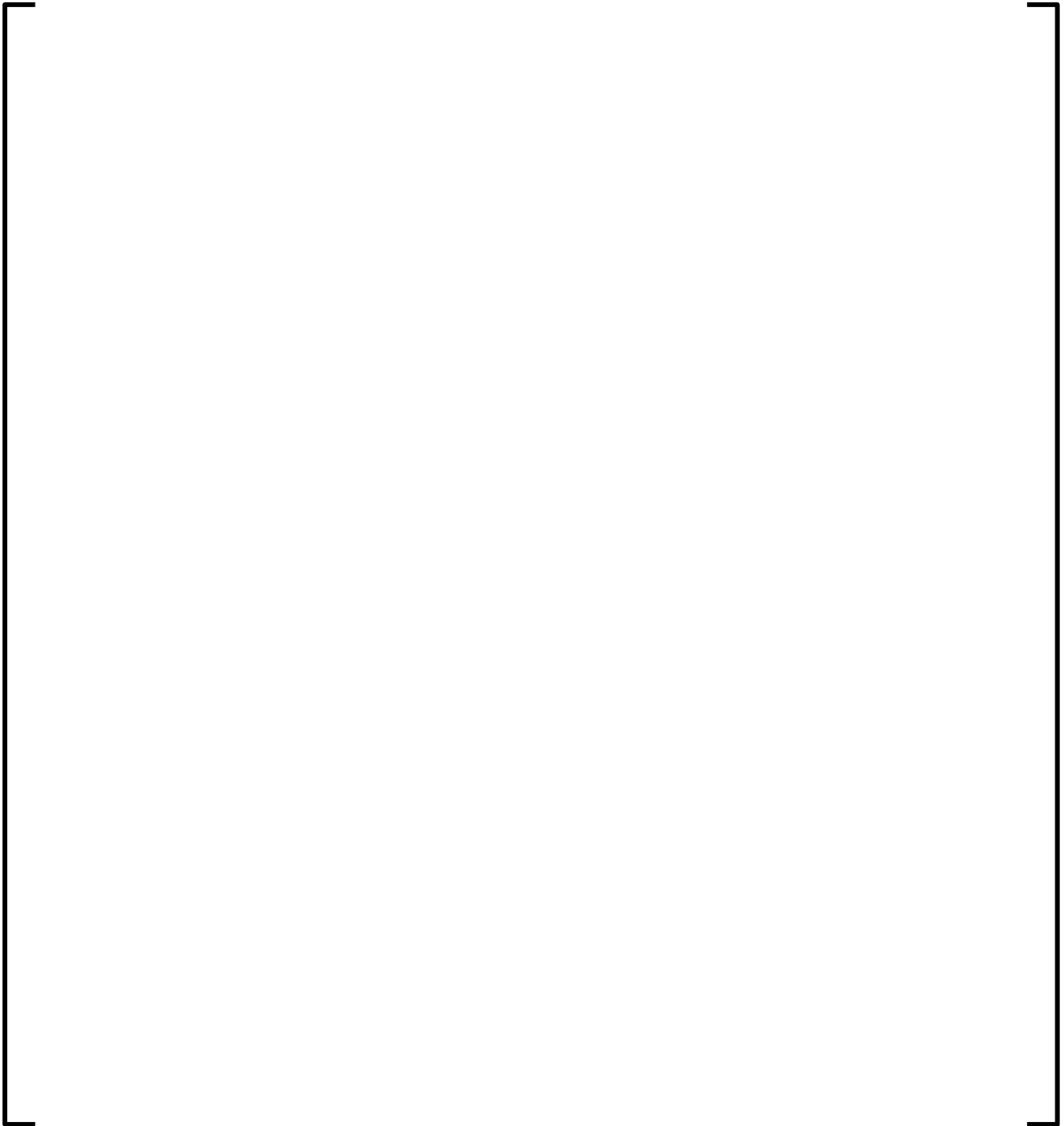


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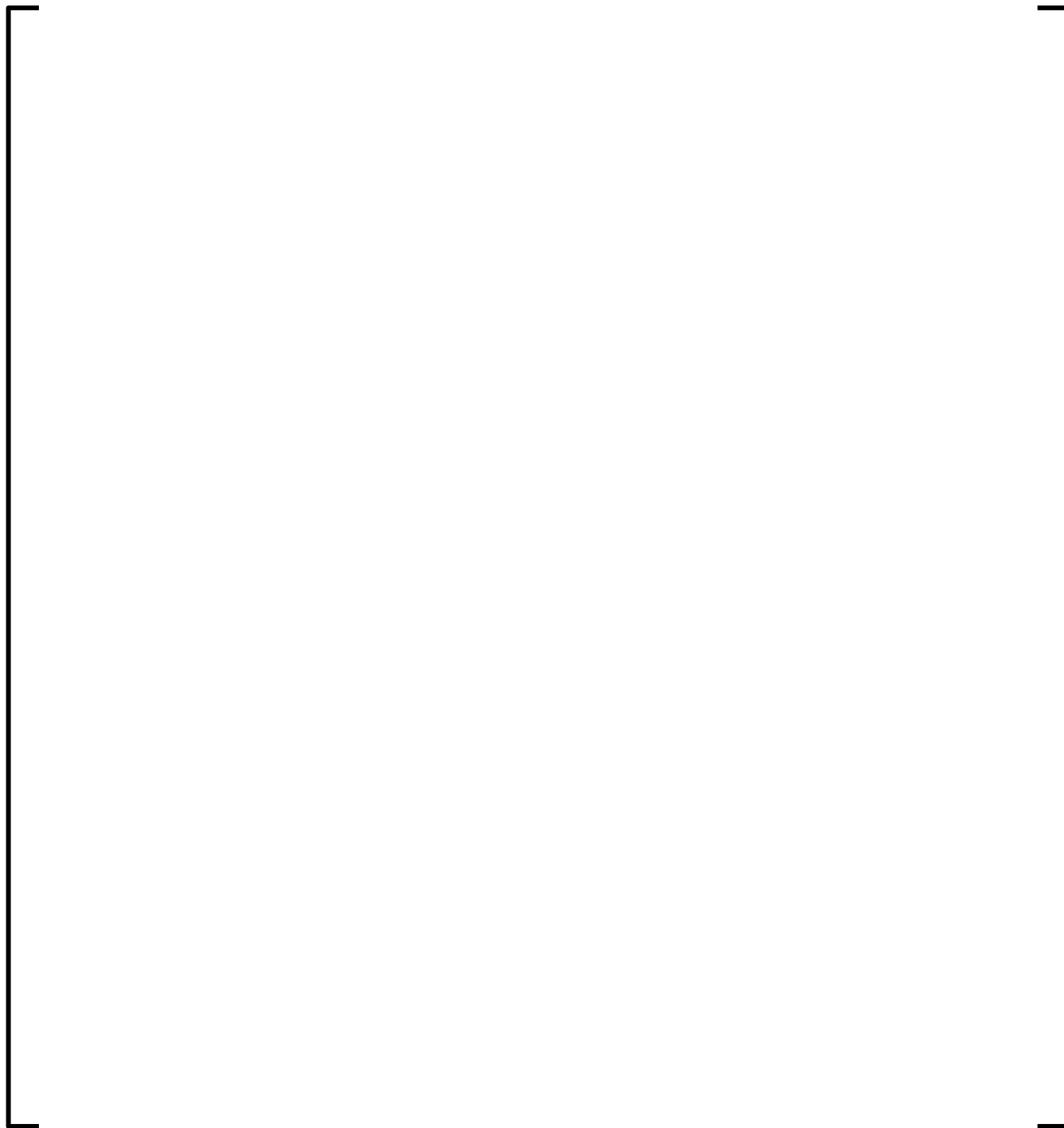


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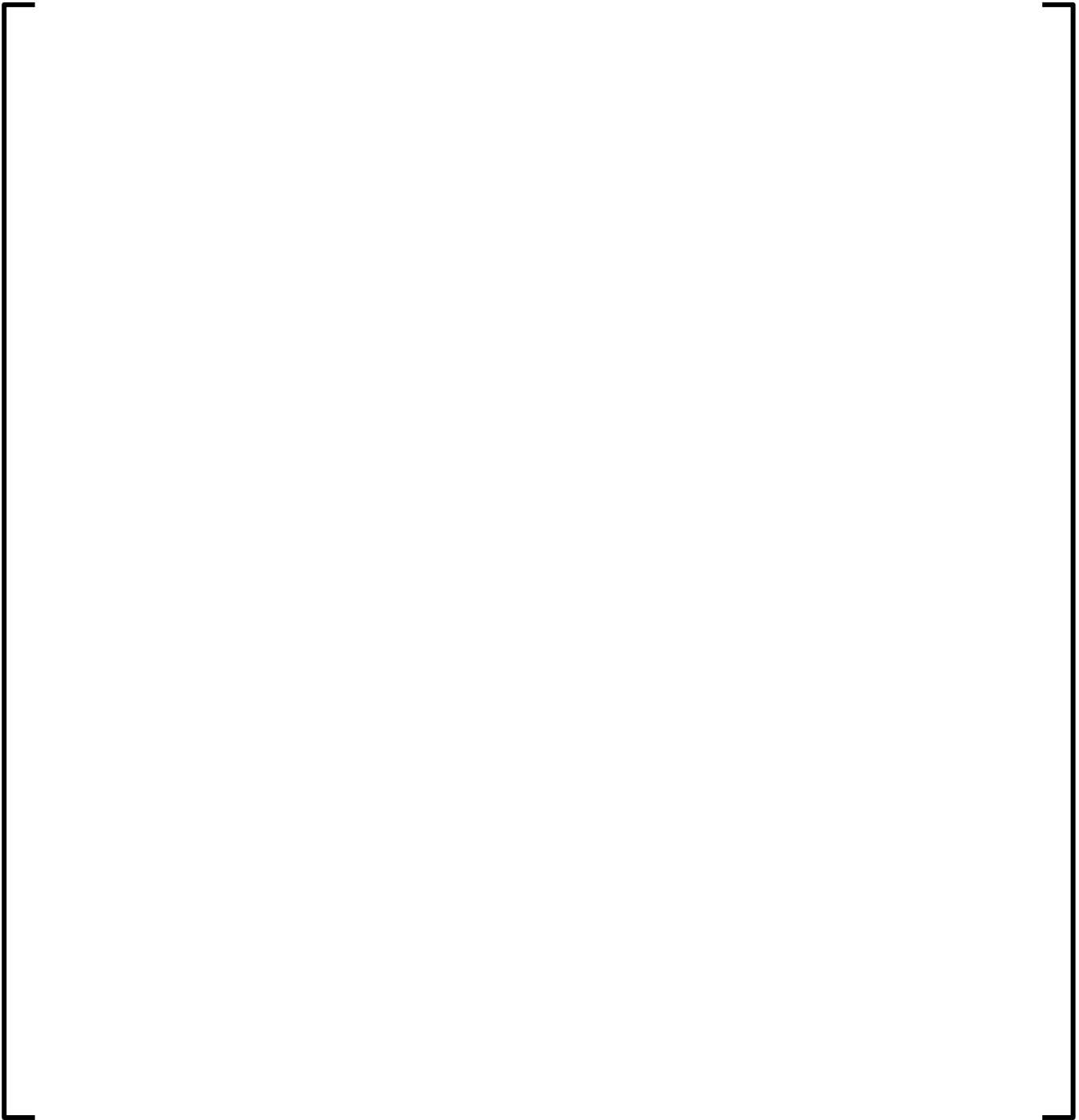


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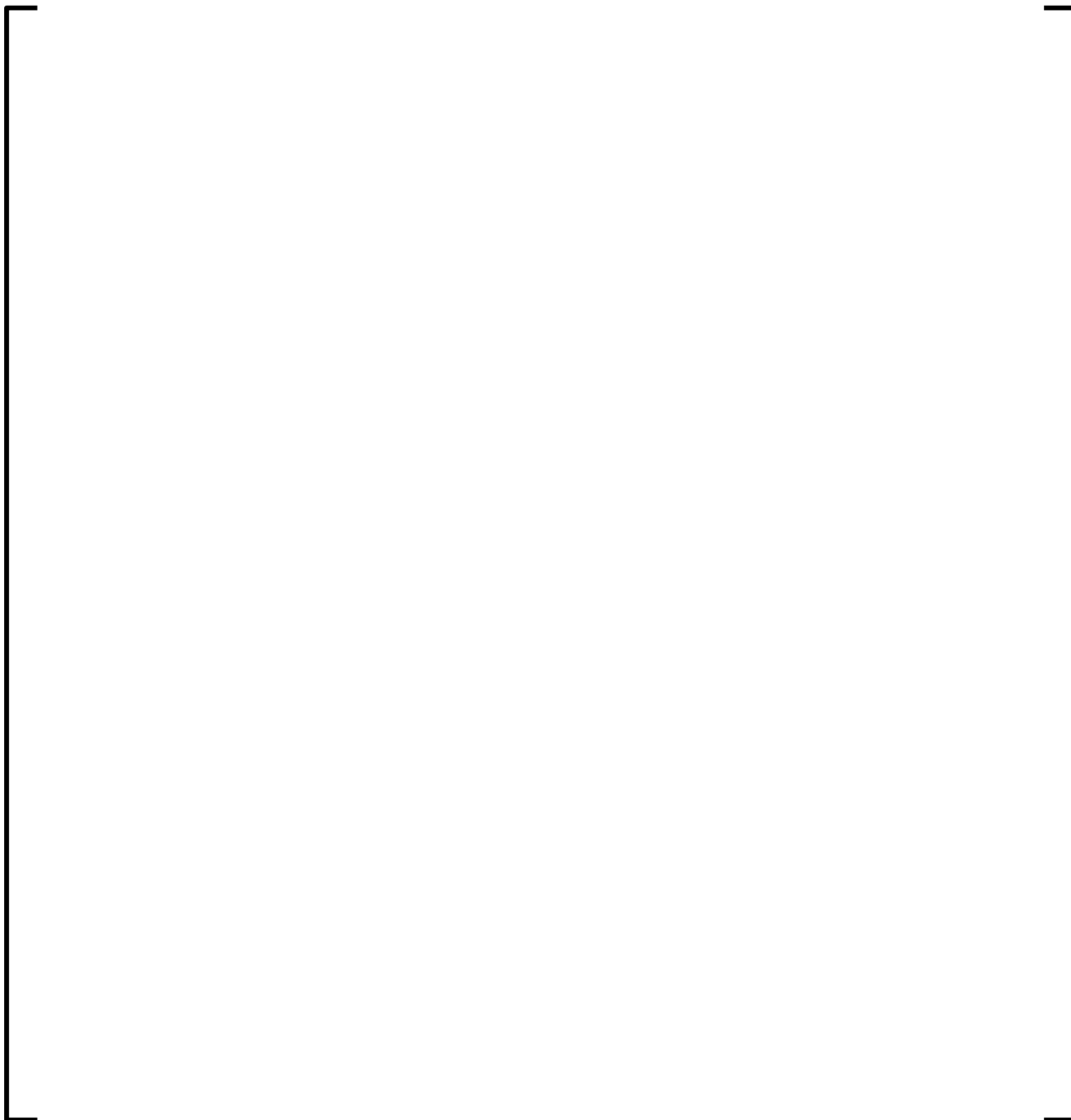


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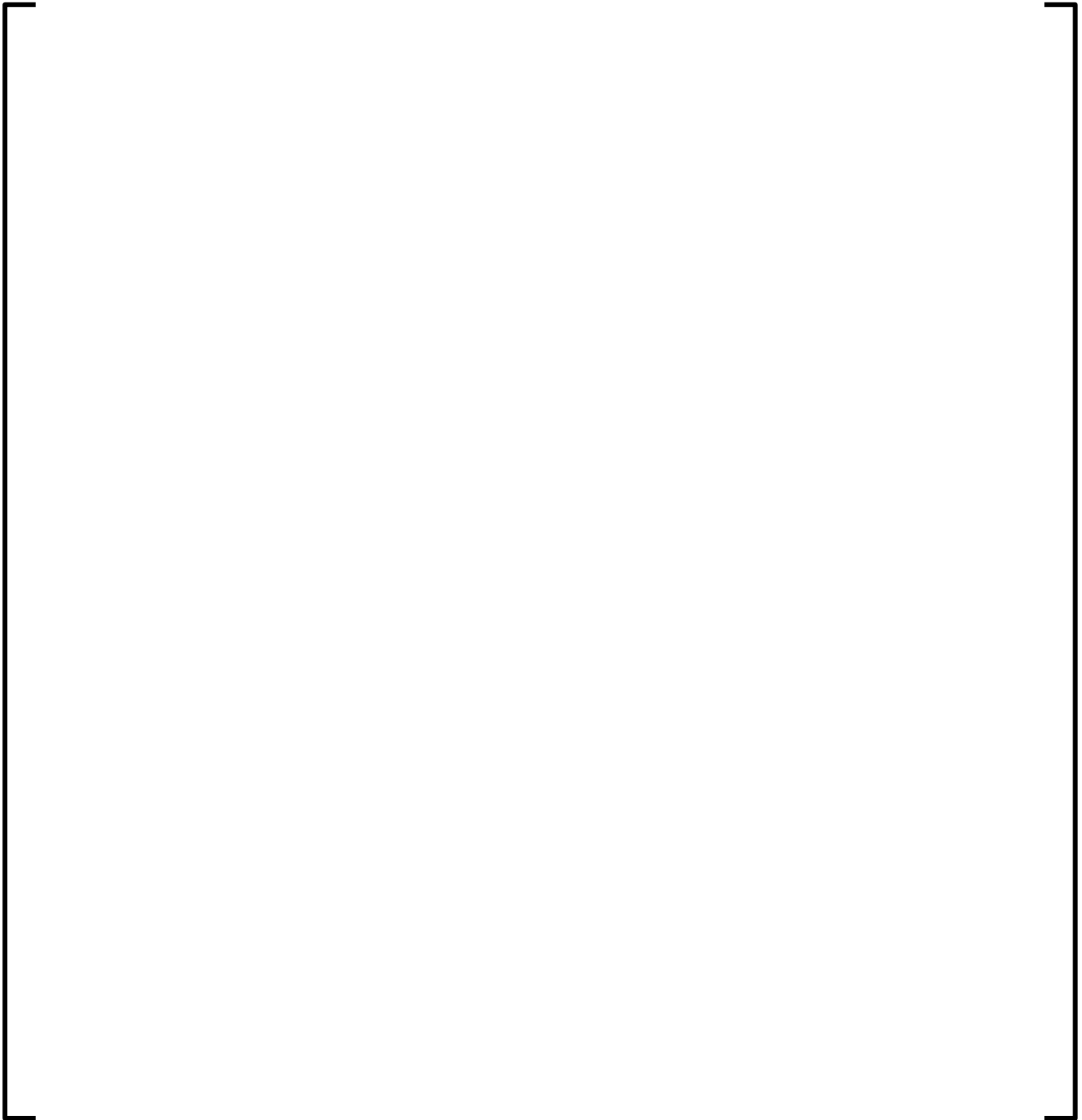


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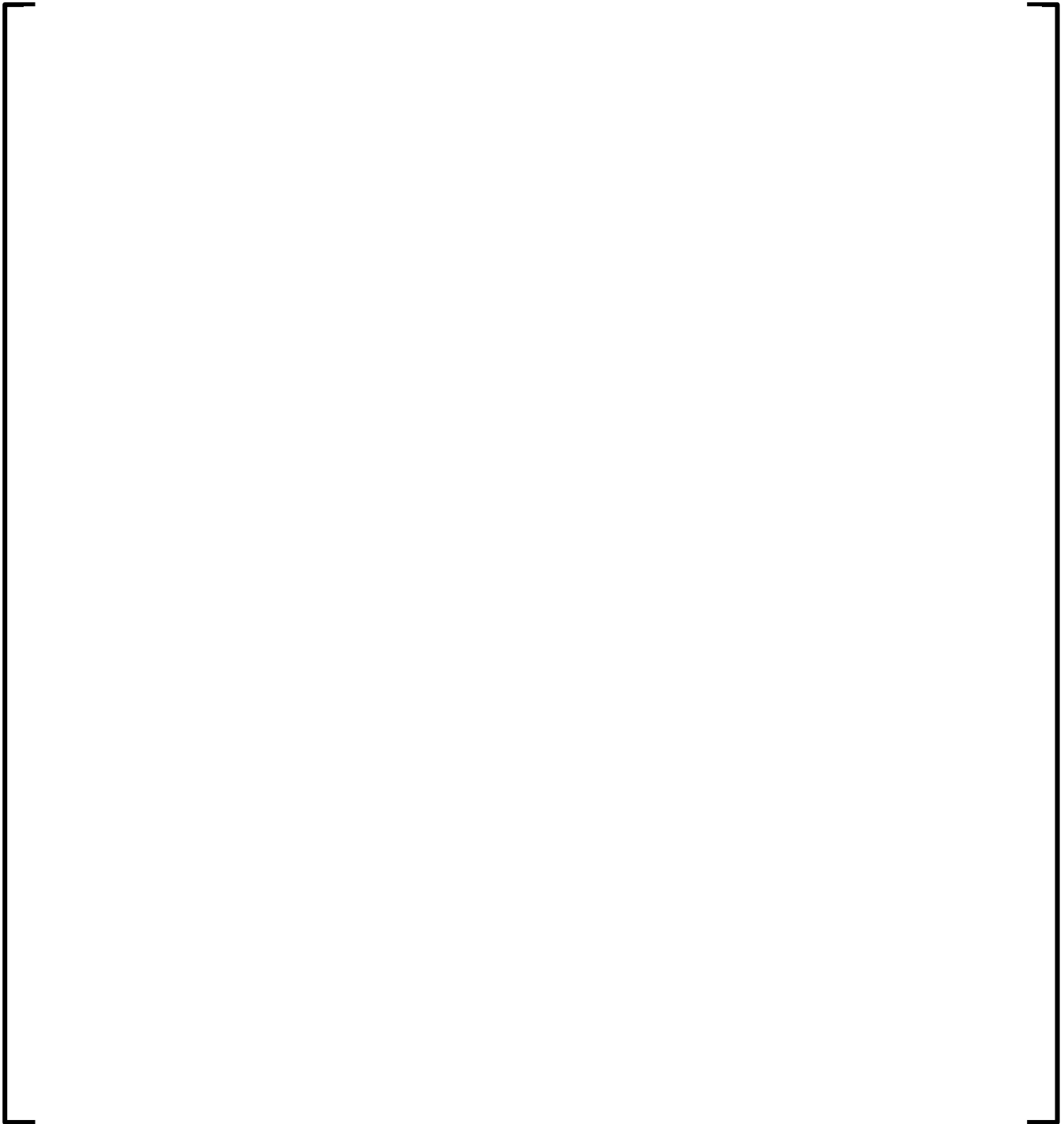


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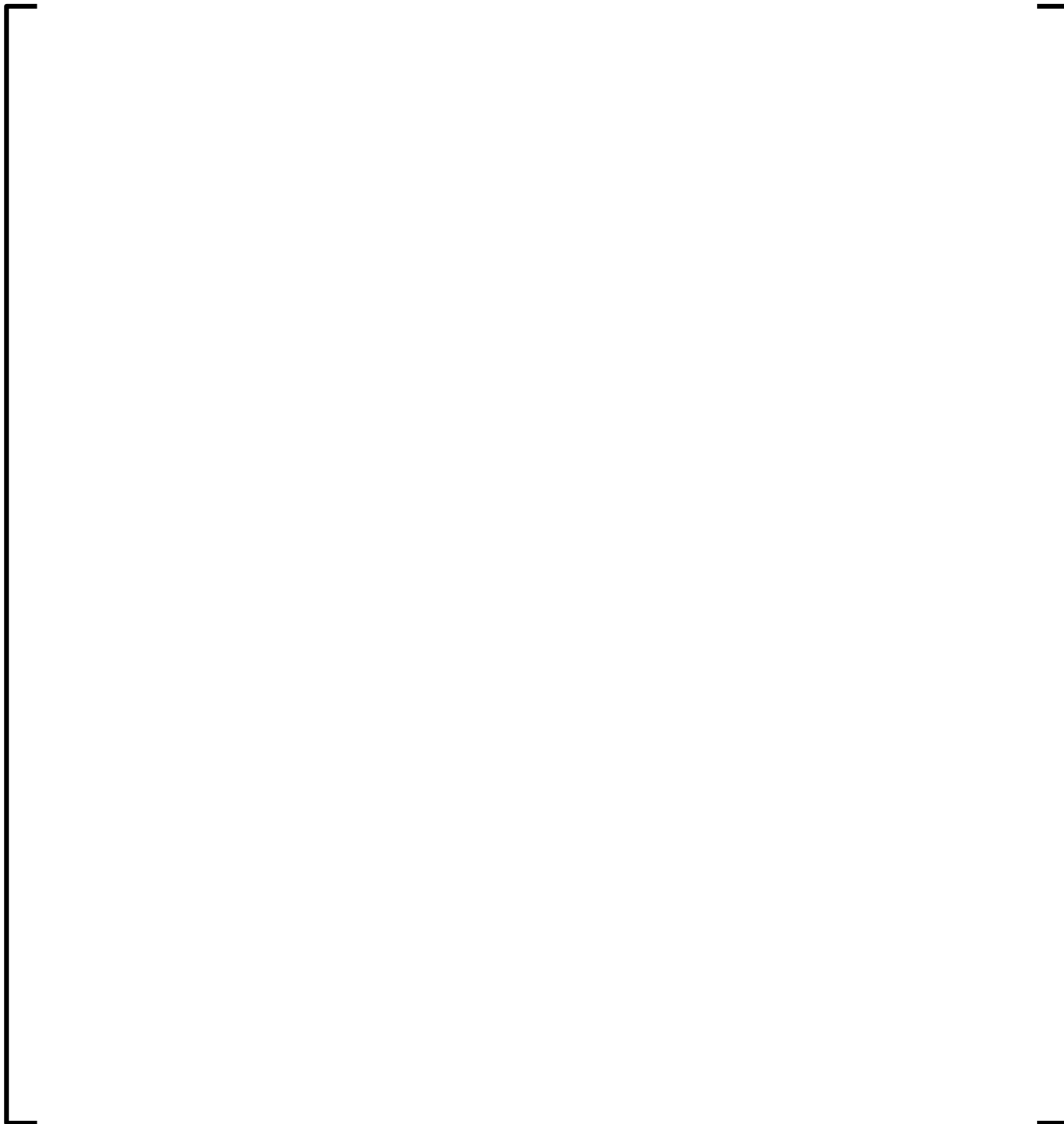


Figure D.19 [] Enrichment Distribution



Figure D.20 [] Enrichment Distribution

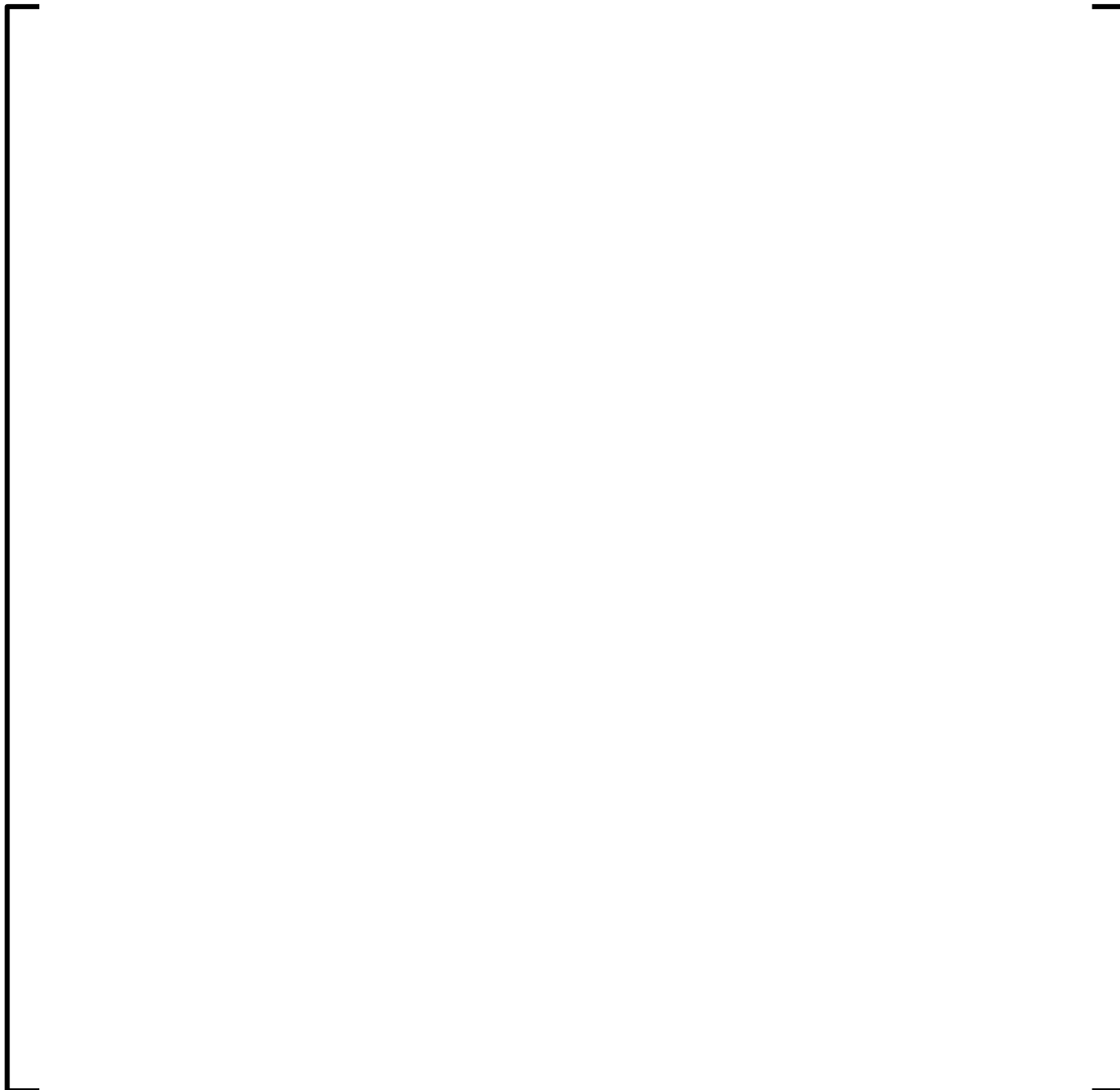


Figure D.21 [] Enrichment Distribution



Figure D.22 [] Enrichment Distribution

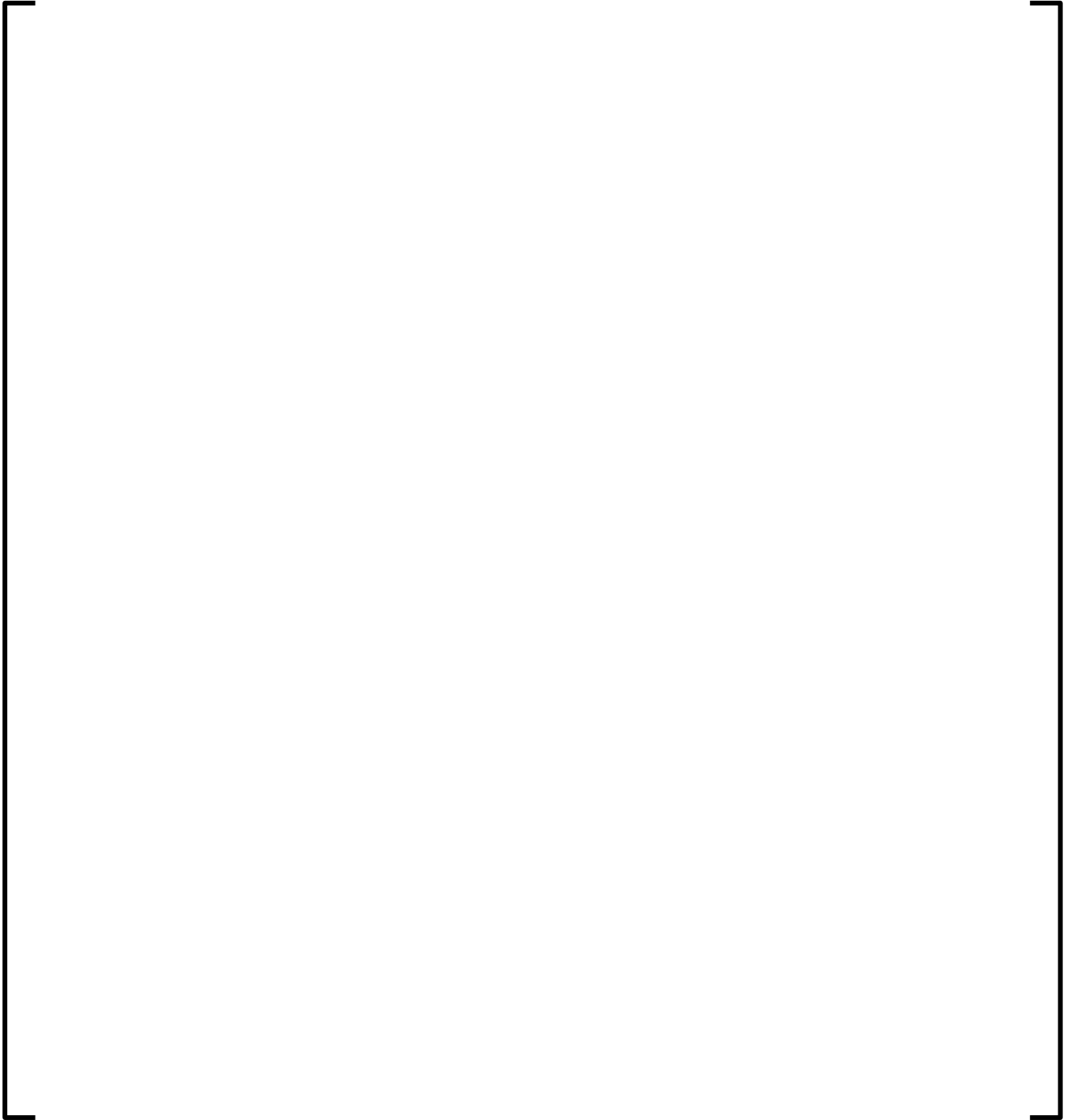


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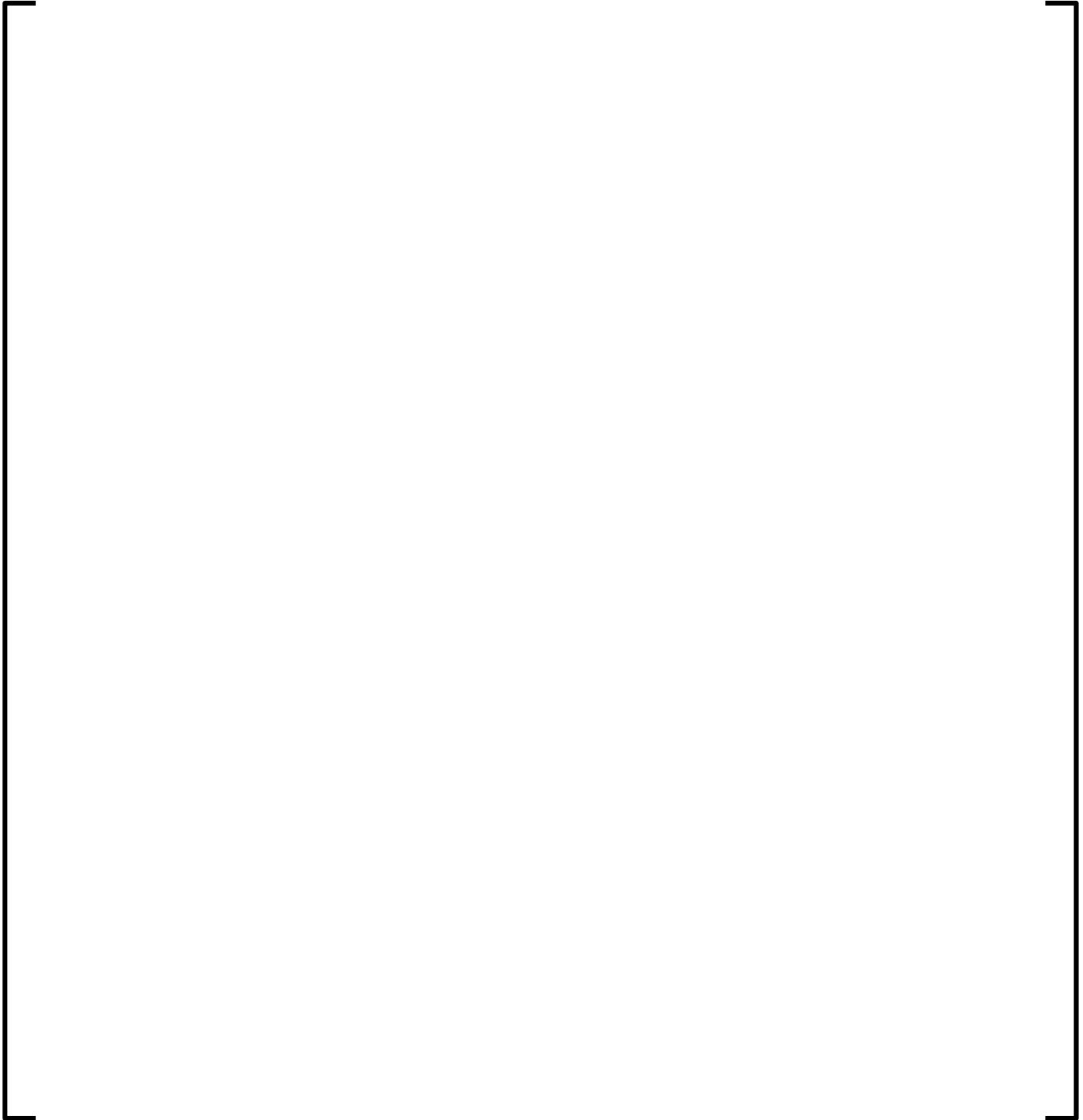


Figure D.24 [] Enrichment Distribution

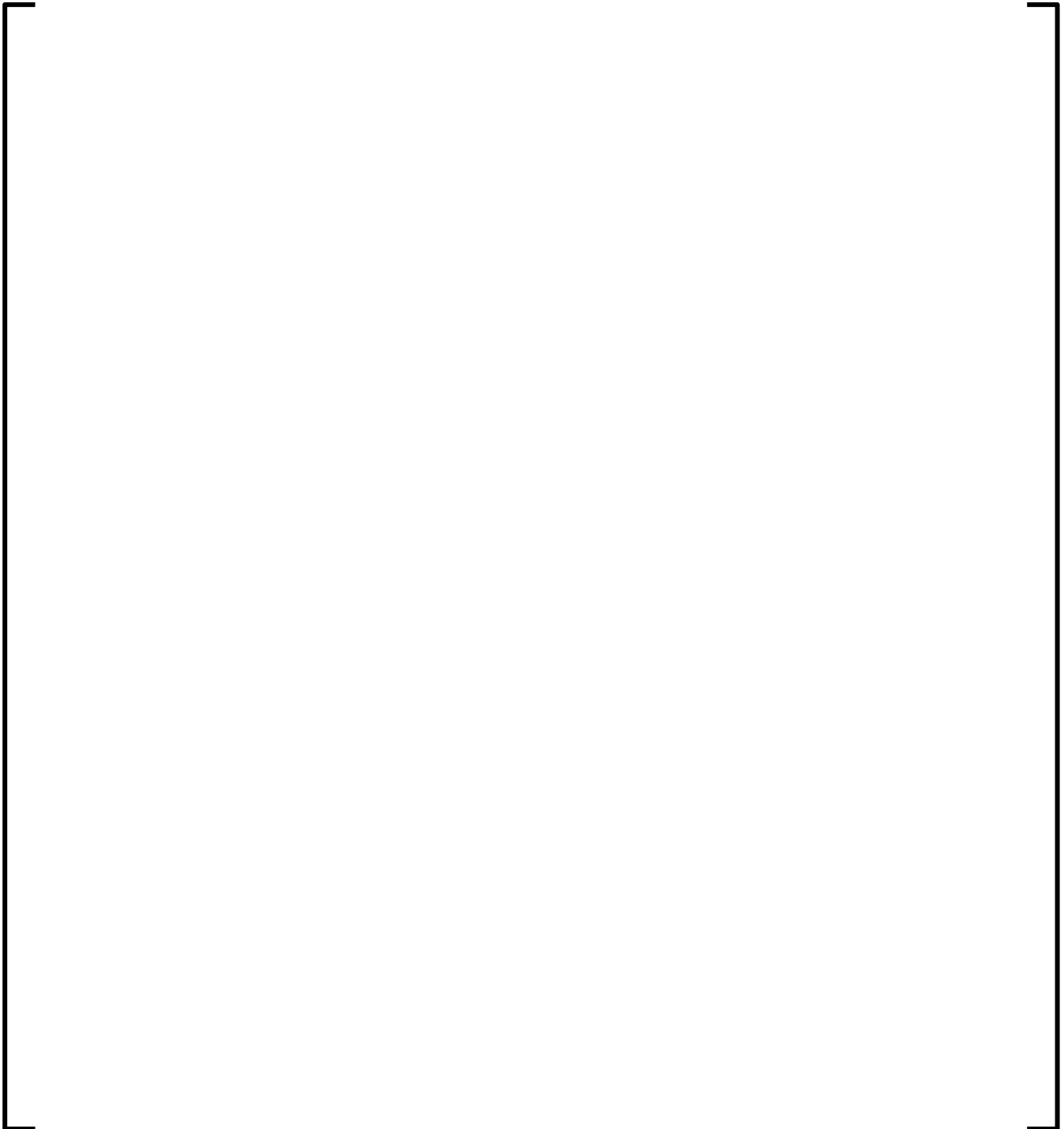


Figure D.25 [] Enrichment Distribution

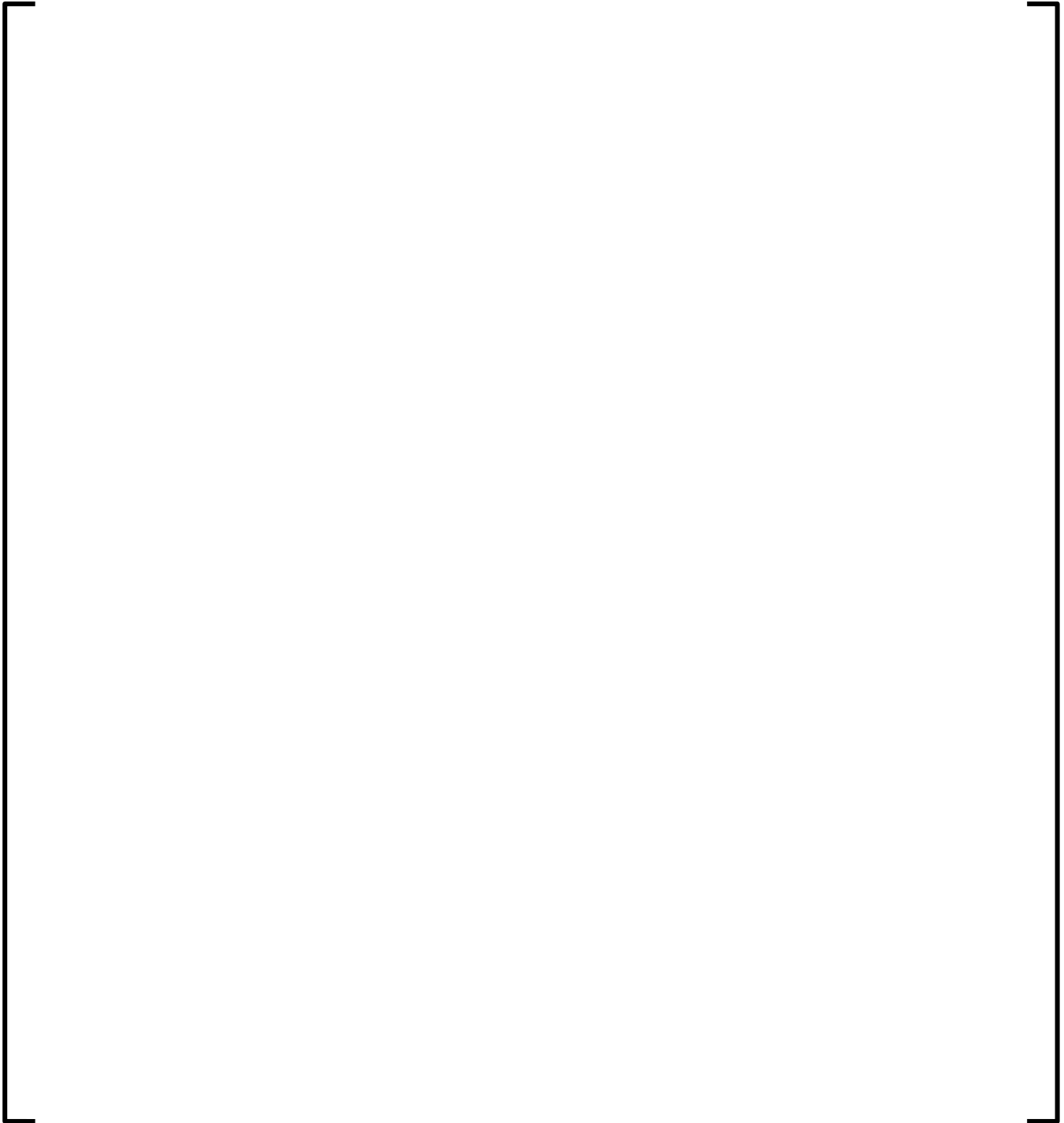


Figure D.26 [] Enrichment Distribution

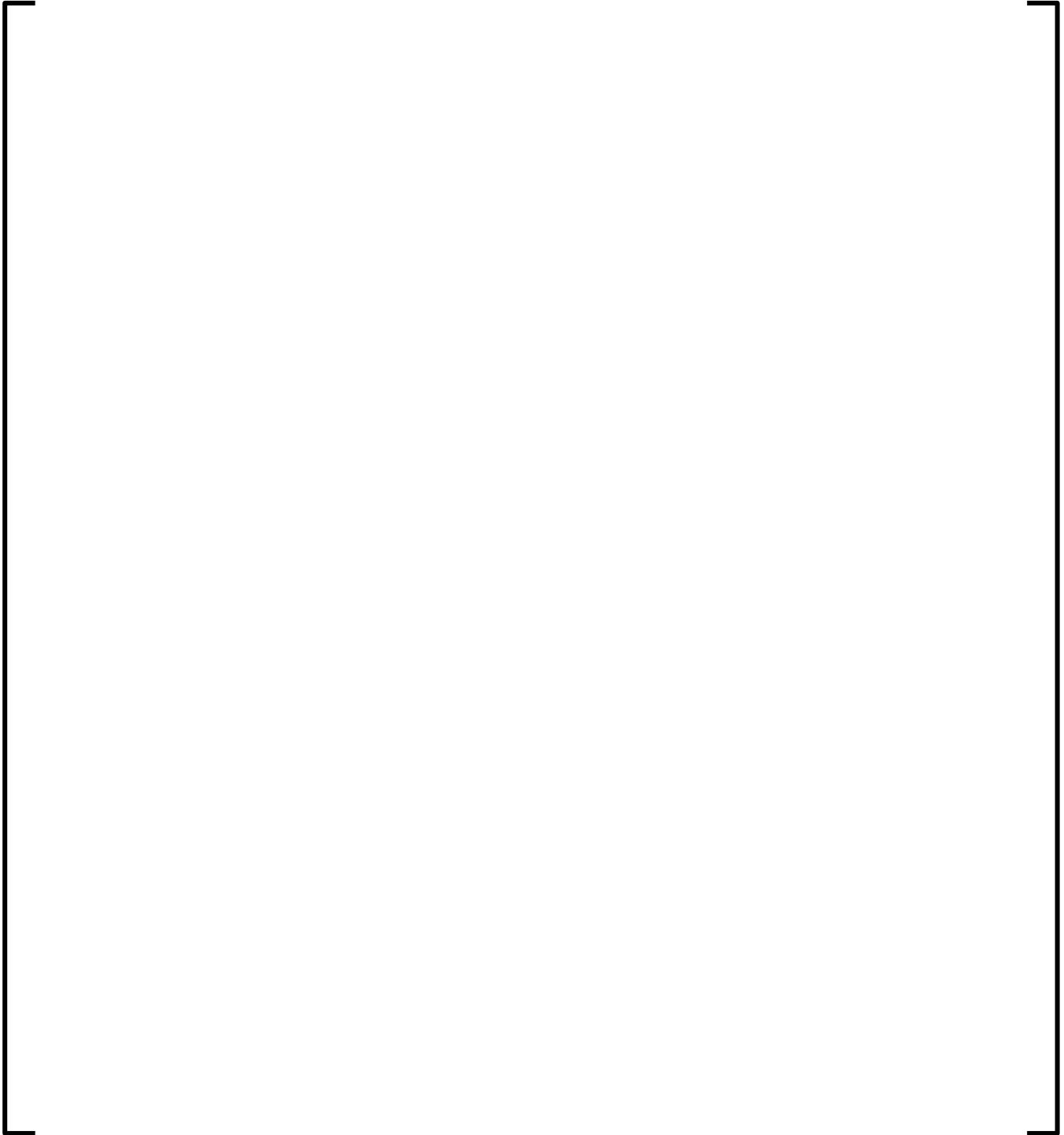


Figure D.27 [] Enrichment Distribution

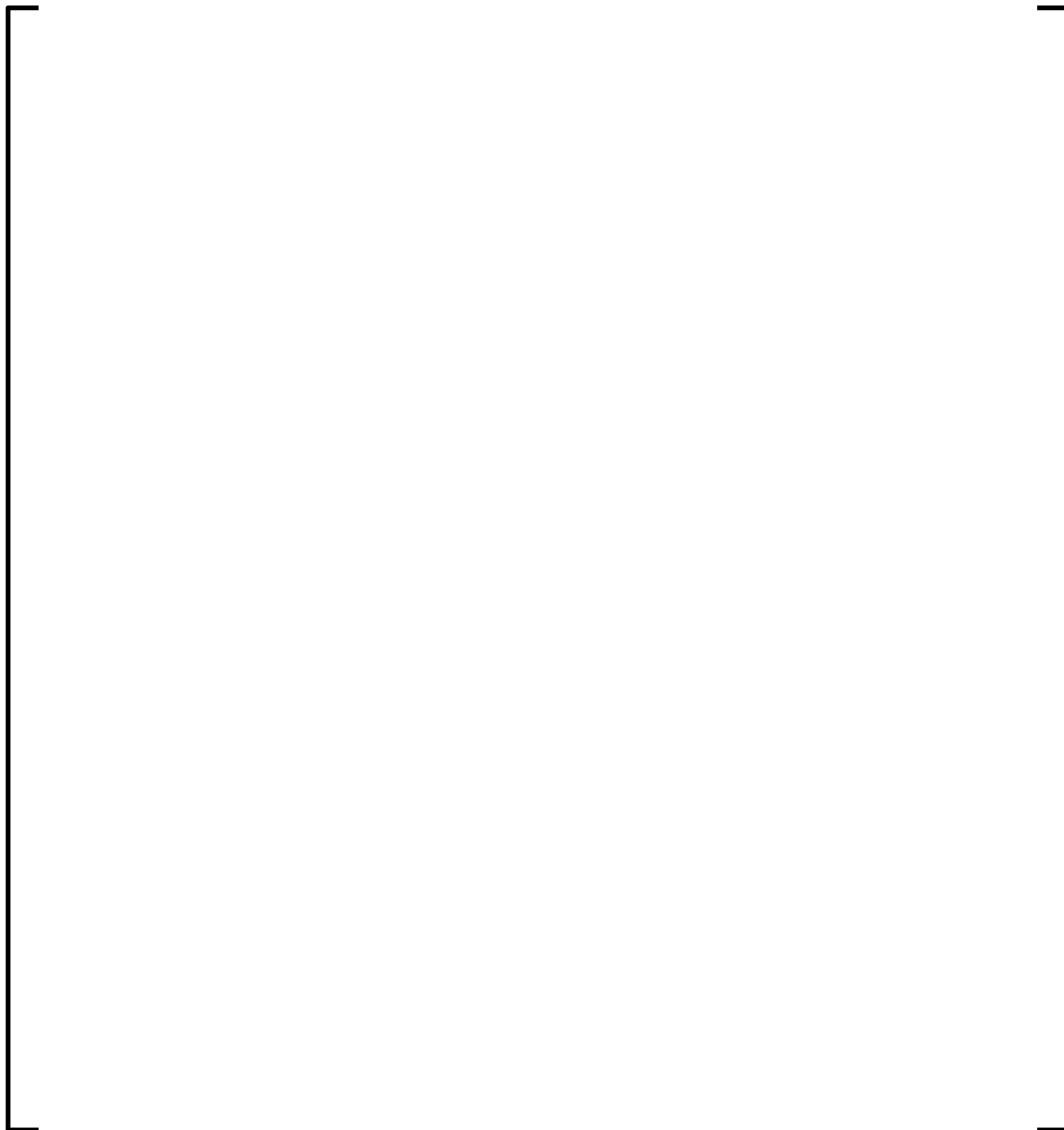


Figure D.28 [] Enrichment Distribution



Figure D.29 [] Enrichment Distribution

Enclosure 3 of PLA-7861

**Framatome Affidavit for ANP-3825P,
“Susquehanna Unit 2 Cycle 21 ATRIUM 11
Fuel Nuclear Fuel Design Report”**

AFFIDAVIT

1. My name is Alan B. Meginnis. I am Manager, Product Licensing, for Framatome Inc. and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by Framatome to determine whether certain Framatome information is proprietary. I am familiar with the policies established by Framatome to ensure the proper application of these criteria.

3. I am familiar with the Framatome information contained in the report ANP-3825P, Revision 0, "Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report," dated March 2020 and referred to herein as "Document." Information contained in this Document has been classified by Framatome as proprietary in accordance with the policies established by Framatome for the control and protection of proprietary and confidential information.

4. This Document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by Framatome and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in this Document be withheld from public disclosure. The request for withholding of proprietary information is made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by Framatome to determine whether information should be classified as proprietary:

- (a) The information reveals details of Framatome's research and development plans and programs or their results.
- (b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.
- (c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for Framatome.
- (d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for Framatome in product optimization or marketability.
- (e) The information is vital to a competitive advantage held by Framatome, would be helpful to competitors to Framatome, and would likely cause substantial harm to the competitive position of Framatome.

The information in the Document is considered proprietary for the reasons set forth in paragraphs 6(b), 6(d) and 6(e) above.

7. In accordance with Framatome's policies governing the protection and control of information, proprietary information contained in this Document have been made available, on a limited basis, to others outside Framatome only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. Framatome policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

Alan Meginnis
Alan Meginnis

STATE OF WASHINGTON)
COUNTY OF BENTON) ss.

SUBSCRIBED before me this 26th day of March, 2020.

Katherine Kerr
Katherine Kerr
NOTARY PUBLIC, STATE OF WASHINGTON
MY COMMISSION EXPIRES: 9/12/2022



Enclosure 5 of PLA-7861

**Framatome Topical Report
ANP-3826NP**

**Susquehanna Unit 2 Cycle 21
Fuel Cycle Design Report**

(Non-Proprietary Version)



Susquehanna Unit 2 Cycle 21

ANP-3826NP
Revision 0

Fuel Cycle Design Report

March 2020

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ANP-3826NP
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Susquehanna Unit 2 Cycle 21
Fuel Cycle Design Report

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Nature of Changes

Item	Section(s) or Page(s)	Description and Justification
1	All	Initial Issue

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Nomenclature

Acronym	Definition
ACE	Framatome critical power correlation
ARO	all rods out
BOC	beginning of cycle
BWR	boiling water reactor
CSDM	cold shutdown margin
EOC	end of cycle
EOFP	end of full power capability
GWd/MTU	gigawatt days per metric ton of initial uranium
HEXR	hot excess reactivity
LHGR	linear heat generation rate
MCPR	minimum critical power ratio
MICROBURN-B2	Framatome Inc. advanced BWR core simulator methodology with PPR capability
MWd/MTU	megawatt days per metric ton of initial uranium
PPR	Pin Power Reconstruction. The PPR methodology accounts for variation in local rod power distributions due to neighboring assemblies and control state. The local rod power distributions are reconstructed based on the actual flux solution for each statepoint.
R Value	the larger of zero or the shutdown margin at BOC minus the minimum calculated shutdown margin in the cycle
SLC	standby liquid control
SPCB	Framatome Inc. (formerly Siemens Power Corporation) critical power correlation

1.0 INTRODUCTION

This report documents the Framatome Inc. fuel cycle design and fuel management calculations for the Cycle 21 operation of the Susquehanna Unit 2 BWR. This design analysis utilizes the ATRIUM 10 and ATRIUM 11 fuel design and has been performed with the approved Framatome Inc. neutronics methodology (References 1, 4 and 5). The CASMO-4 lattice depletion code was used to generate nuclear data including cross sections and local power peaking factors. The MICROBURN-B2 three dimensional core simulator code, combined with the application of the applicable critical power correlation, was used to model the core. The following MICROBURN-B2 version 2 modeling features were also used in the analyses supporting this report:

- Pin power reconstruction (PPR) to determine thermal margins
- []
- []
- []
- []

Design results for the Cycle 21 reactor core loading including projected control rod patterns and evaluations of thermal and reactivity margins are presented. The Cycle 21 results are based on Cycle 20 core operational history as summarized in Table 2.1

2.0 SUMMARY

The Cycle 21 fresh batch size [] and batch average enrichment [] were determined to meet the energy requirements provided by Talen Energy (Reference 3). For a complete description of the fresh reload assemblies, see Reference 2. The loading of the Cycle 21 fuel as described in this report results in a projected Cycle 21 full power energy capability of []. Beyond the full power capability, the cycle has been designed to achieve [] additional energy via power coastdown at constant core dome pressure operation.

In order to obtain optimum operating flexibility, the projected control rod patterns for Cycle 21 were developed to be consistent with a conservative margin to thermal limits (References 6, 7, 8, and 9). The cycle design calculations also demonstrate adequate hot excess reactivity and cold shutdown margin throughout the cycle. Key results from the design analysis are summarized in Table 2.1. Table 3.1 summarizes the core composition and the assembly description for Cycle 21 by nuclear fuel type batch. Tables 3.2, 3.3 and 3.4 contain the assumed thermal limits for both the ATRIUM 10 and ATRIUM 11 fuel in the design.

Table 2.1 Energy and Key Results Summary

--

3.0 CYCLE 21 FUEL CYCLE DESIGN

3.1 *General Description*

The assembly design for the Cycle 21 SUS2-21 fresh reload fuel for Susquehanna Unit 2 is described in detail in Reference 2. Elevation views of the fresh reload fuel design axial enrichment and gadolinia distributions are shown in Appendix B, Figures B.1 through B.3.

[

] . This loading in conjunction with the control rod patterns presented in Appendix A shows acceptable power peaking and associated margins to limits for projected Cycle 21 operation. The analyses supporting this fuel cycle design were based on the core parameters shown in Table 3.1. Figures 3.1 and 3.2 along with Table 3.1 define the reference loading pattern used in the fuel cycle design. The specific core location of the fresh assemblies in Cycle 21 is provided in Appendix C. Key results for the cycle are summarized in Table 2.1.

3.2 *Control Rod Patterns and Thermal Limits*

Projected control rod patterns for Cycle 21 and resultant key operating parameters including thermal margins are shown in Appendix A. The thermal margins presented in this report were determined using the MICROBURN-B2 3D core simulator PPR model to provide adequate margin to thermal limits from References 6, 7 and 8. A detailed summary of the core parameters resulting from the step-through projection analysis is provided in Tables A.1 and A.2. Limiting results from the step-through are summarized in Table 2.1. The hot operating target k-eff versus cycle exposure which was determined to be appropriate for Cycle 21 is shown in Table 3.5. The k-eff values presented in Appendix A are not bias corrected. Selected exposure and radial power distributions from the design step-through are presented in Appendix D.

3.3 *Hot Excess Reactivity and Cold Shutdown Margin*

The cycle design calculations demonstrate adequate hot excess reactivity, SLC shutdown margin, and cold shutdown margin throughout the cycle. Key shutdown margin and R-Value results are presented in Table 2.1. The shutdown margin for Cycle 21 is in conformance with the Technical Specification limit of $R + 0.38 \% \Delta k/k$ at BOC. The shutdown margin was calculated at [] The cold target k_{eff} versus exposure determined to be appropriate for calculation of cold shutdown margin in Cycle 21 is shown in Table 3.6. [

]. Table 3.7 summarizes the Cycle 21 reactivity margins versus cycle exposure, including the SLC shutdown margin for the cycle.

Table 3.1 Cycle 21 Core Composition and Design Parameters

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Table 3.2 ATRIUM 10 and ATRIUM 11 Assumed MCPR Operating Limit

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Table 3.3 ATRIUM 10 and ATRIUM 11 Assumed LHGR Limit

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Table 3.4 ATRIUM 10 and ATRIUM 11 Assumed MAPLHGR Limit

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Table 3.5 Hot Operating Target k-eff Versus Cycle Exposure

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Table 3.6 Cold Critical Target k-eff Versus Cycle Exposure

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*

[

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Table 3.7 Reactivity Margin Summary

Table 3.7 Reactivity Margin Summary (continued)

Table 3.7 Reactivity Margin Summary (continued)

Figure 3.1 Reference Loading Pattern

Figure 3.1 Reference Loading Pattern (Continued)

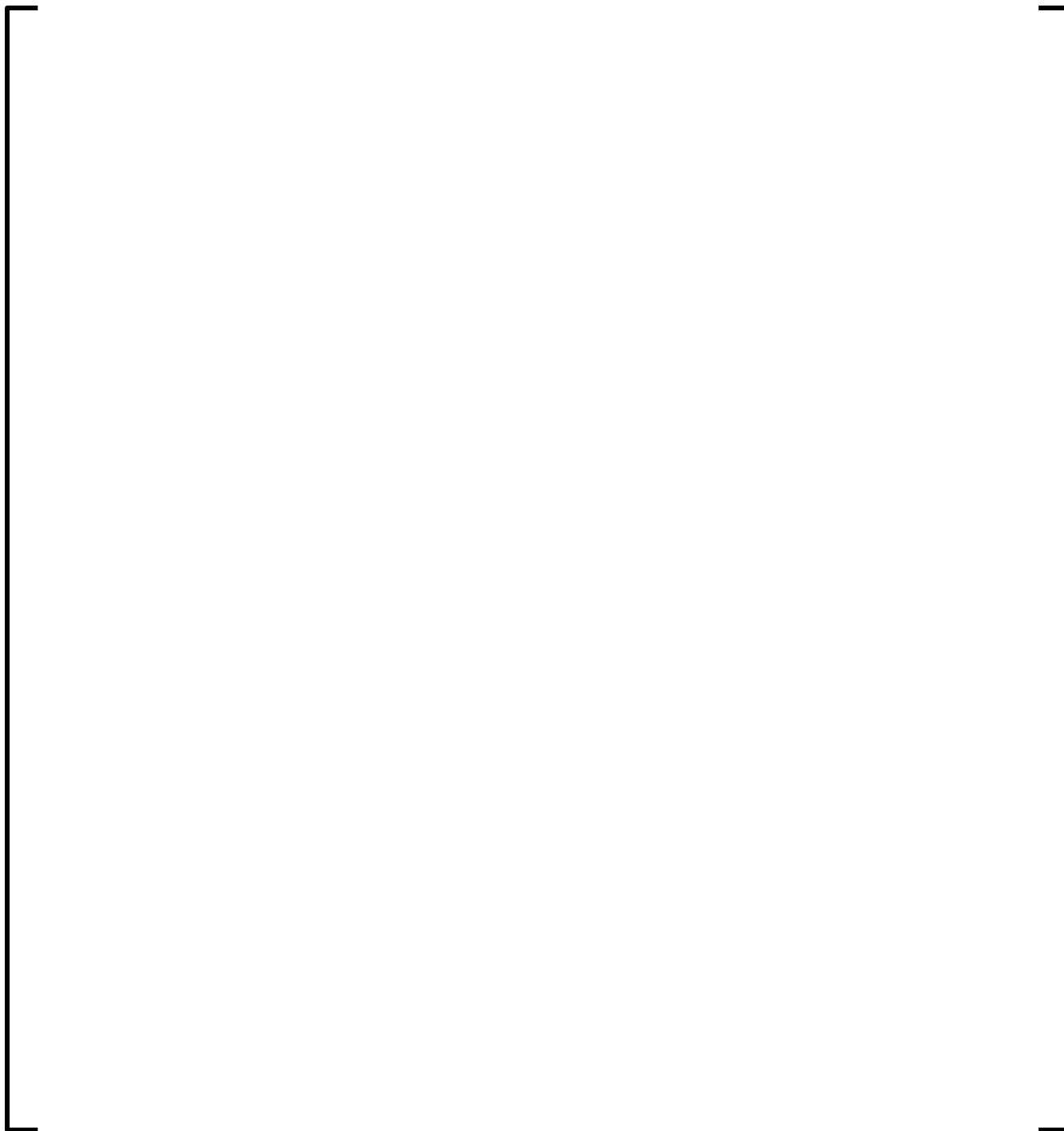


Figure 3.2 Lower Right Quarter Core Layout by Fuel Type

4.0 REFERENCES

1. EMF-2158(P)(A) Revision 0, Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2, Siemens Power Corporation
2. ANP-3825P, Revision 0, Susquehanna Unit 2 Cycle 21 ATRIUM 11 Fuel Nuclear Fuel Design Report
3. Letter, I. Brisson (Susquehanna) to R. Follett (Framatome), "Susquehanna Unit 2 Cycle 21 Reload Design Plan," EML 01384, November 6, 2019. (FS1-0047729 Revision 1.0, "Susquehanna Unit 2 Cycle 21 Reload Design Plan," Framatome Inc., January 2, 2020.)
4. EMF-2209(P)(A) Revision 3, SPCB Critical Power Correlation, AREVA
5. ANP-10335P-A, Revision 0, ACE/ATRIUM 11 Critical Power Correlation
6. EMF-3243(P), Revision 0, Susquehanna LOCA MALPHGR Analysis for ATRIUM-10 Fuel and Extended Power Uprate
7. ANP-3416P, Revision 2, Mechanical Design Report for Susquehanna Units 1 and 2 ATRIUM-10 Fuel Assemblies Licensing Report
8. ANP-3784P, Revision 0, Susquehanna Units 1 and 2 LOCA Analysis for ATRIUM 11 Fuel
9. ANP-3745P, Revision 0, ATRIUM 11 Fuel Rod Thermal-Mechanical Evaluation for Susquehanna LAR

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**Appendix A Susquehanna Unit 2 Cycle 21 Step-through Depletion Summary,
Control Rod Patterns and Core Average Axial Power and Exposure Distributions**

Table A.1 Design Depletion Summary

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Table A.1 Design Depletion Summary (continued)

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Table A.2 Design Depletion Thermal Margin Summary

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Table A.2 Design Depletion Thermal Margin Summary (continued)

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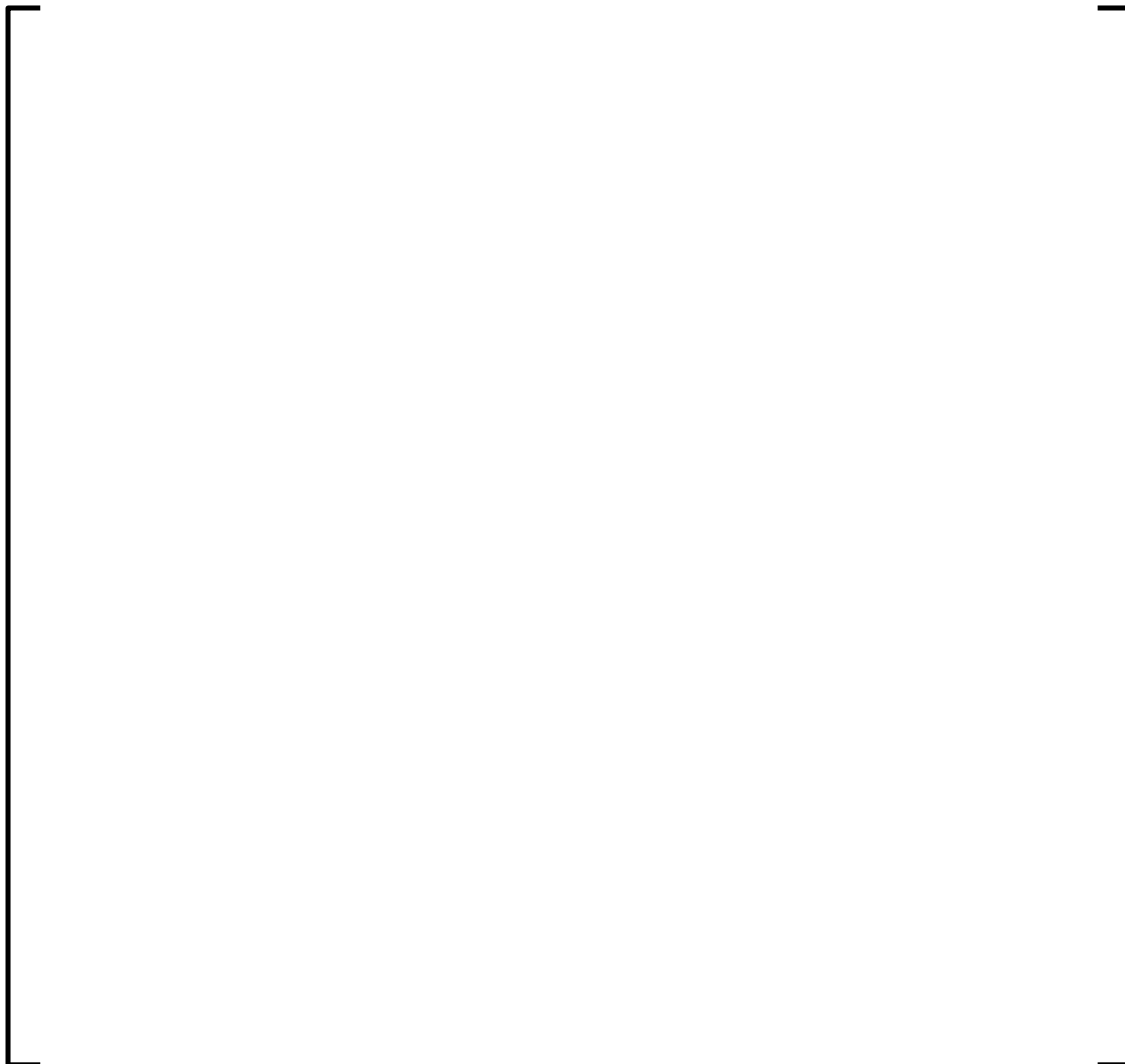


Figure A.1 Control Rod Pattern and Axial Distributions at []

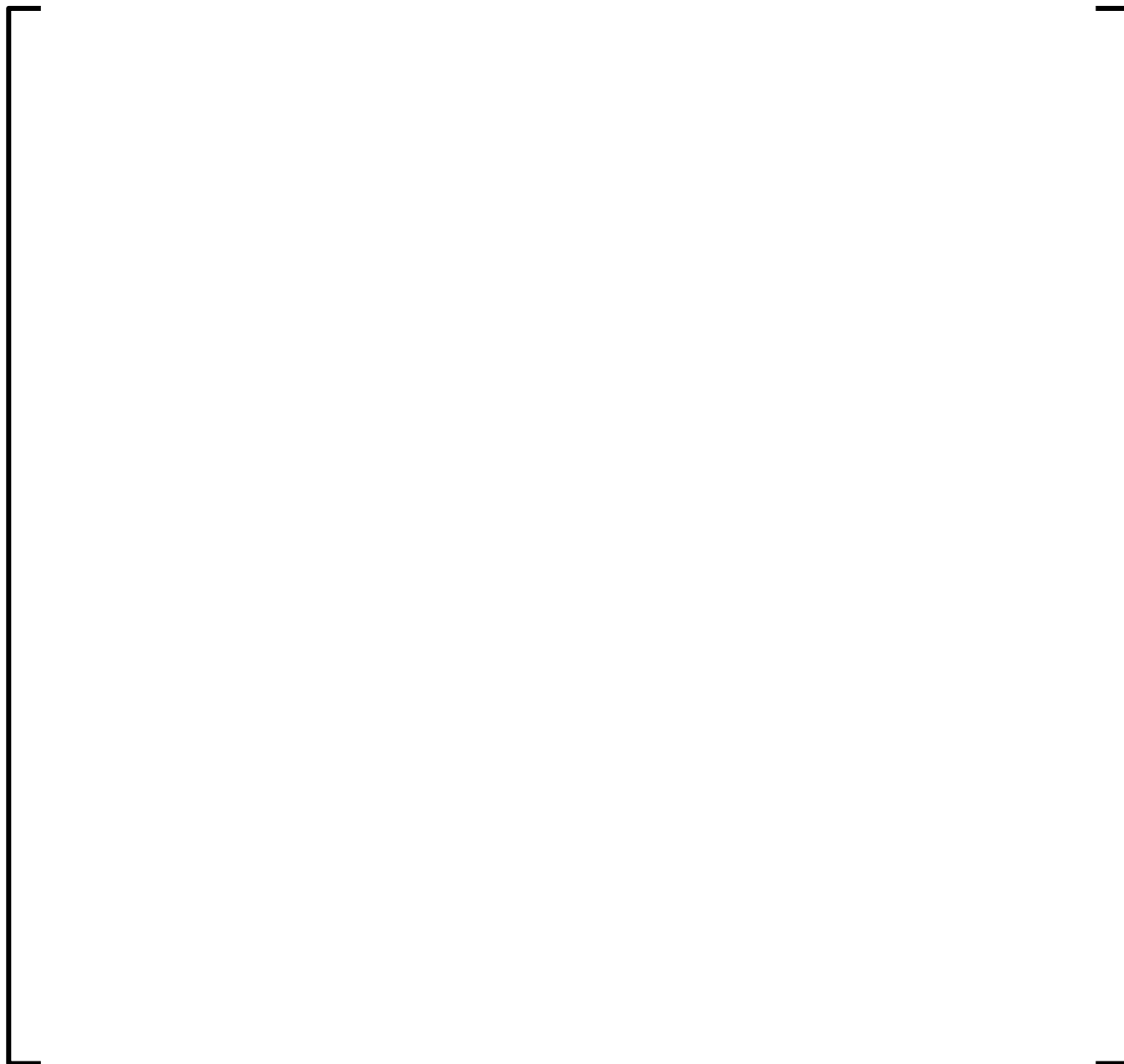


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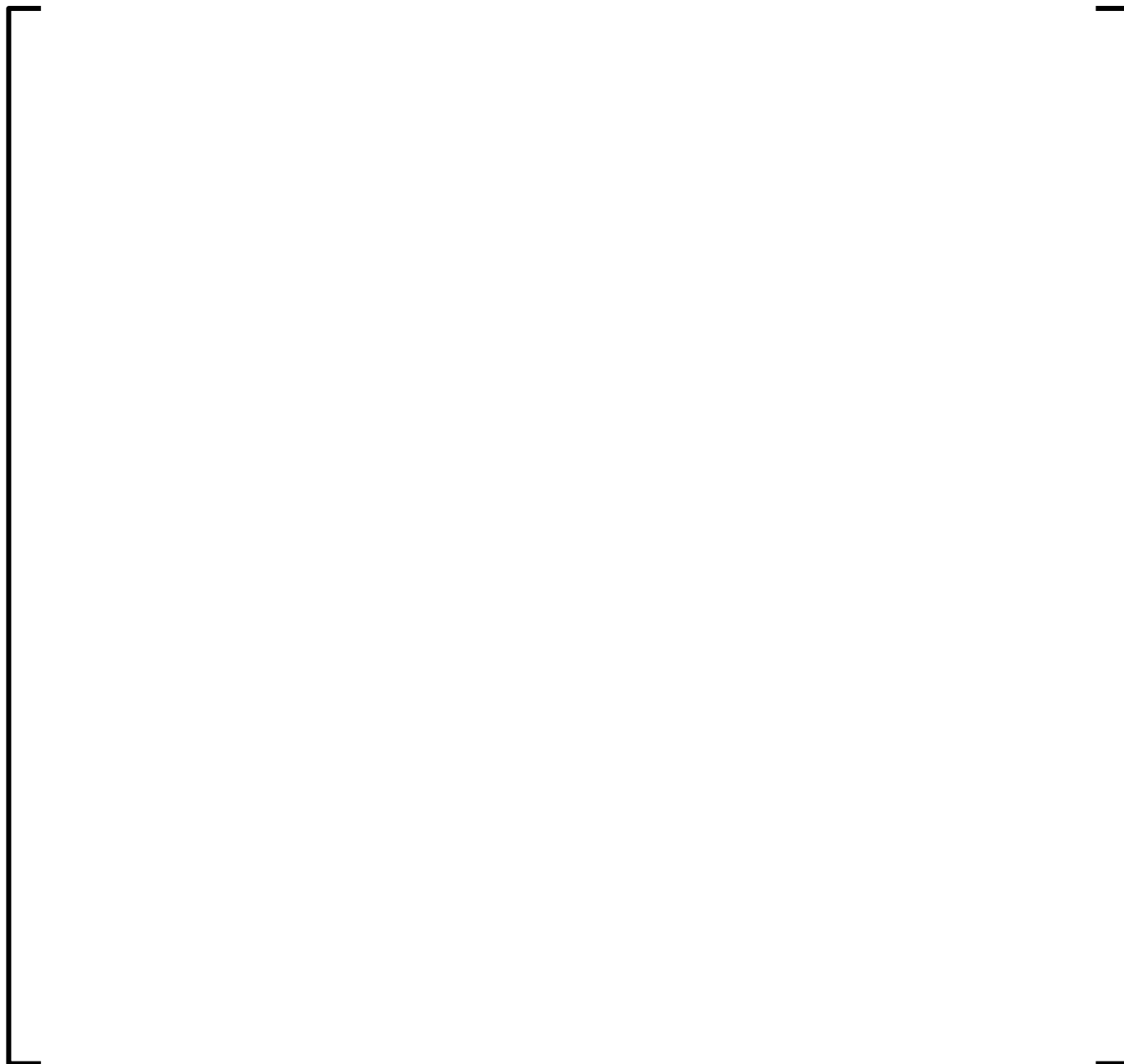


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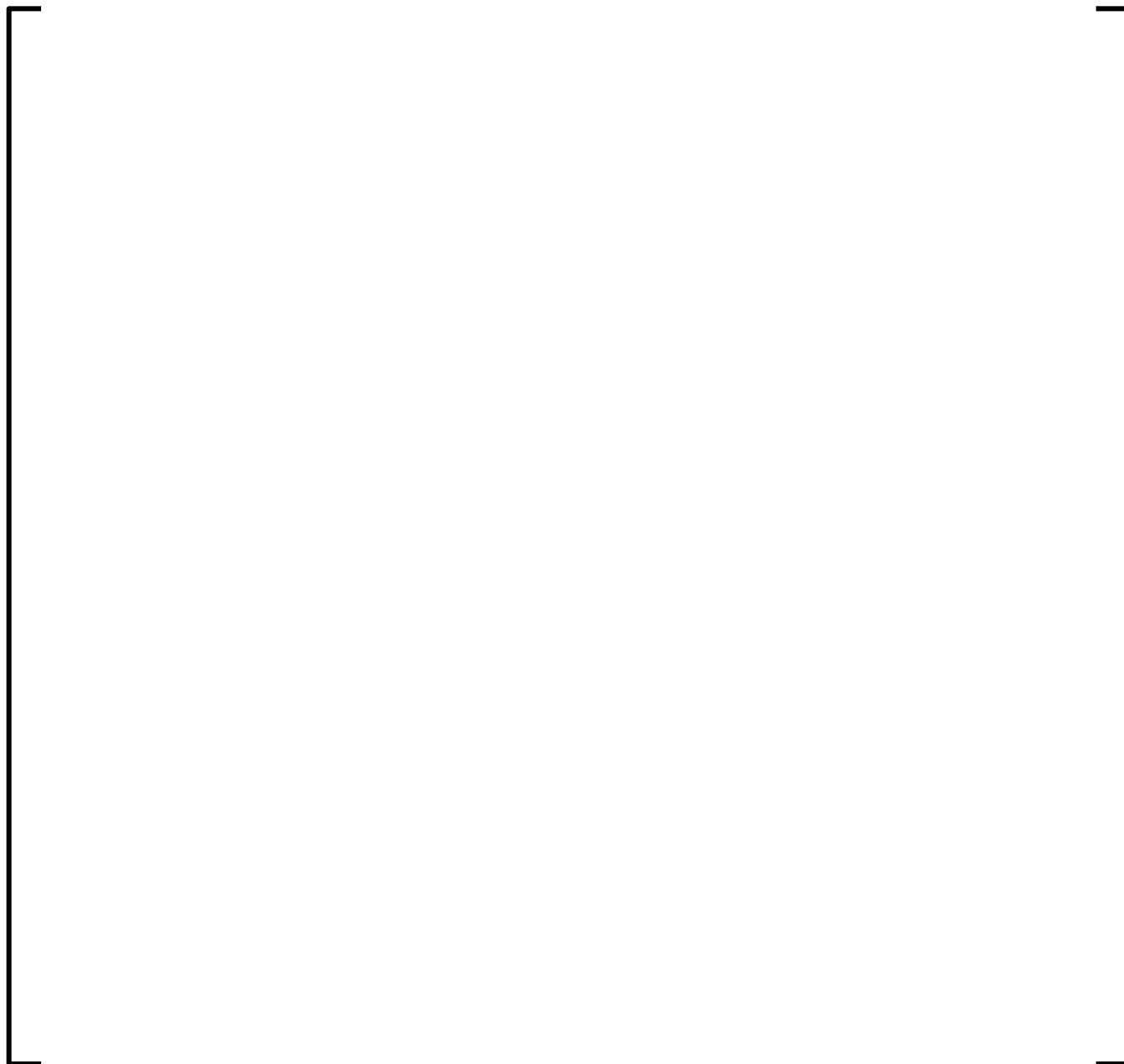


Figure A.4 Control Rod Pattern and Axial Distributions at []

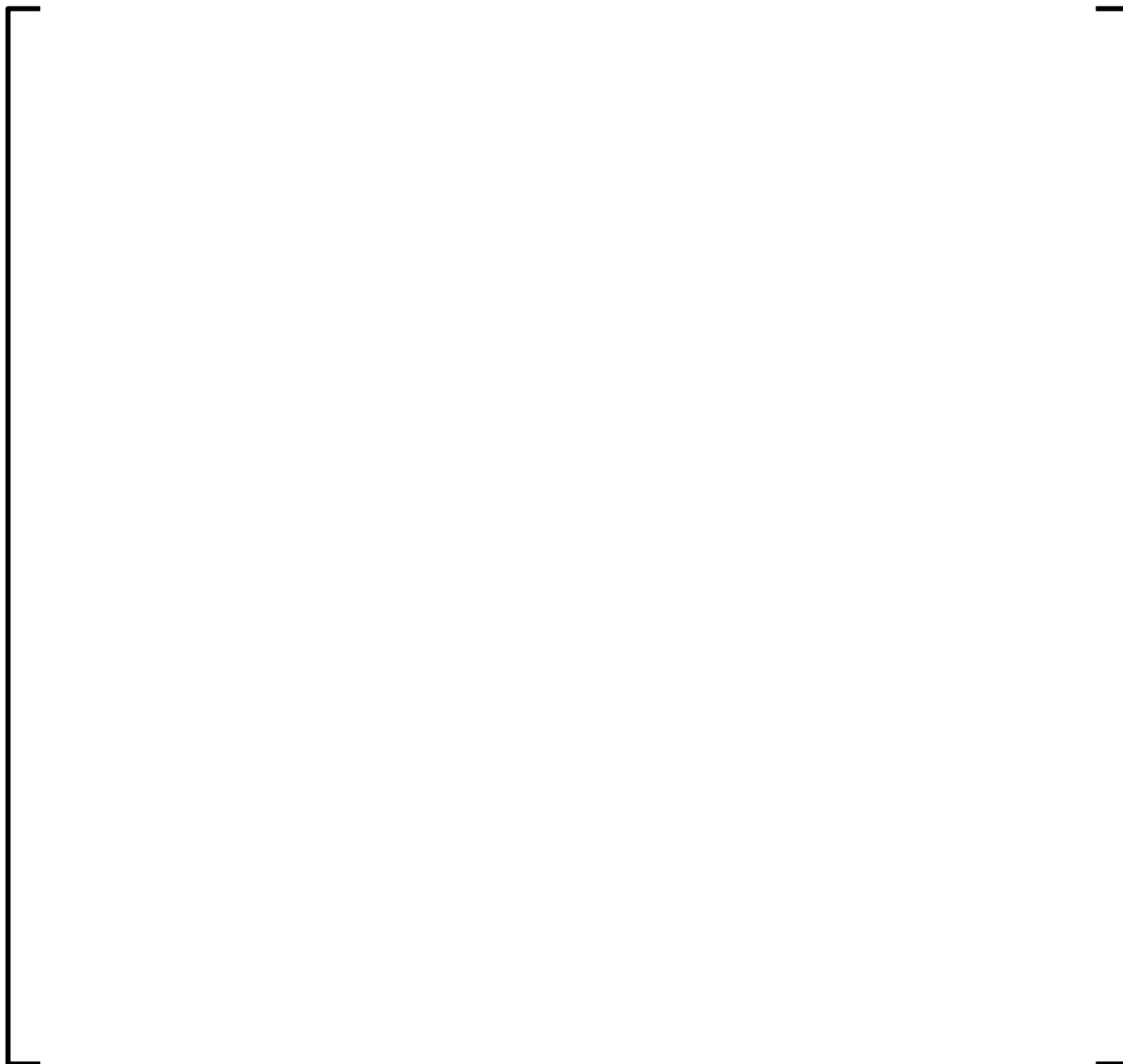


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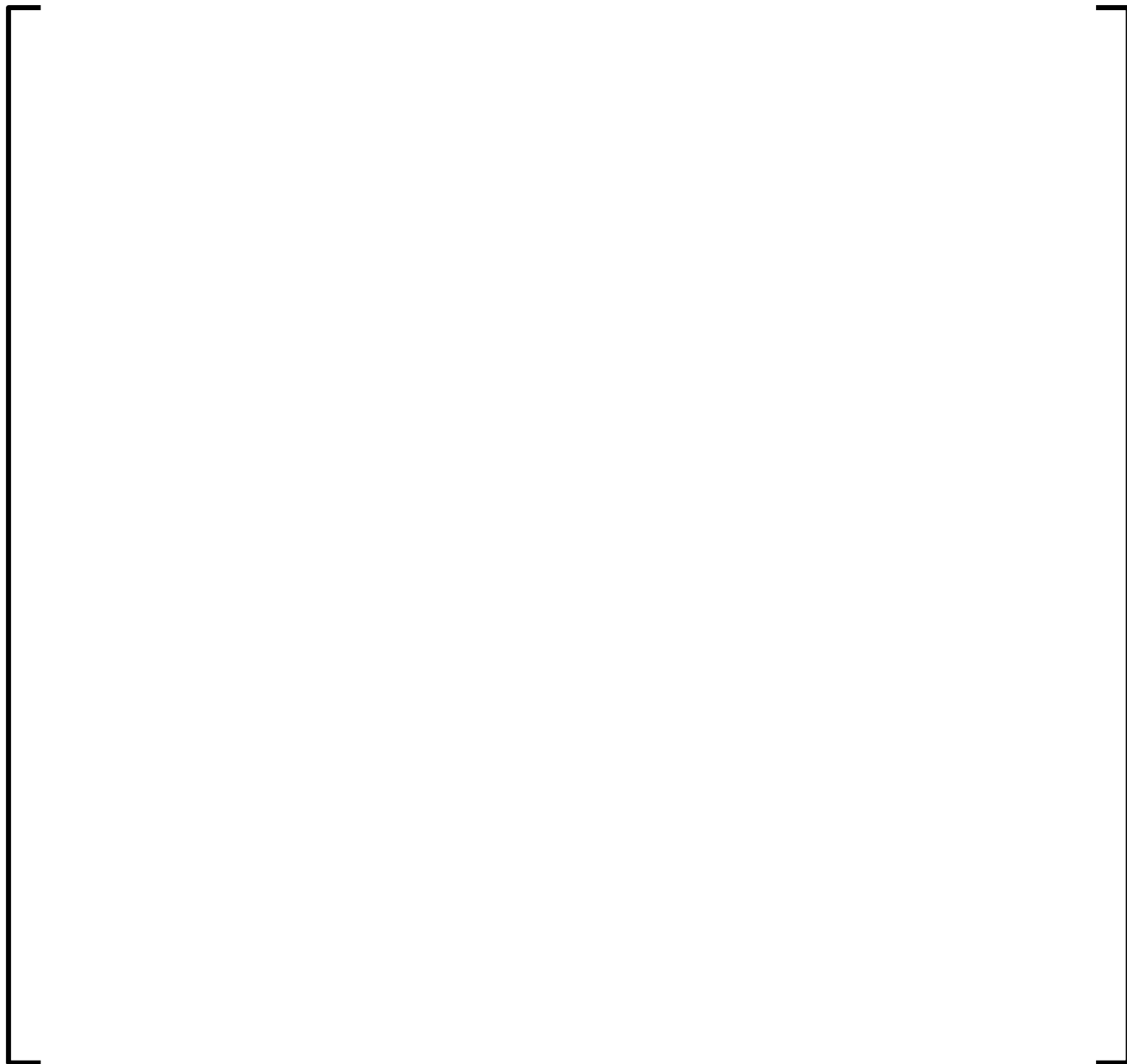


Figure A.6 Control Rod Pattern and Axial Distributions at []

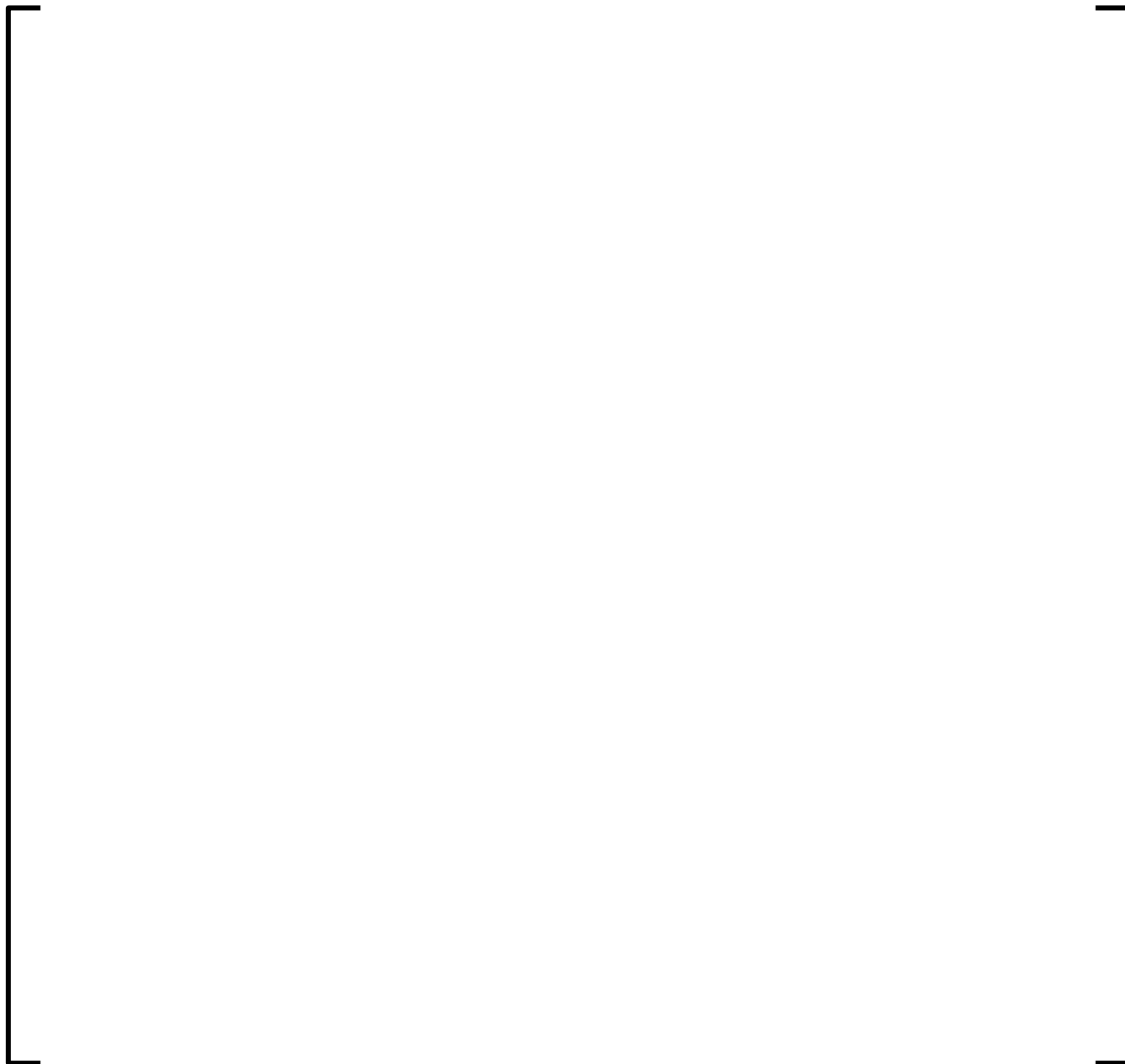


Figure A.7 Control Rod Pattern and Axial Distributions at []



Figure A.8 Control Rod Pattern and Axial Distributions at []

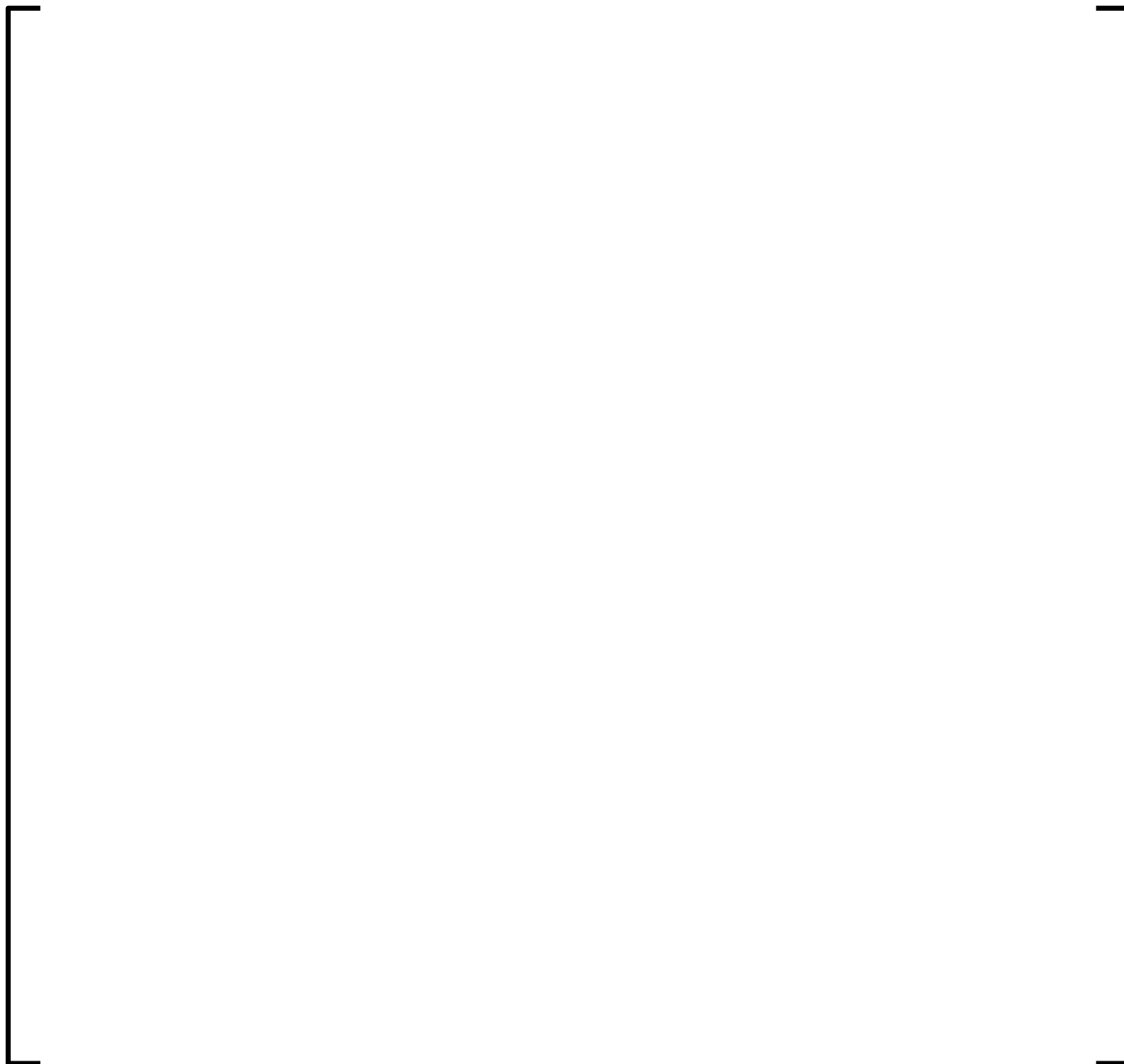


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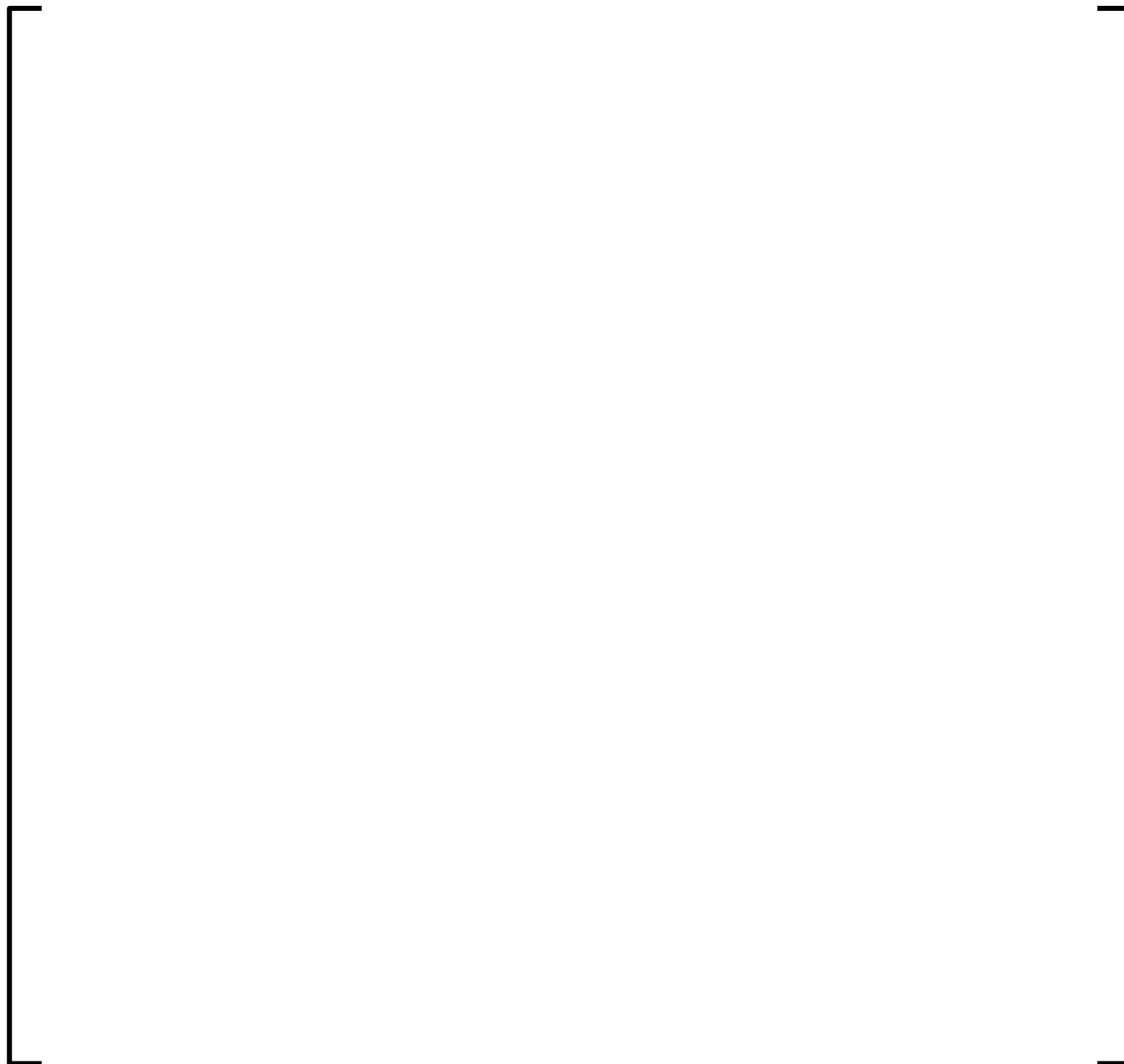


Figure A.10 Control Rod Pattern and Axial Distributions at []

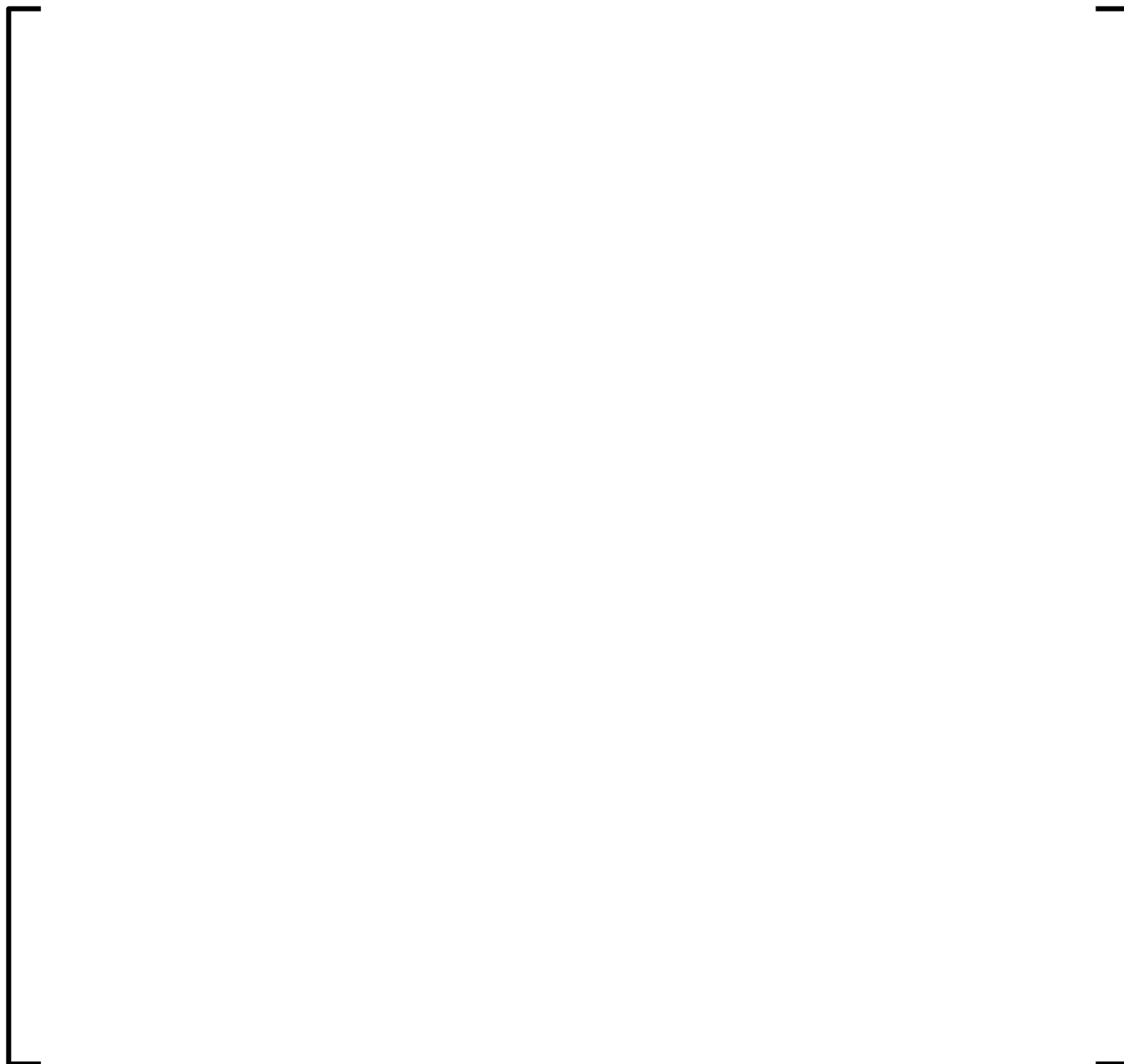


Figure A.11 Control Rod Pattern and Axial Distributions at []



Figure A.12 Control Rod Pattern and Axial Distributions at []

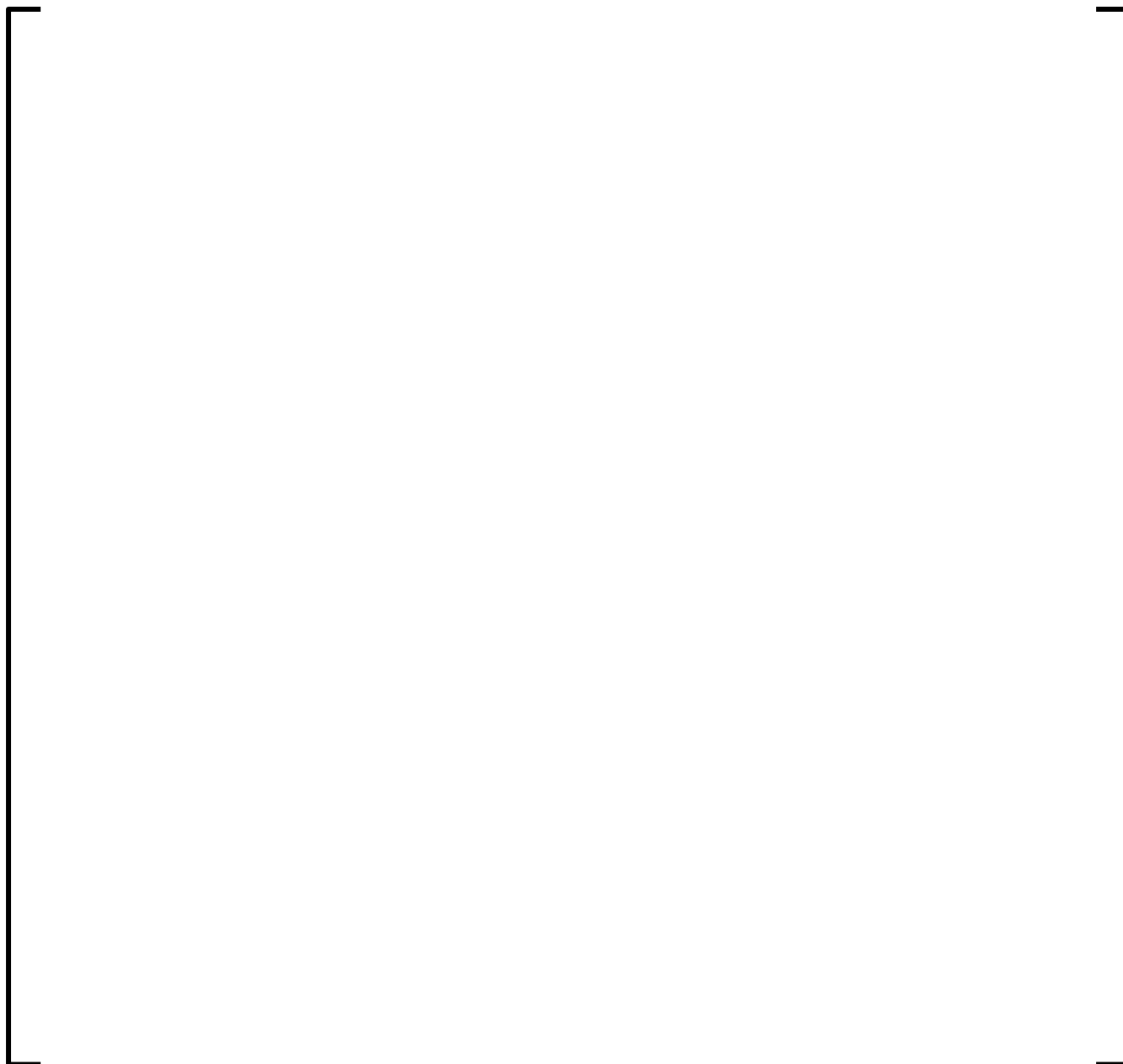


Figure A.13 Control Rod Pattern and Axial Distributions at []



Figure A.14 Control Rod Pattern and Axial Distributions at []



Figure A.15 Control Rod Pattern and Axial Distributions at []



Figure A.16 Control Rod Pattern and Axial Distributions at []

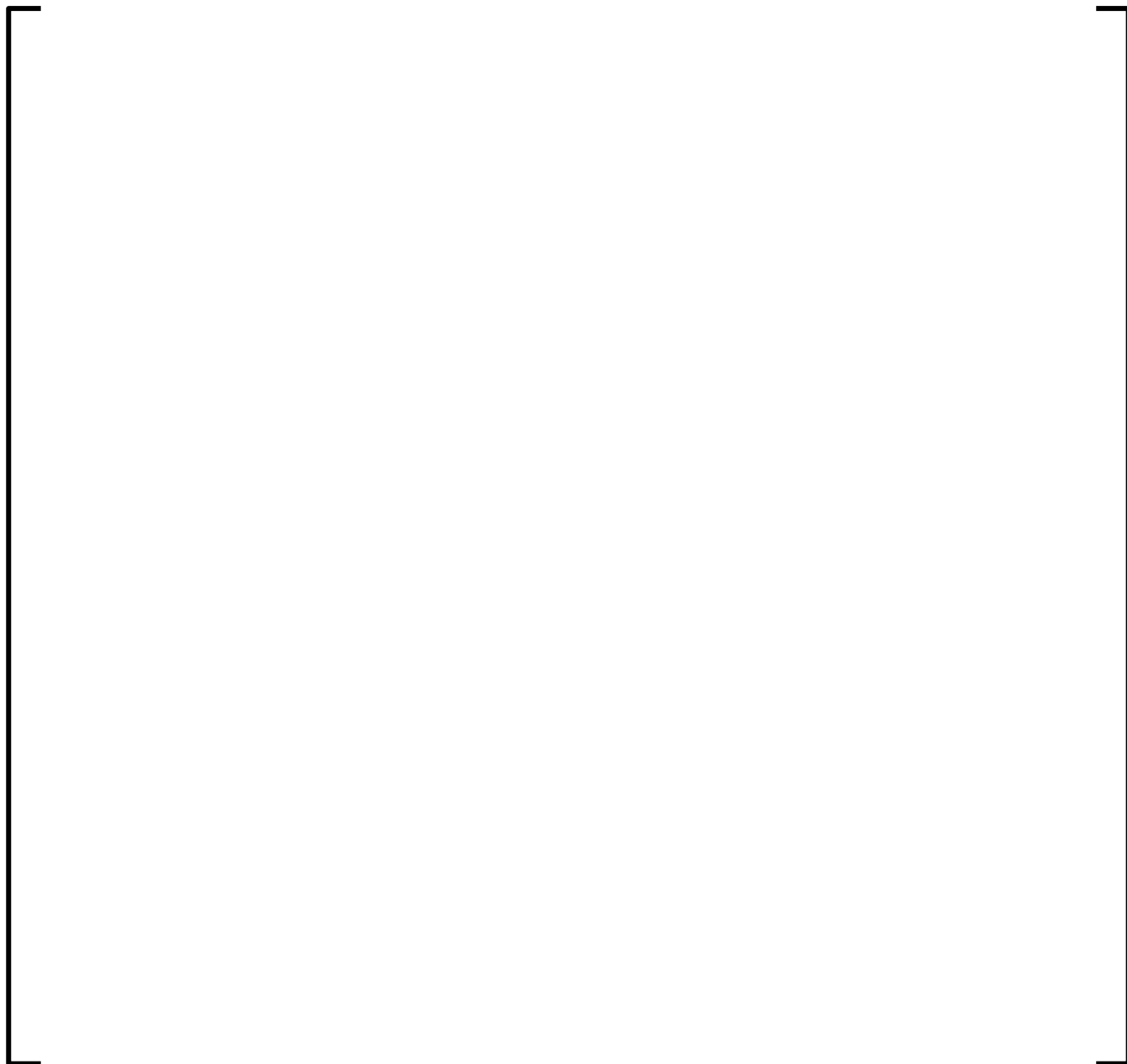


Figure A.17 Control Rod Pattern and Axial Distributions at []

Figure A.18 Control Rod Pattern and Axial Distributions at []

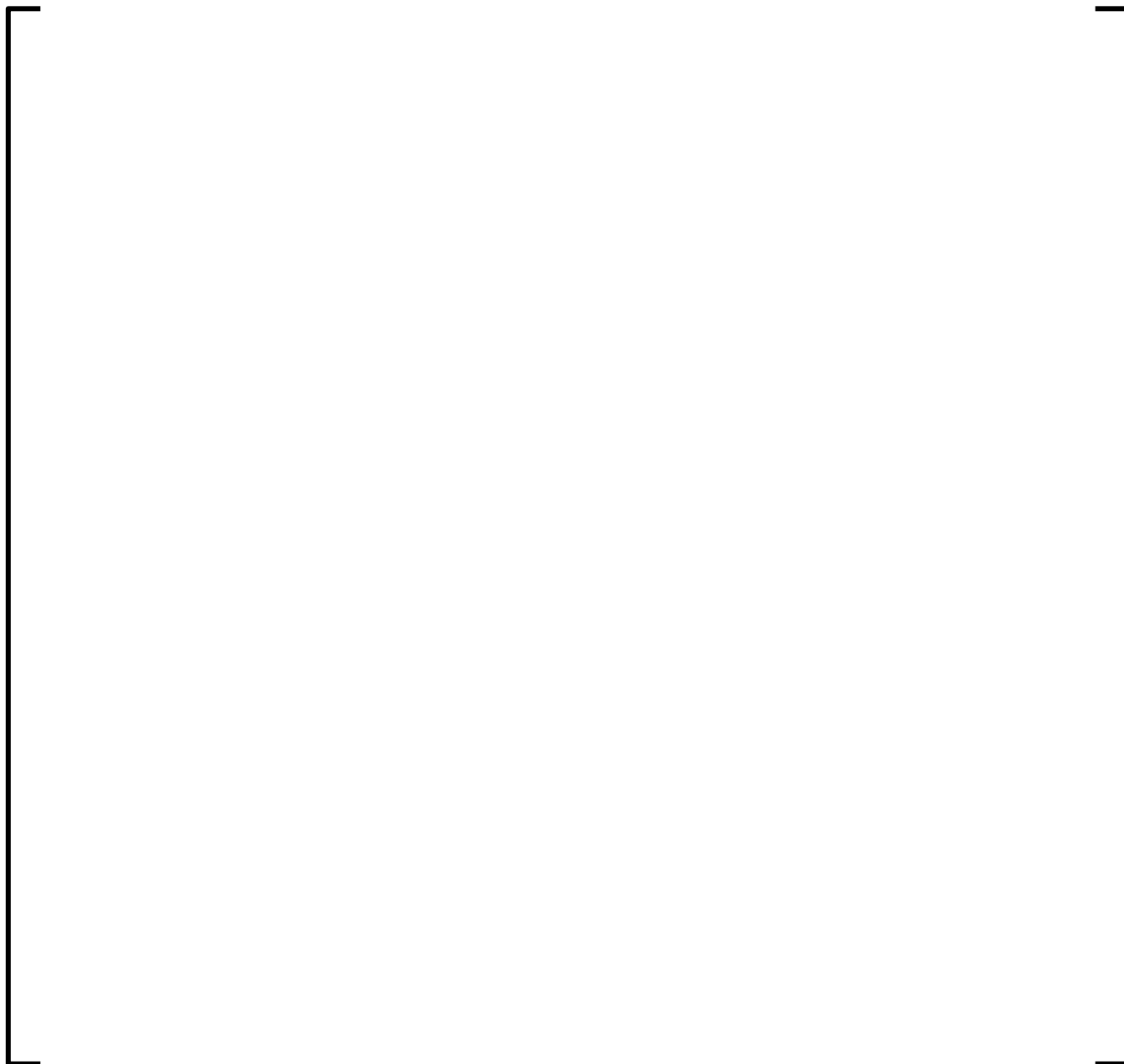


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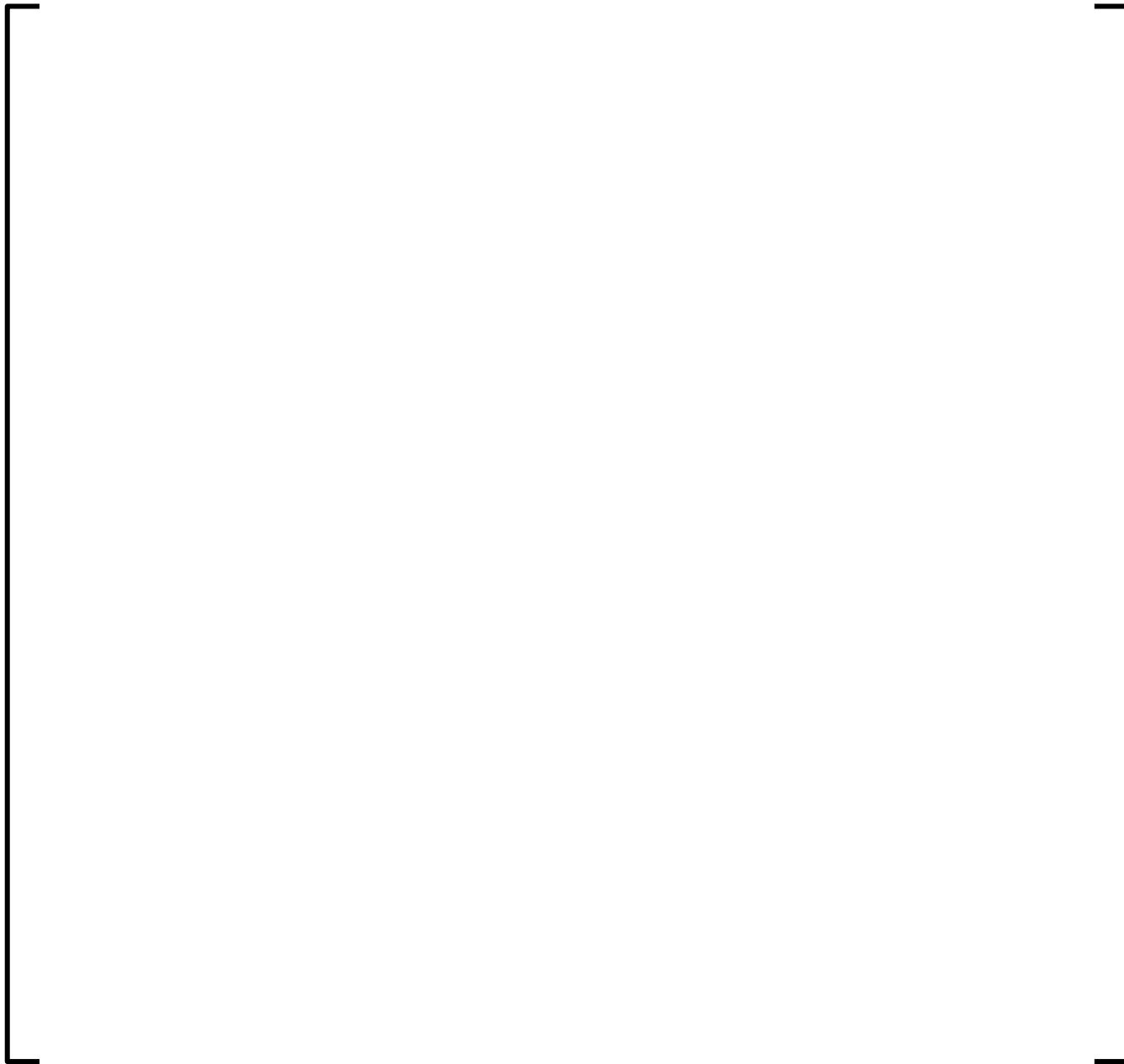


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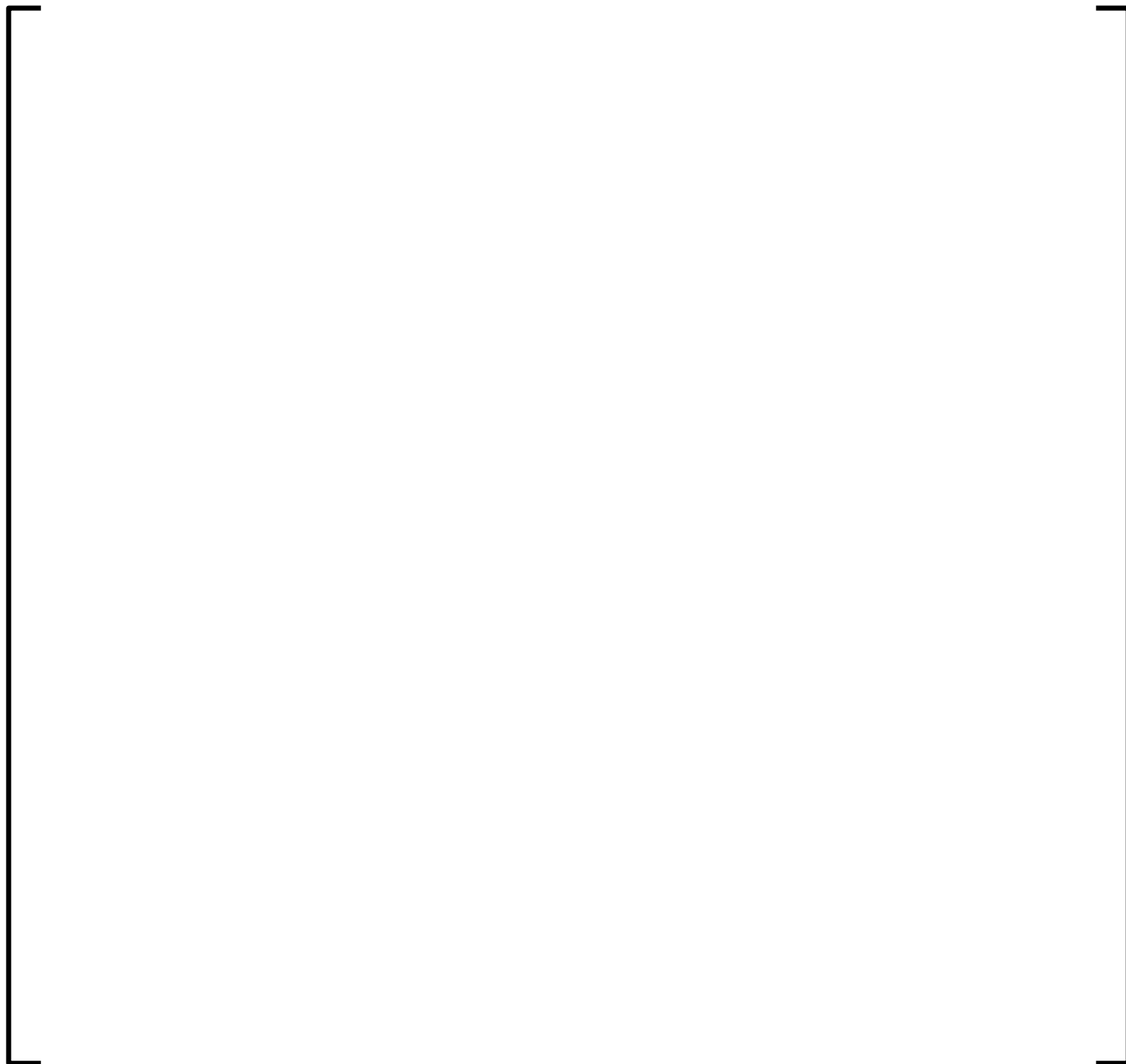


Figure A.21 Control Rod Pattern and Axial Distributions at []



Figure A.22 Control Rod Pattern and Axial Distributions at []



Figure A.23 Control Rod Pattern and Axial Distributions at []

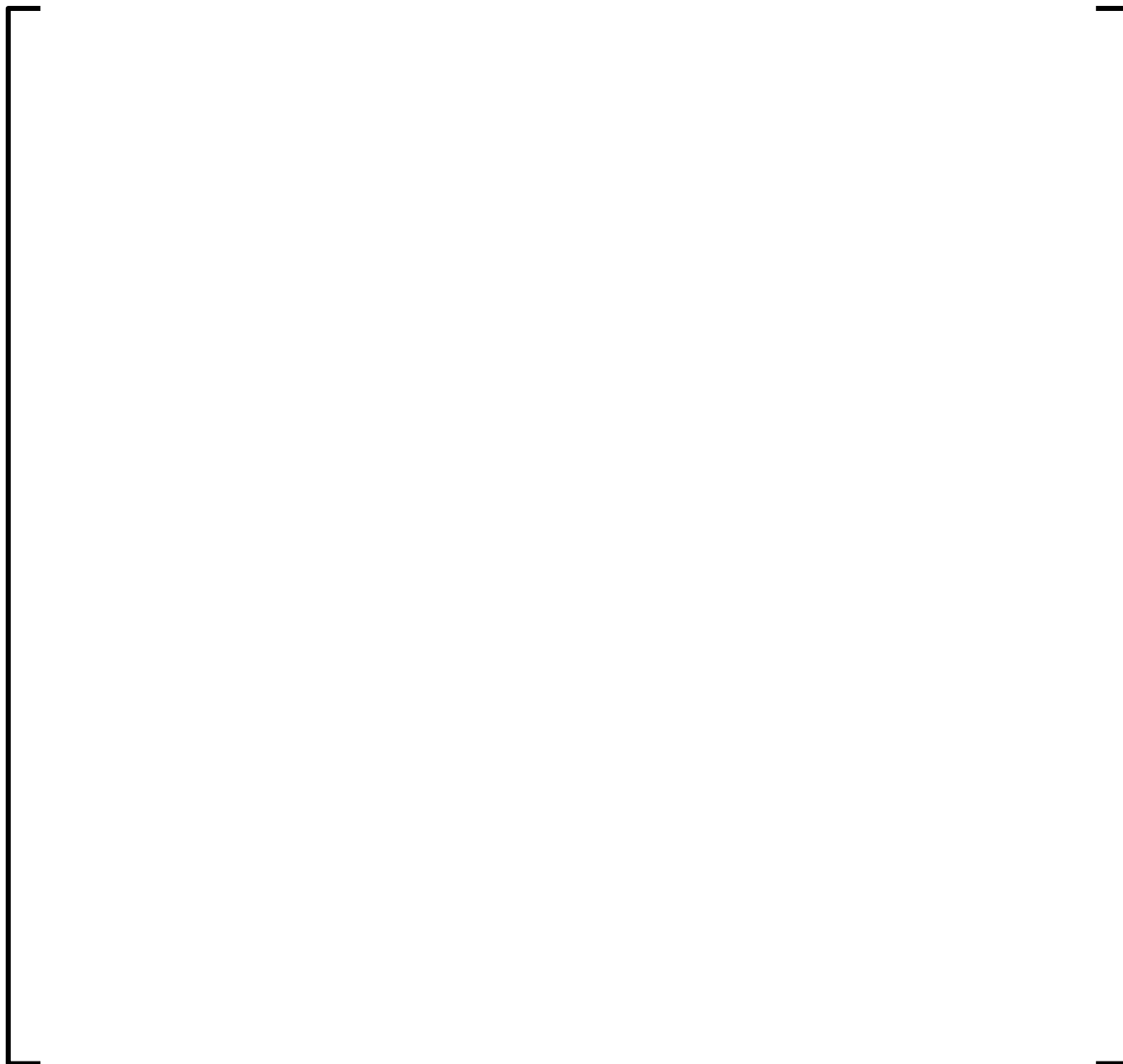


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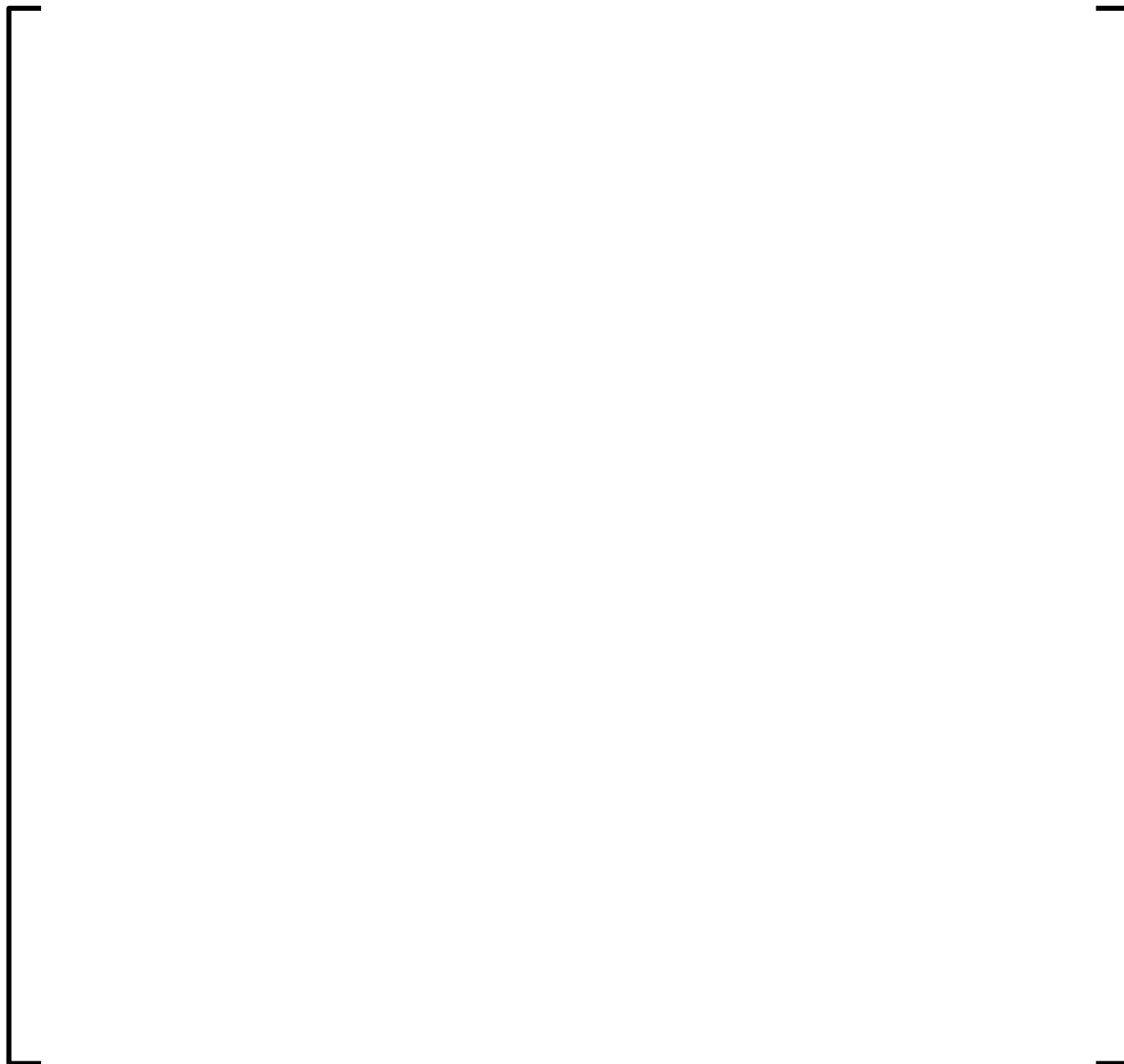


Figure A.25 Control Rod Pattern and Axial Distributions at []

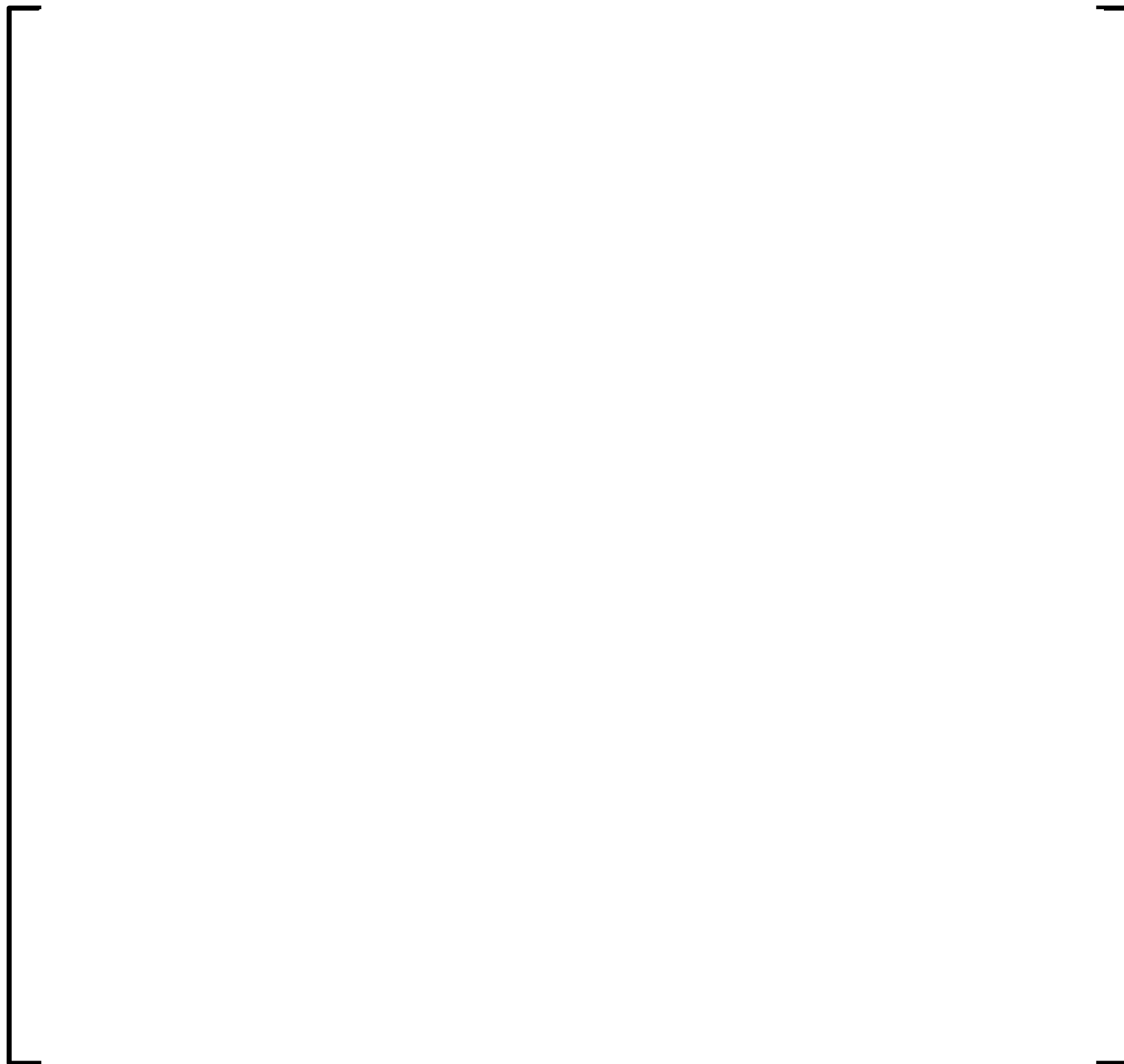


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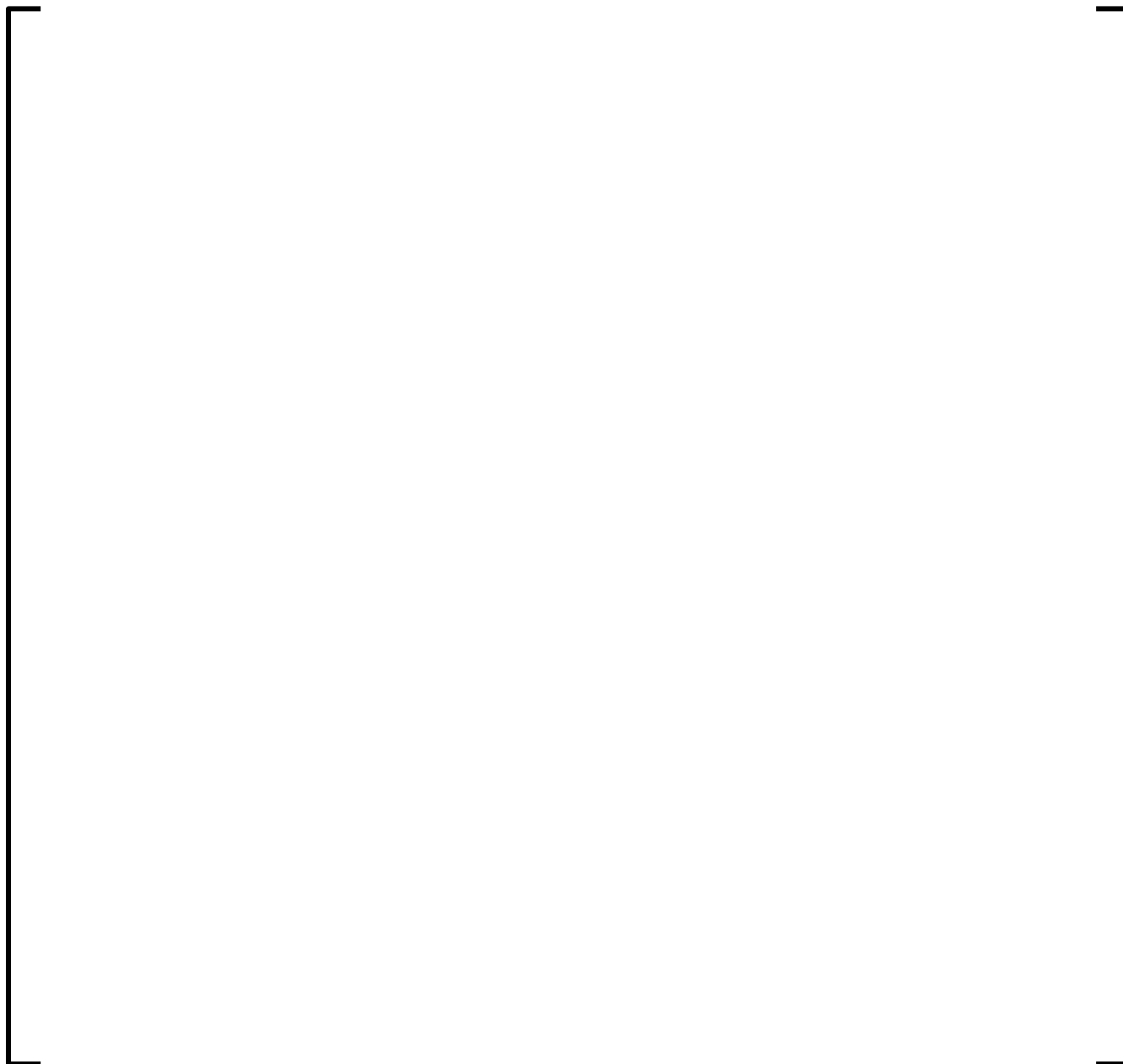


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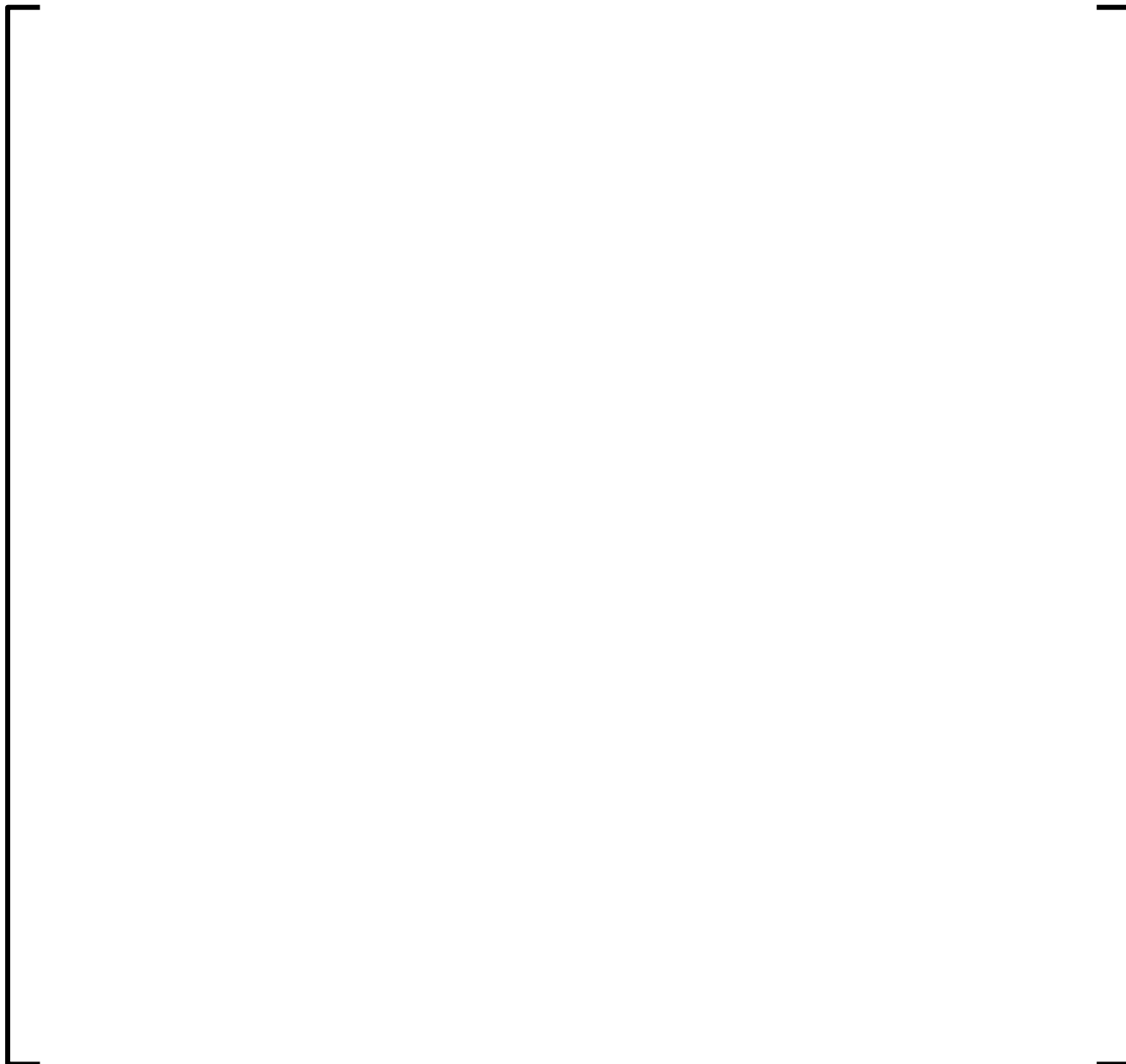


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Figure A.29 Control Rod Pattern and Axial Distributions at []



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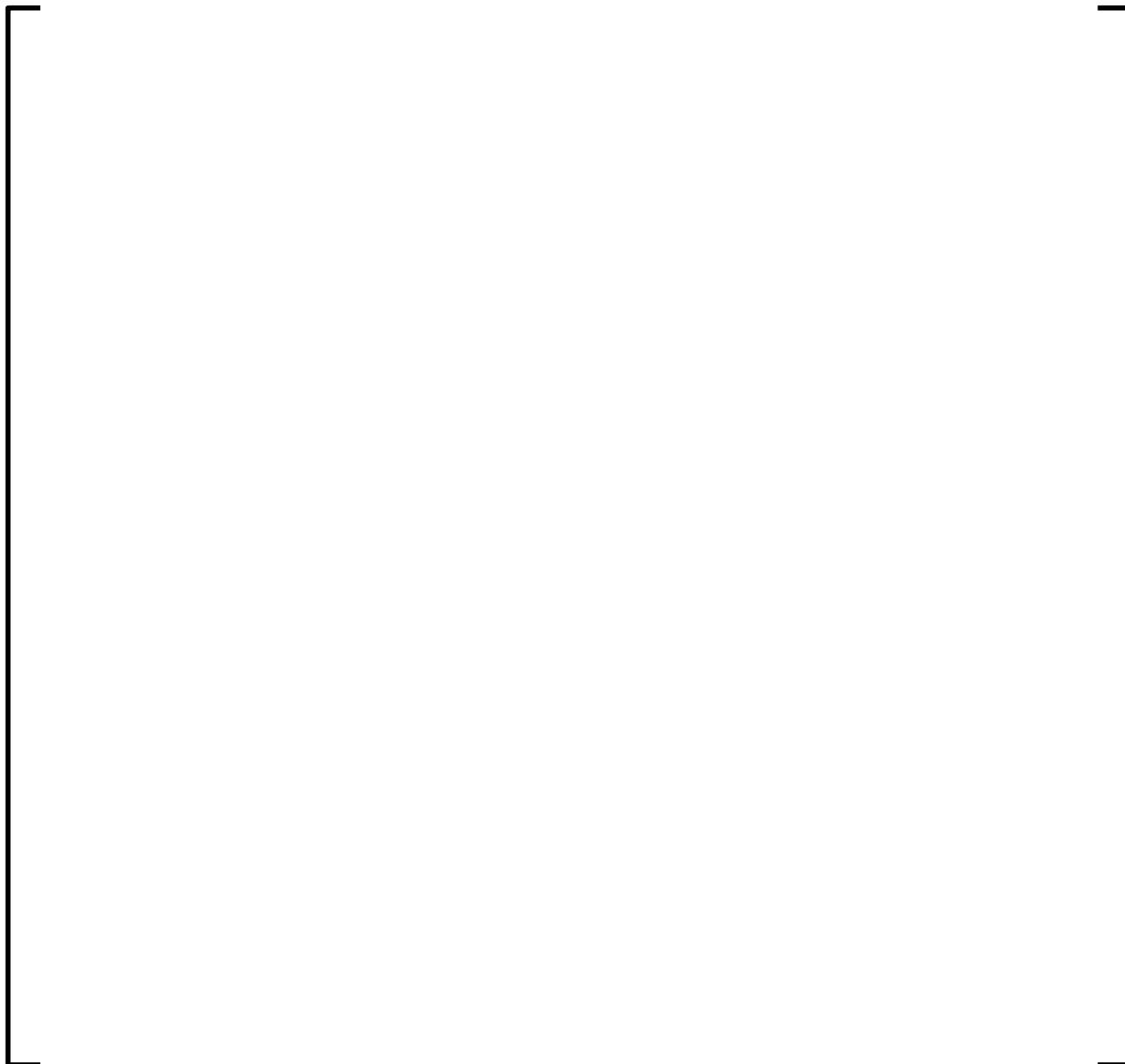


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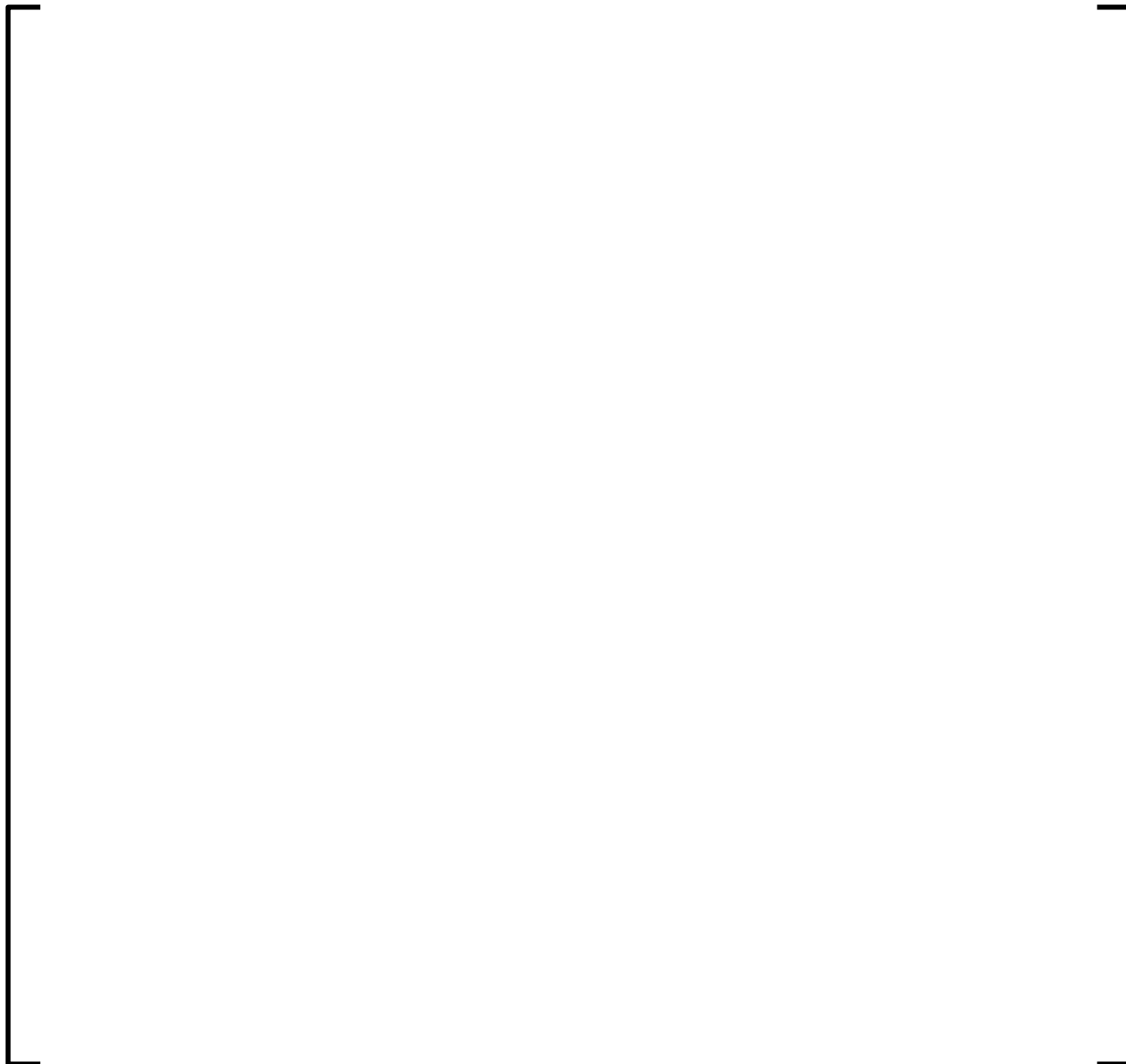


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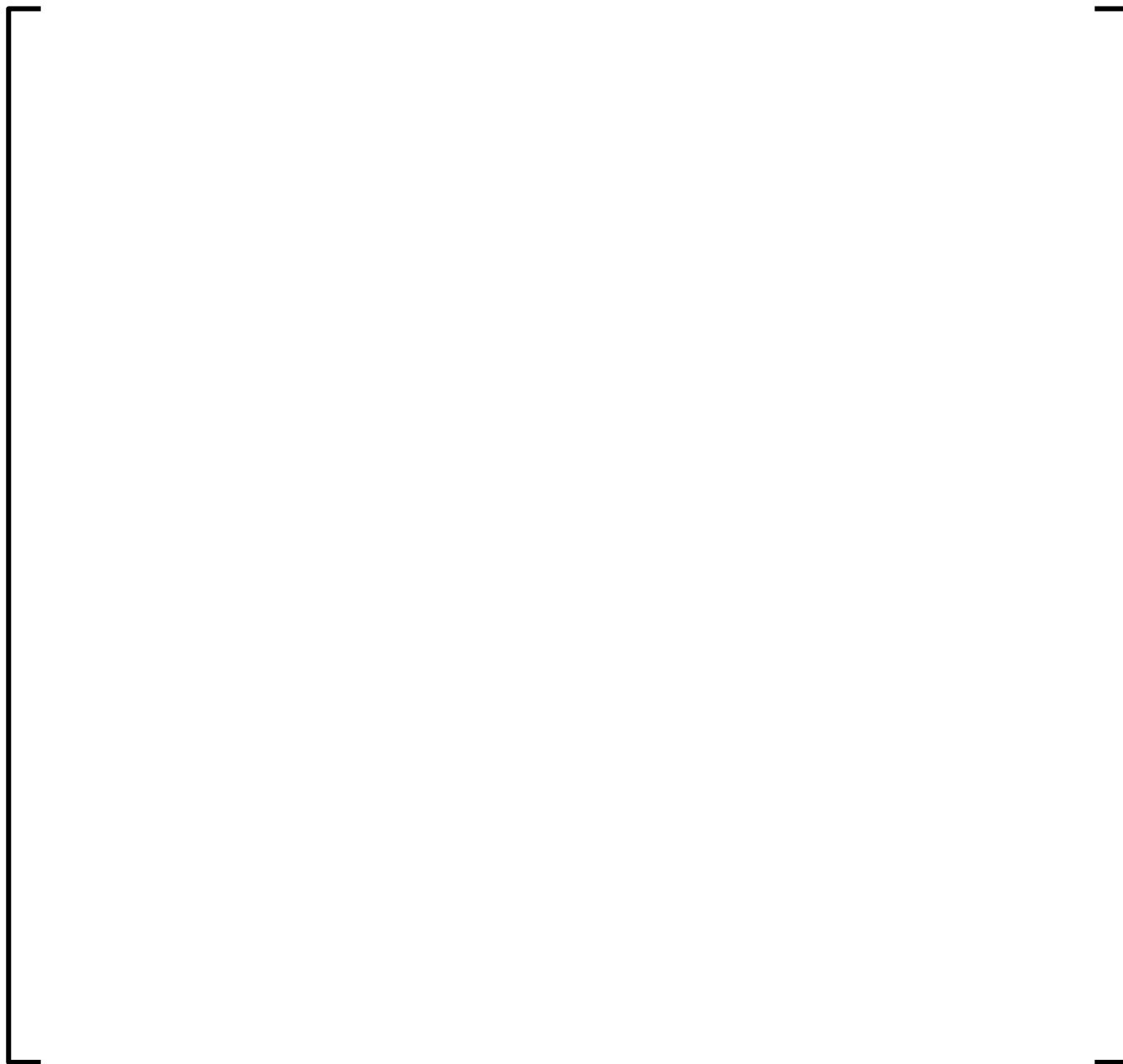


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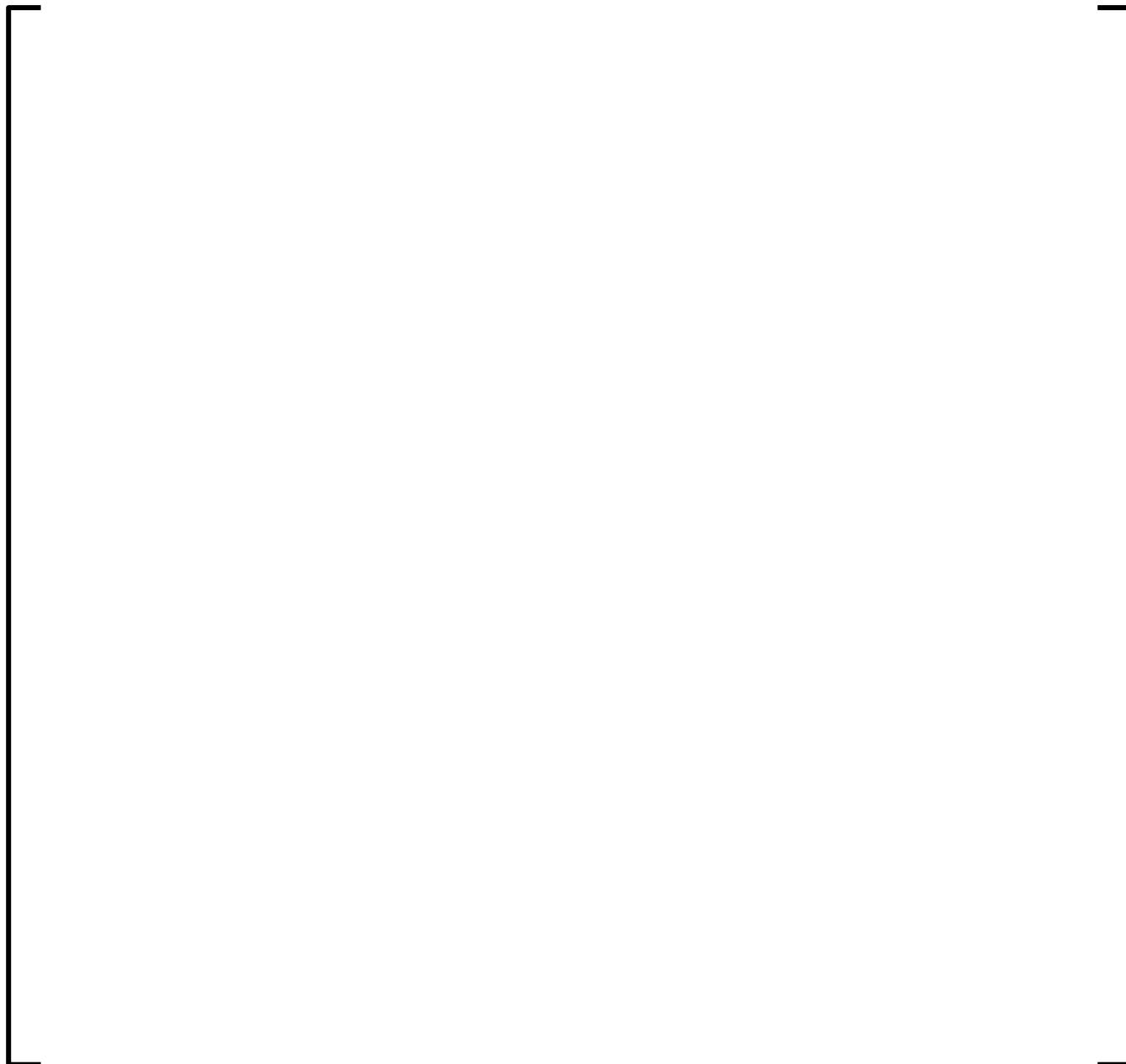


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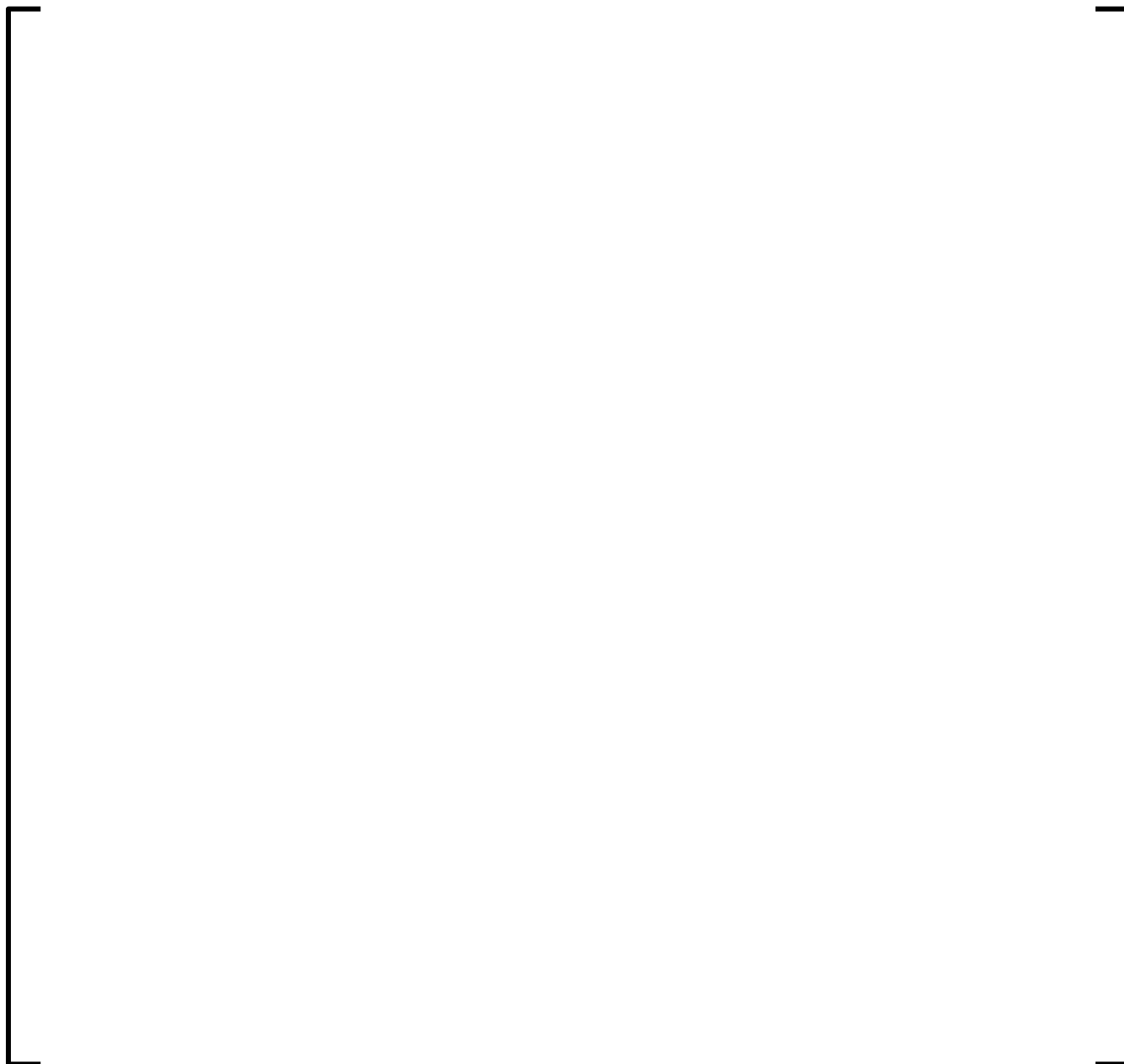


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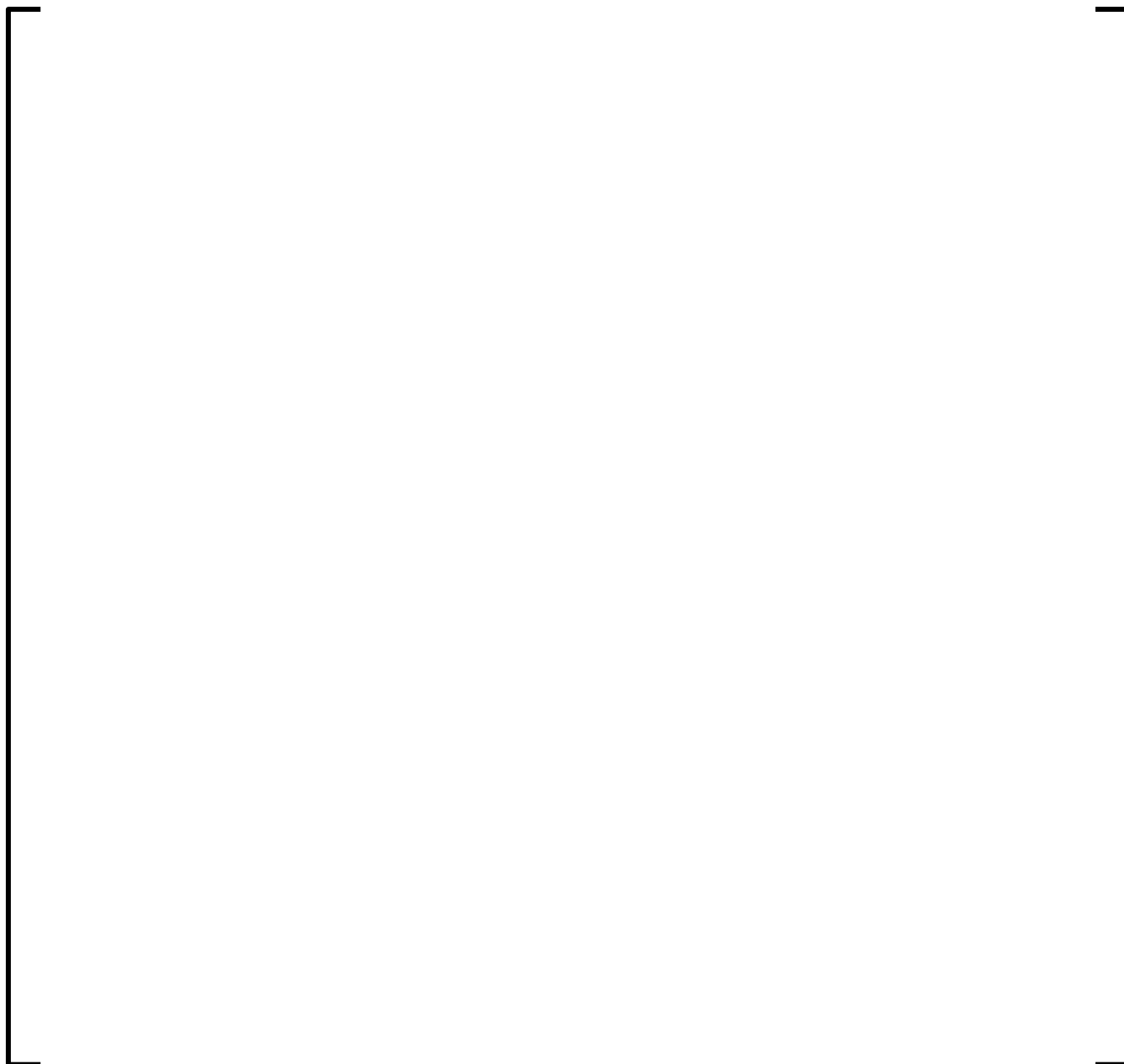


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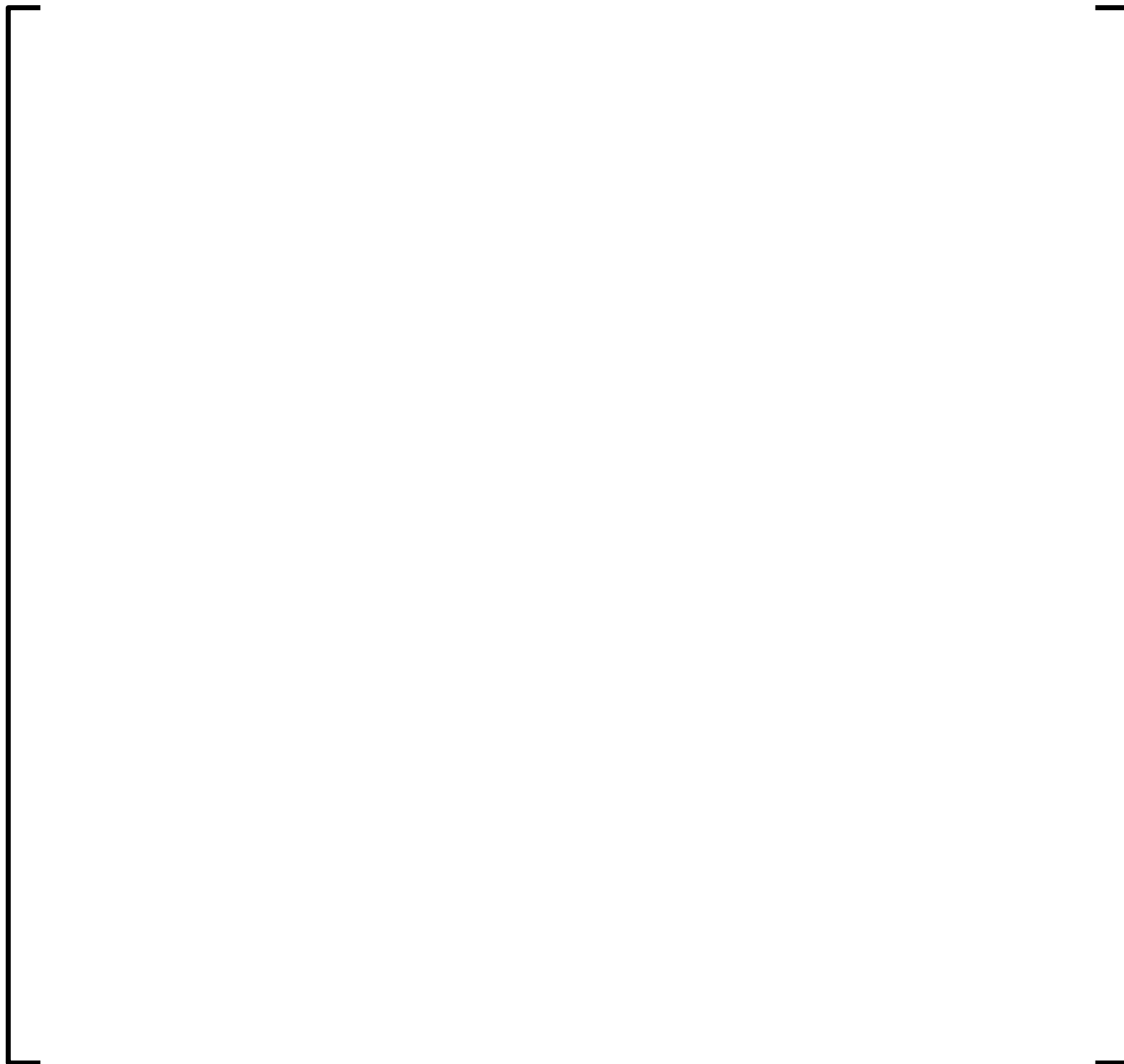


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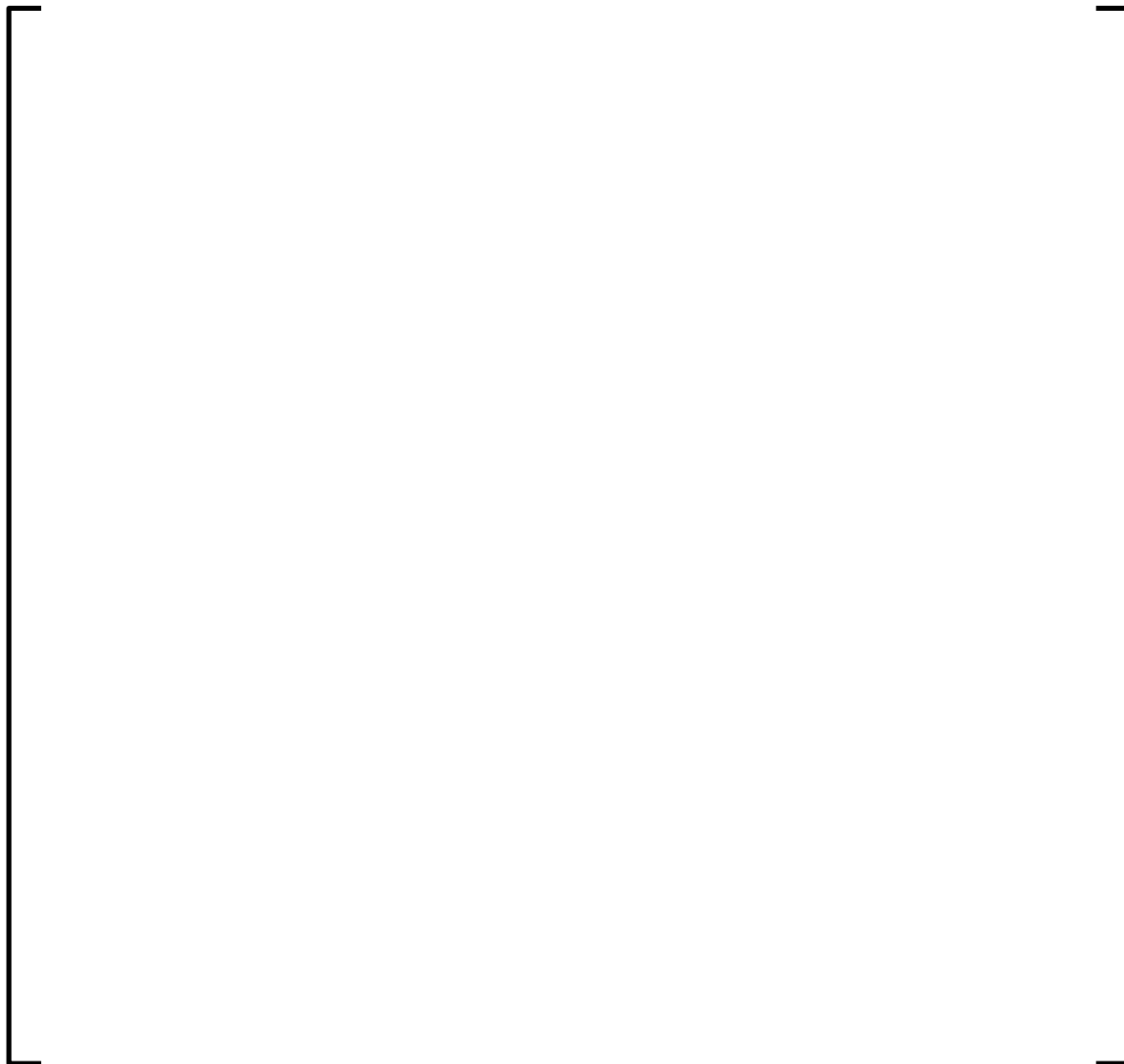


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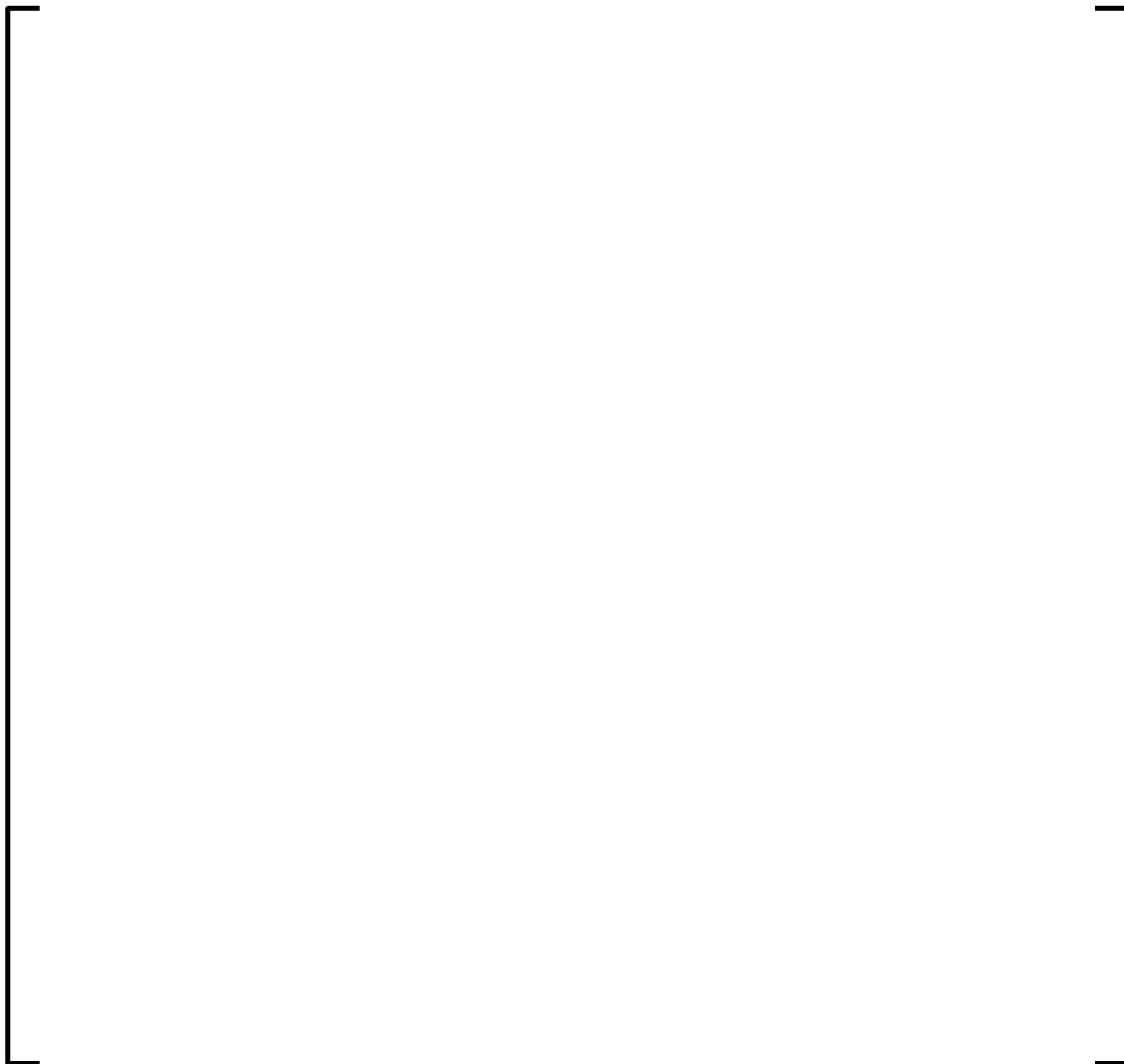


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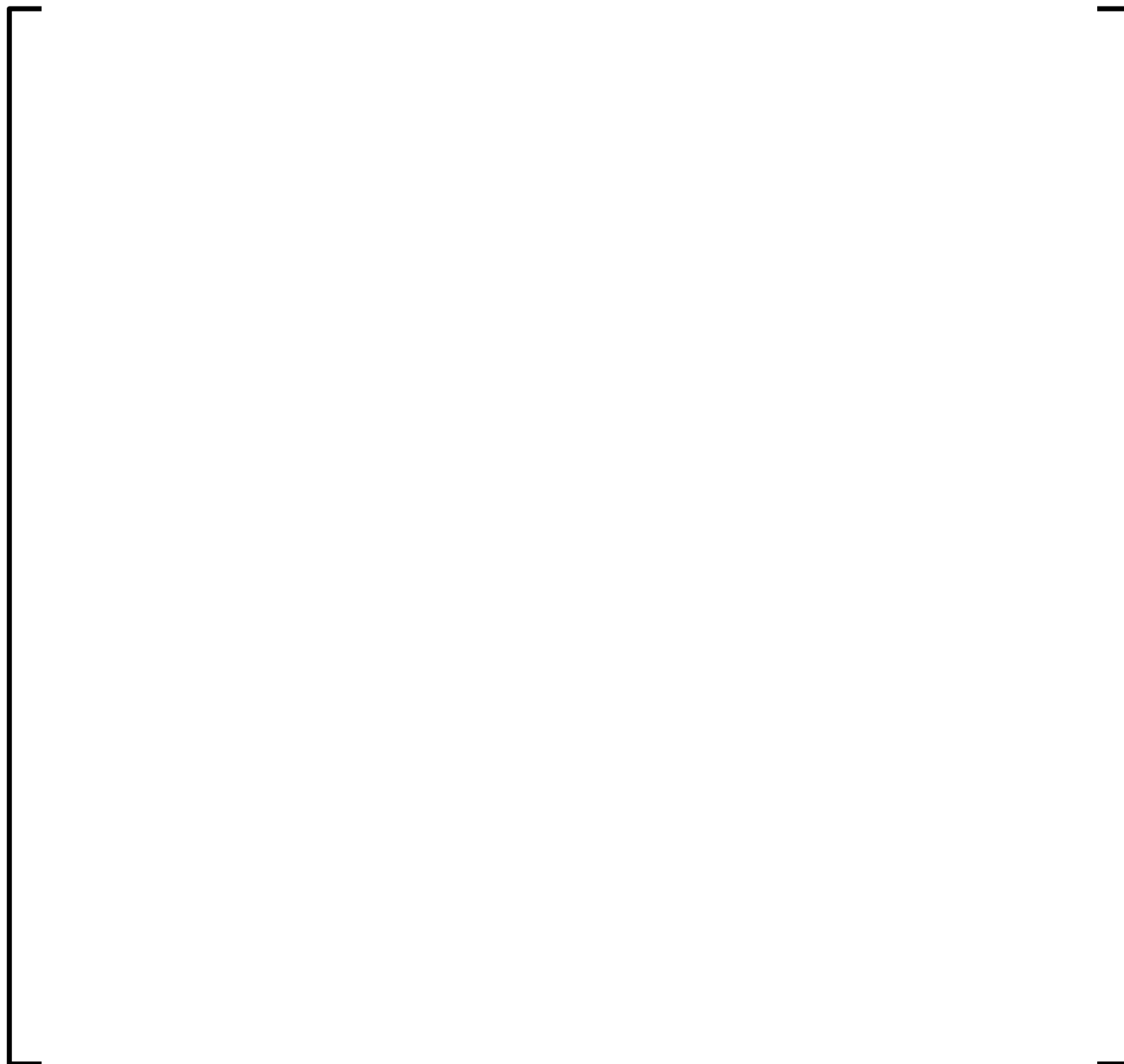


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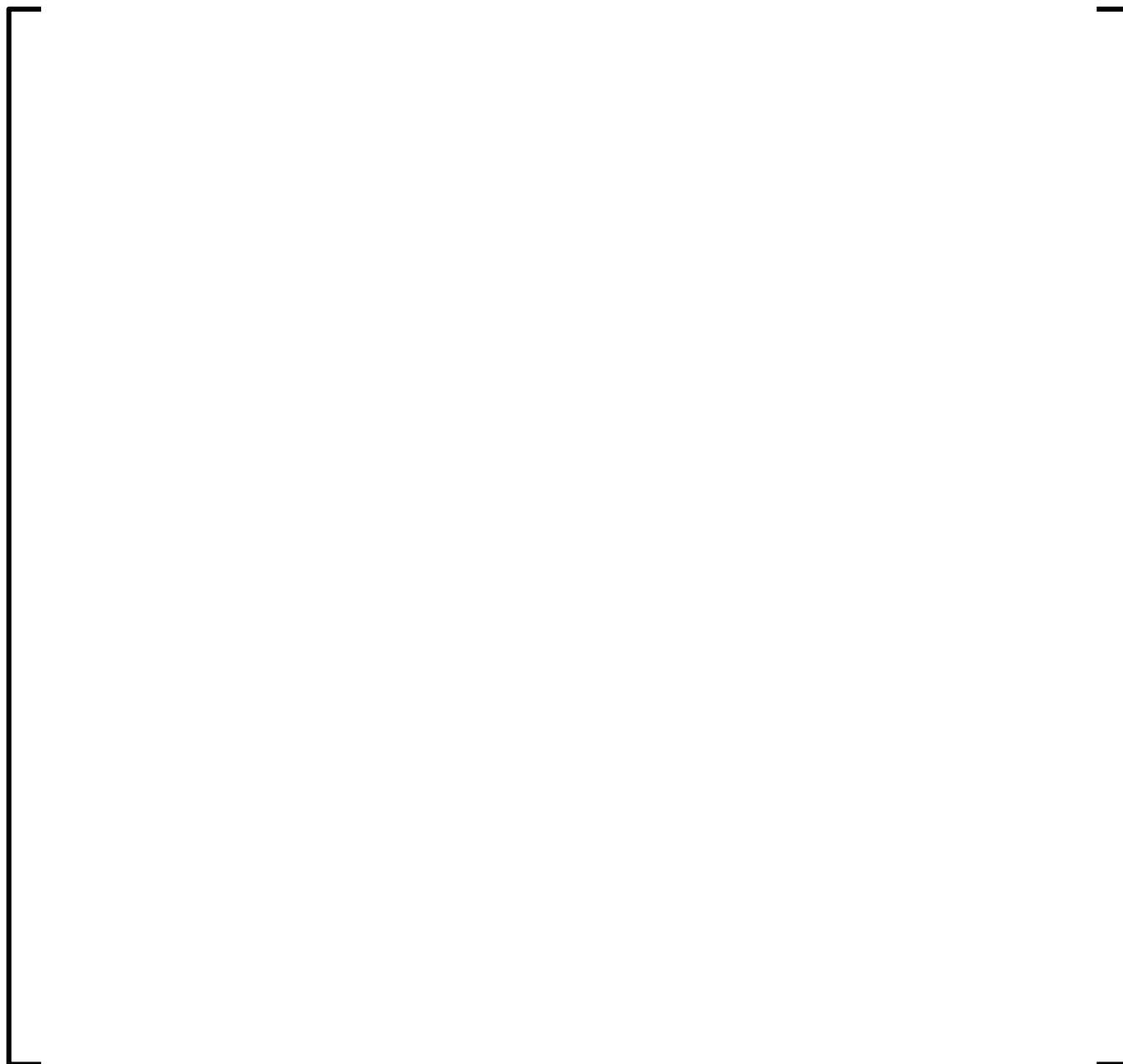


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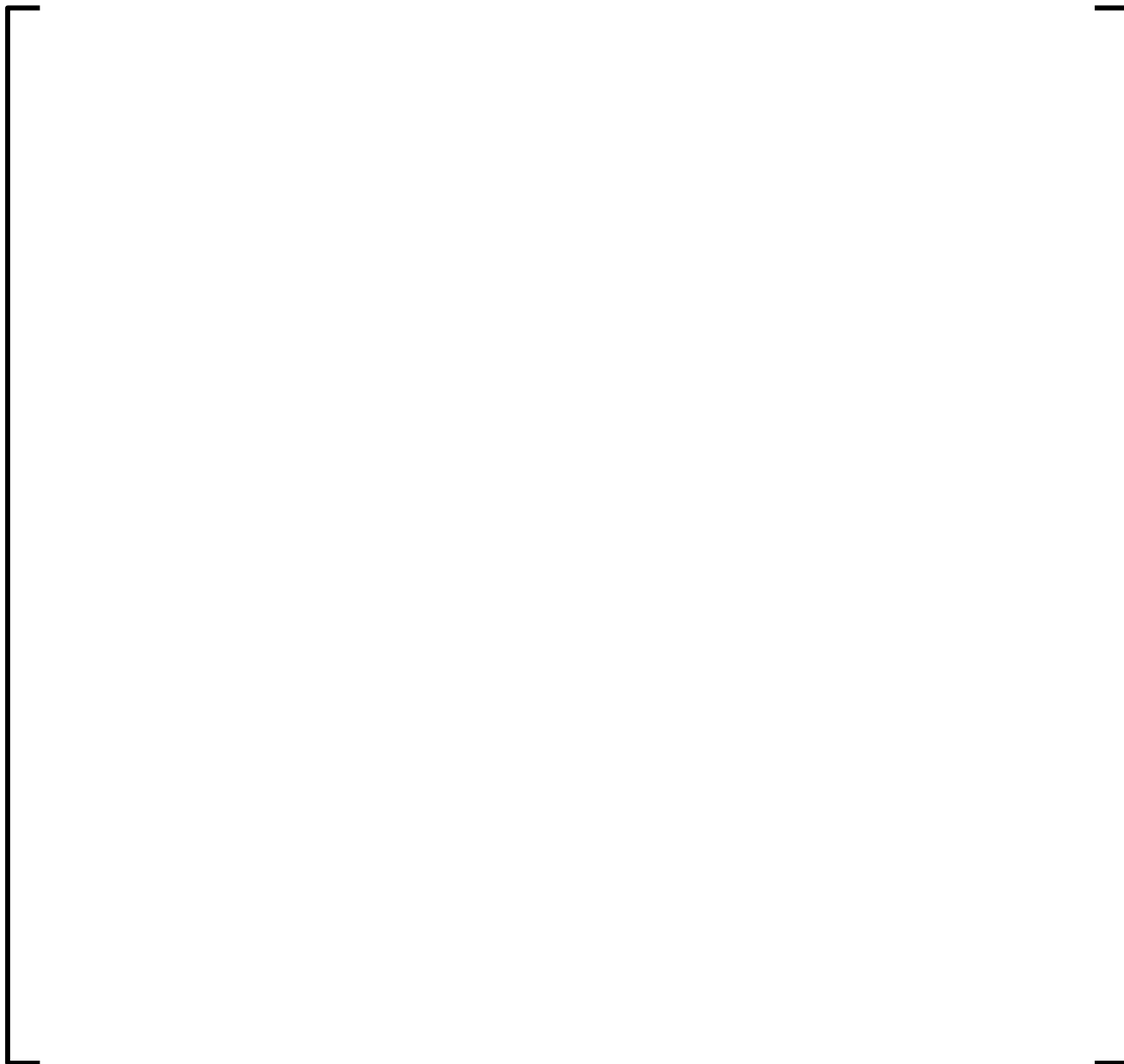


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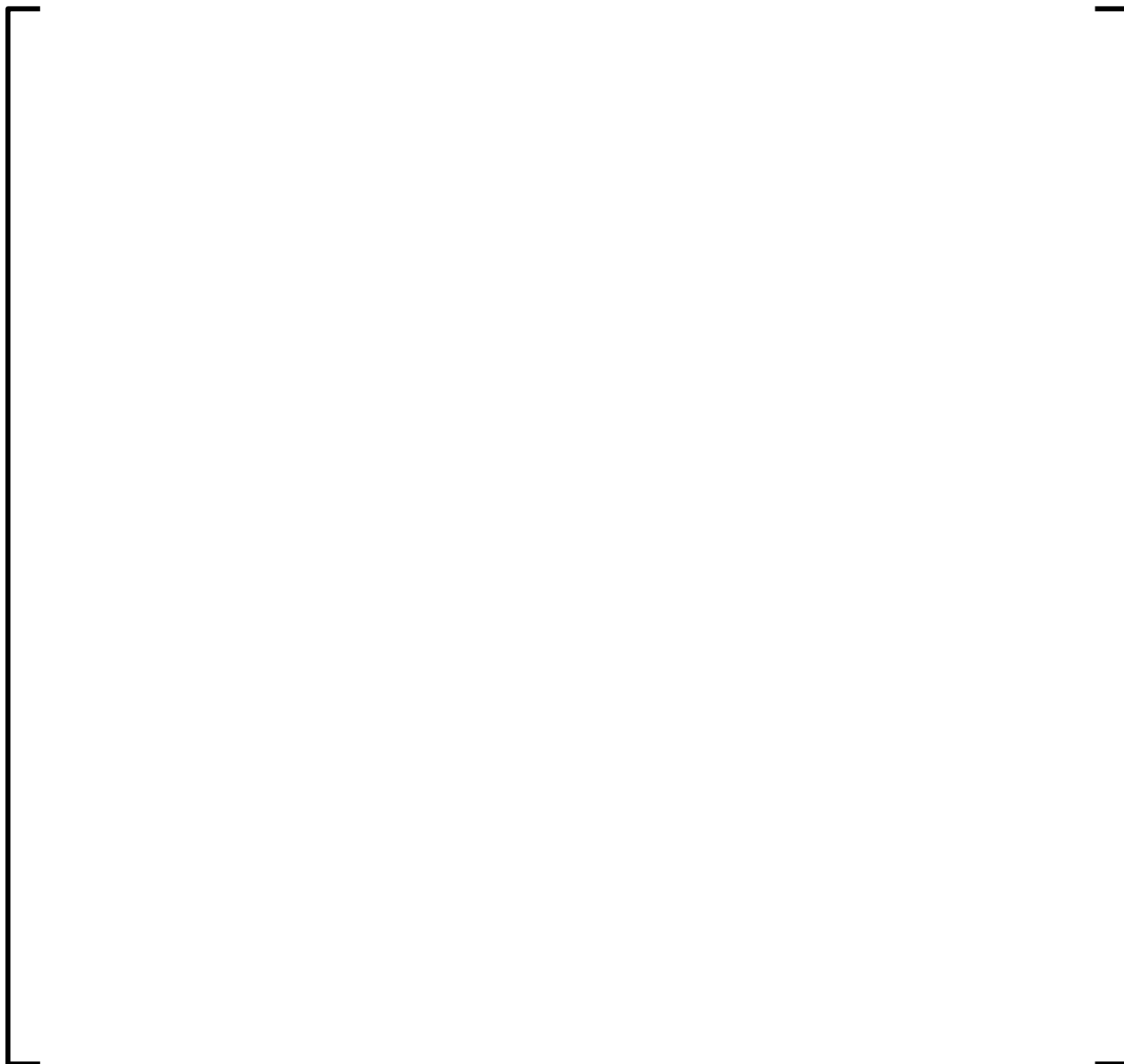


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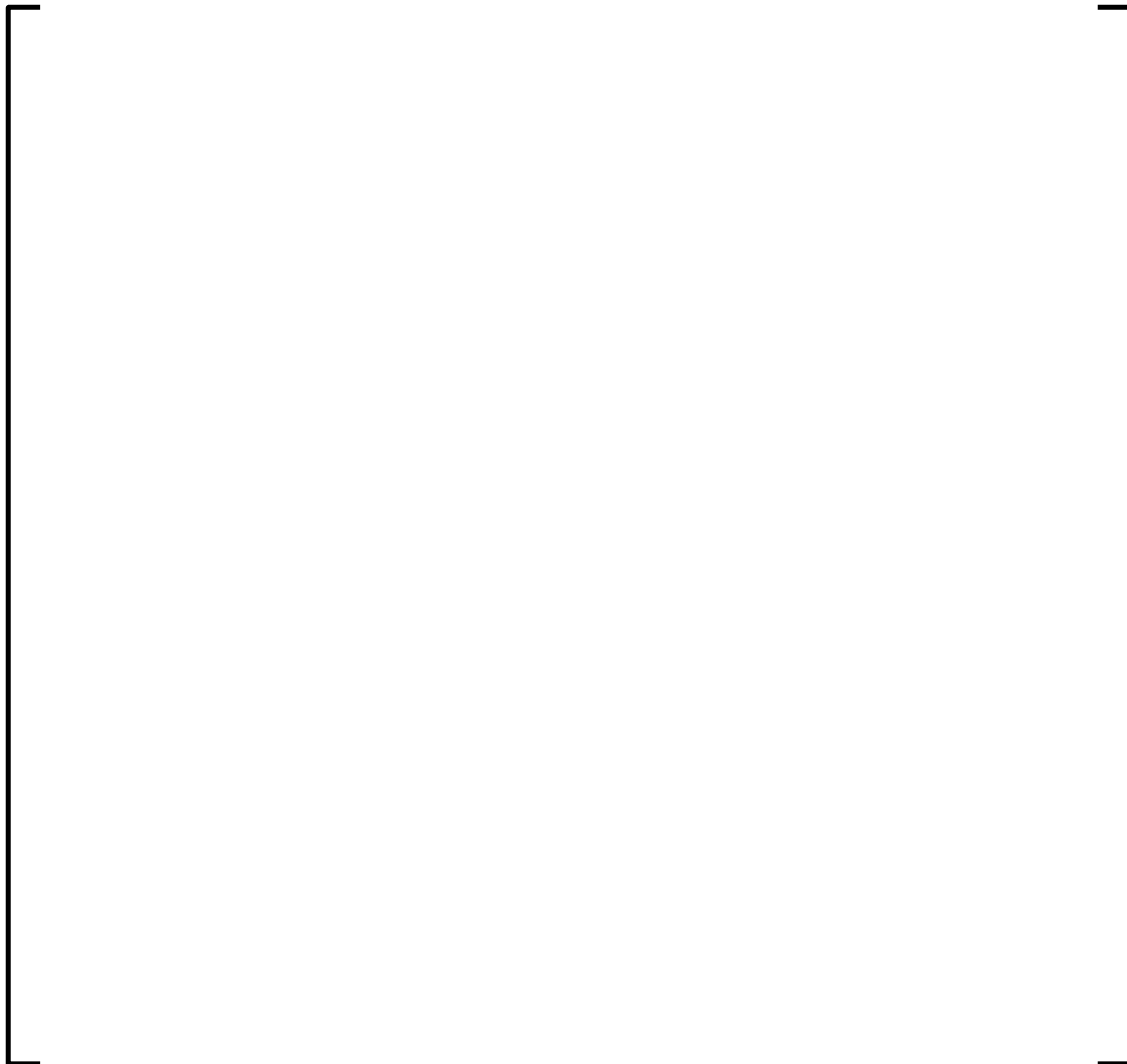


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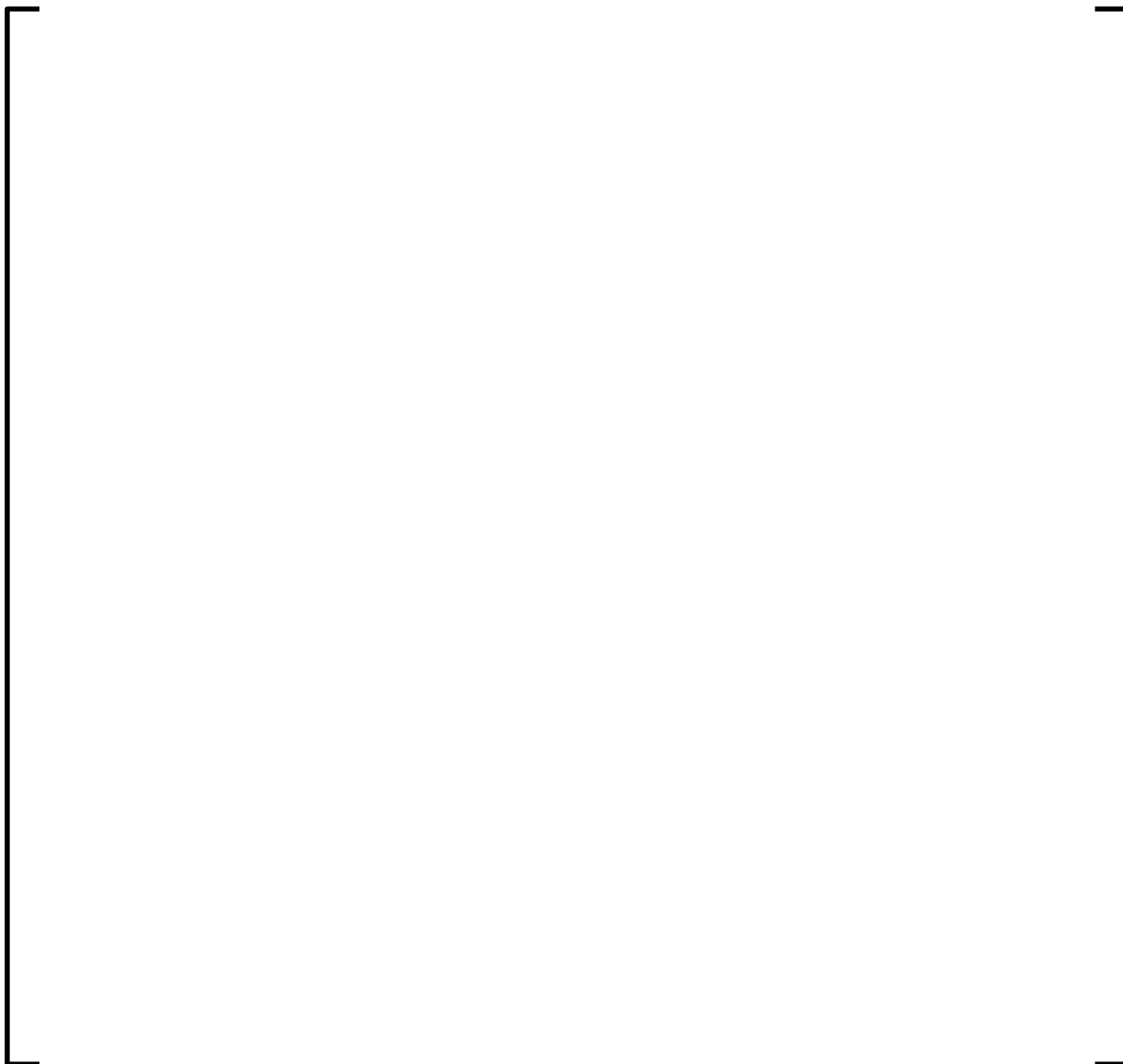


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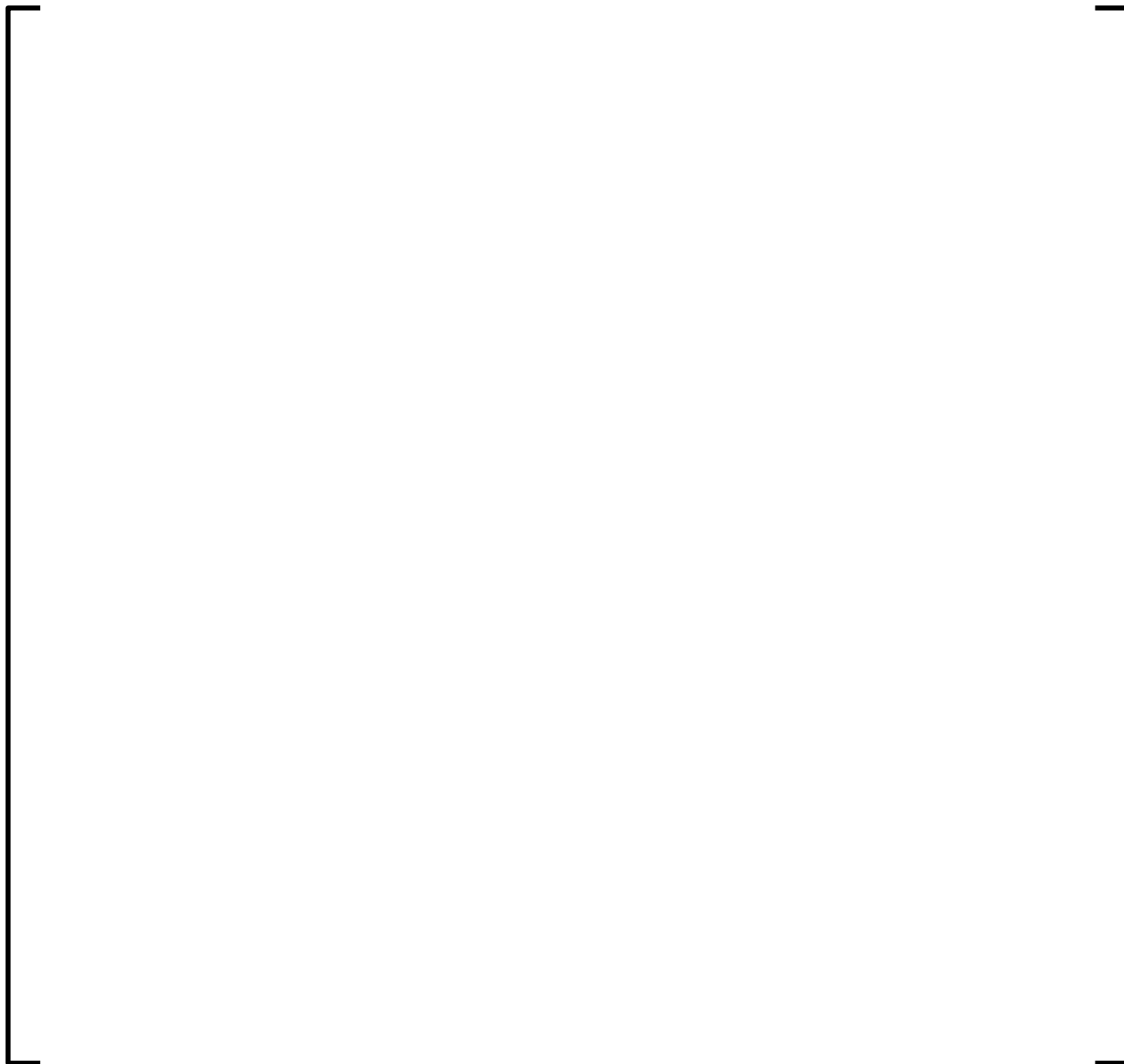


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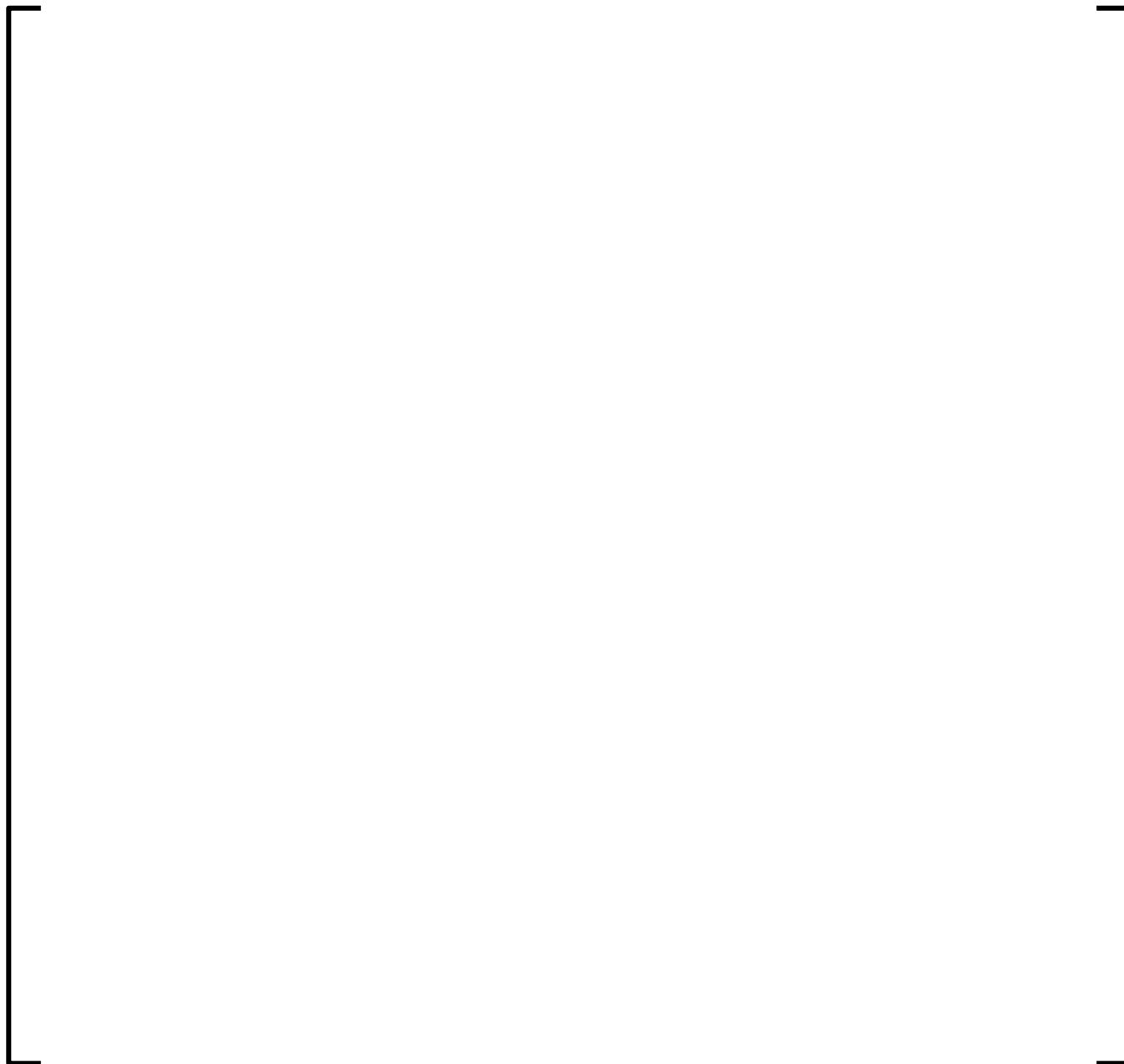


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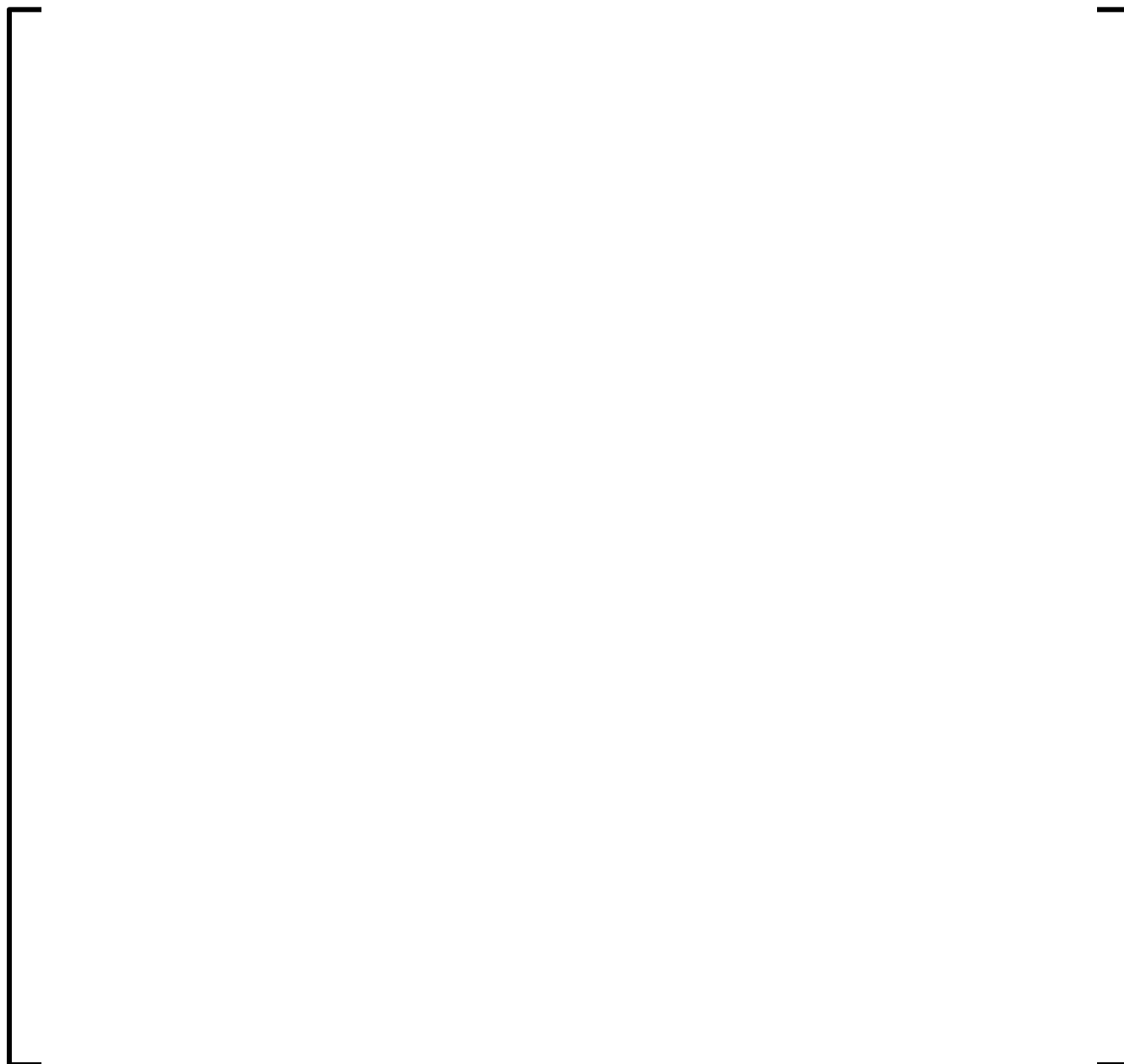


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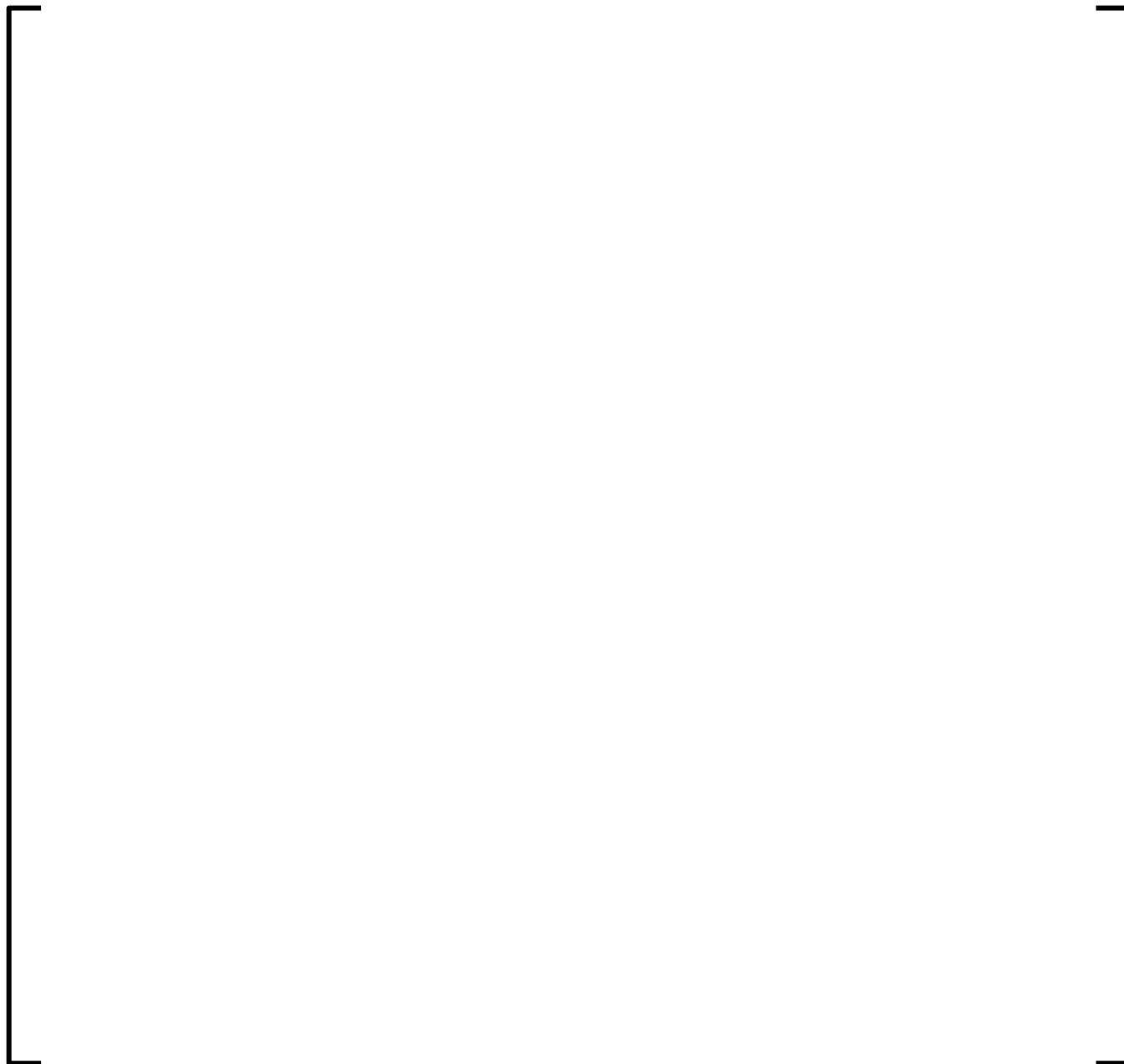


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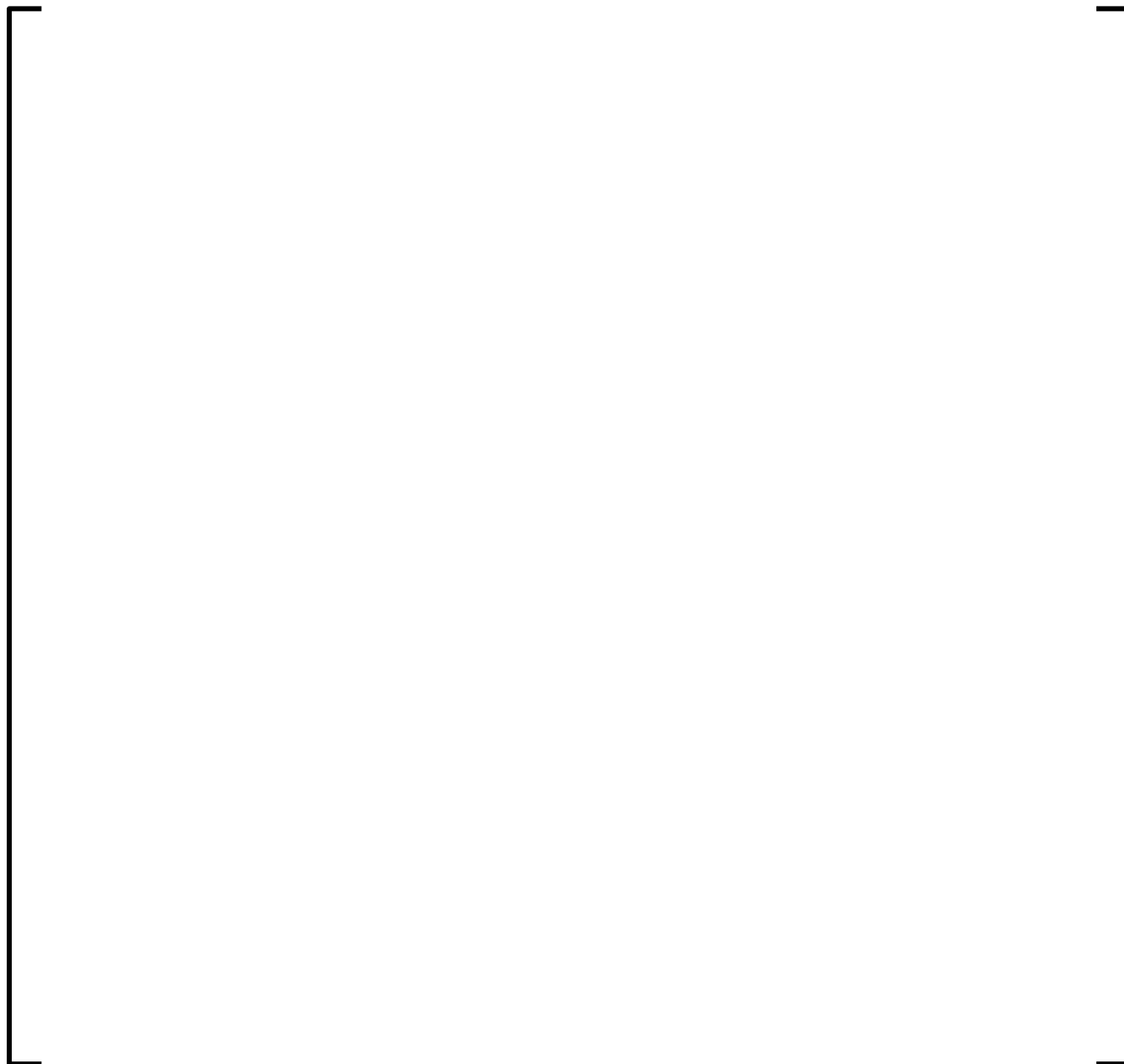


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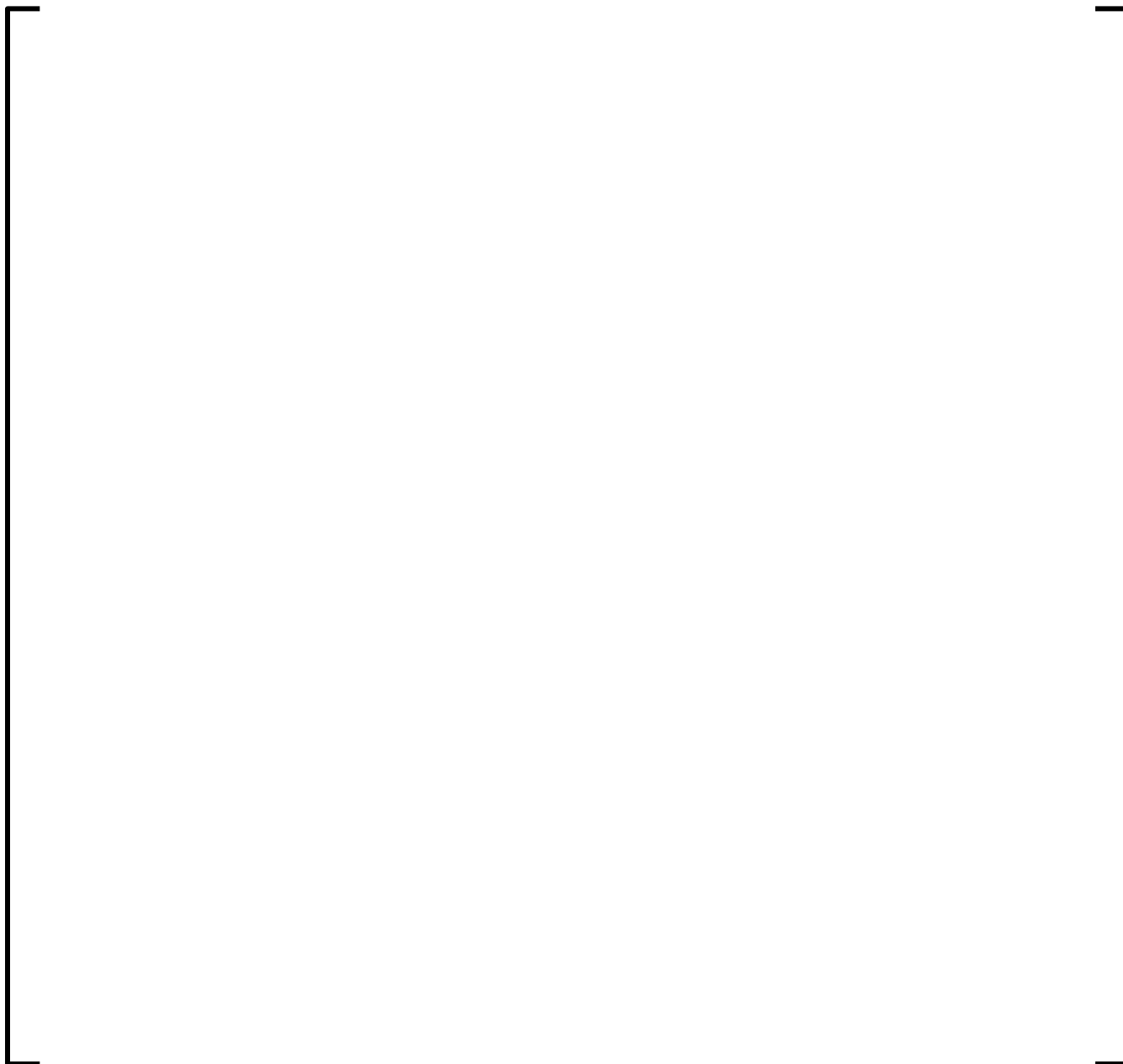


Figure A.58 Control Rod Pattern and Axial Distributions at []

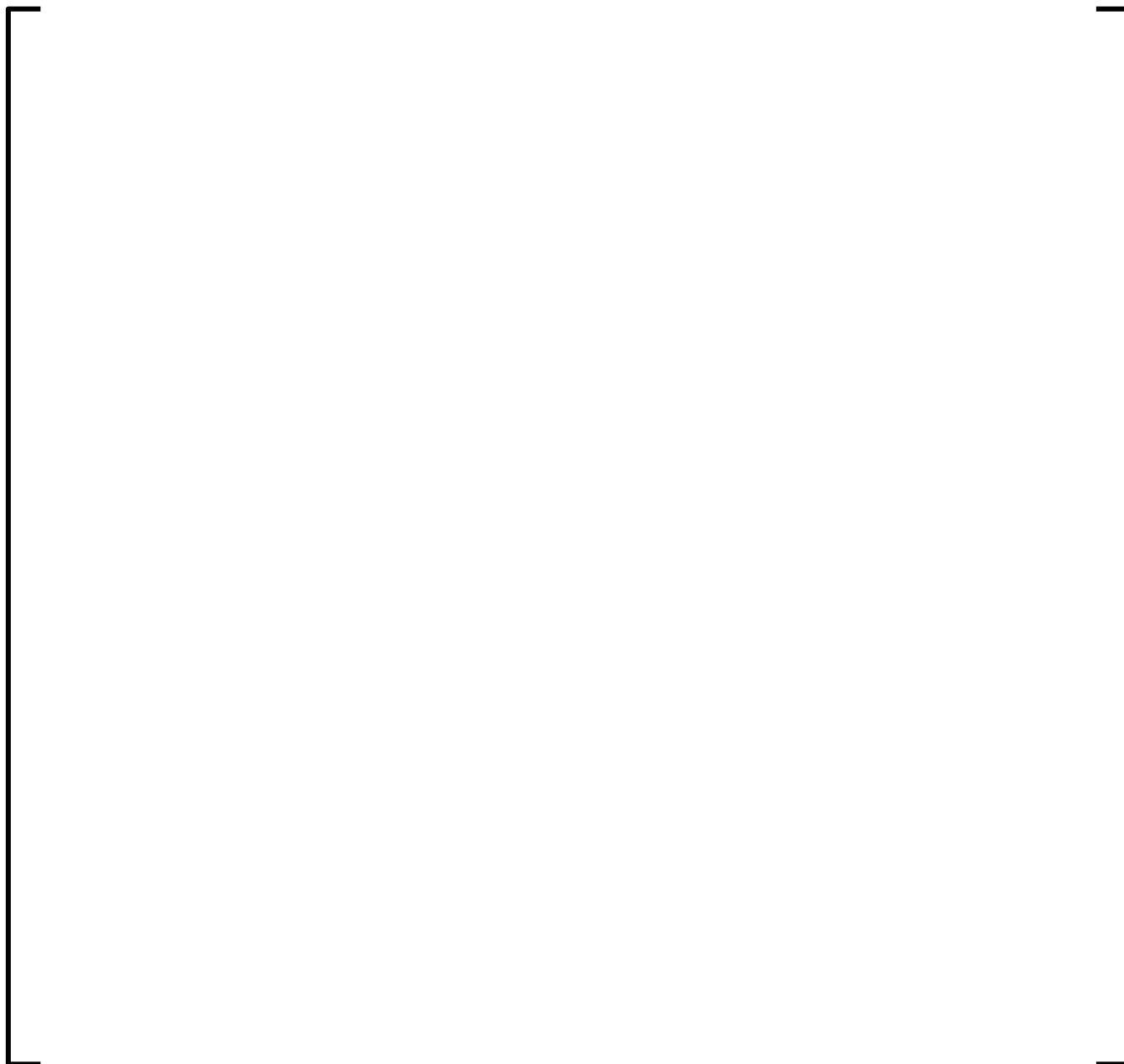


Figure A.59 Control Rod Pattern and Axial Distributions at []

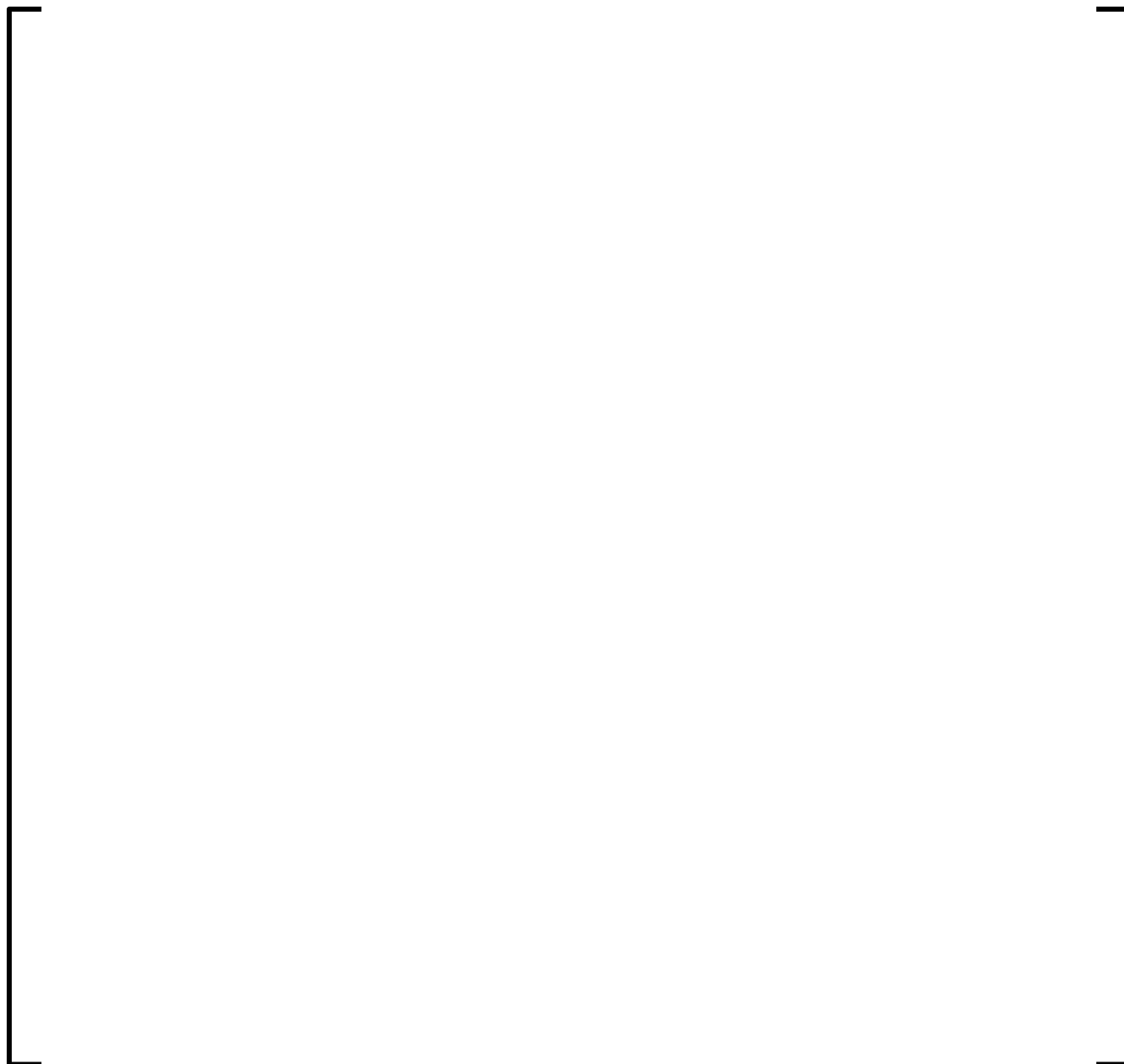


Figure A.60 Control Rod Pattern and Axial Distributions at []

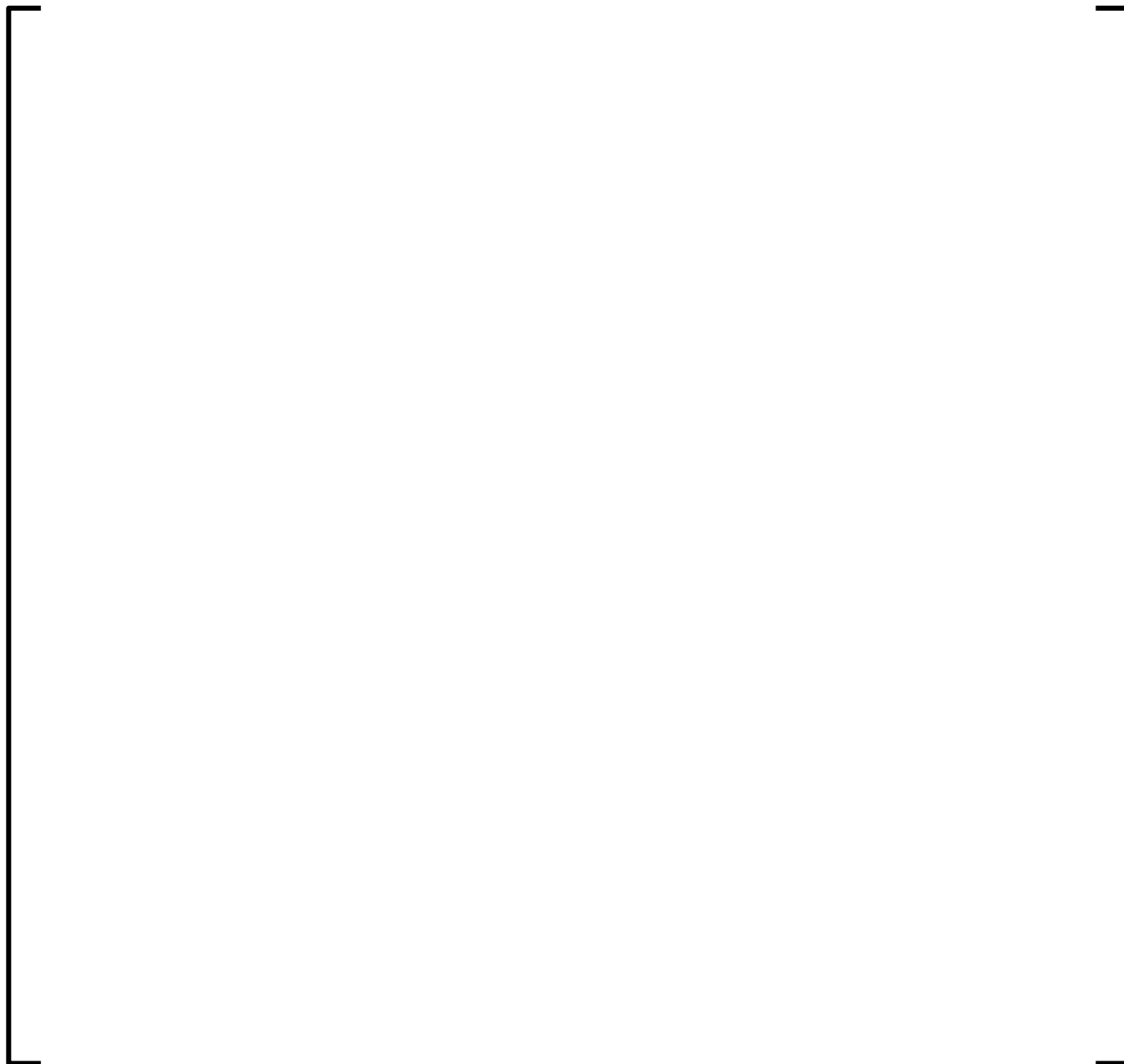


Figure A.61 Control Rod Pattern and Axial Distributions at []

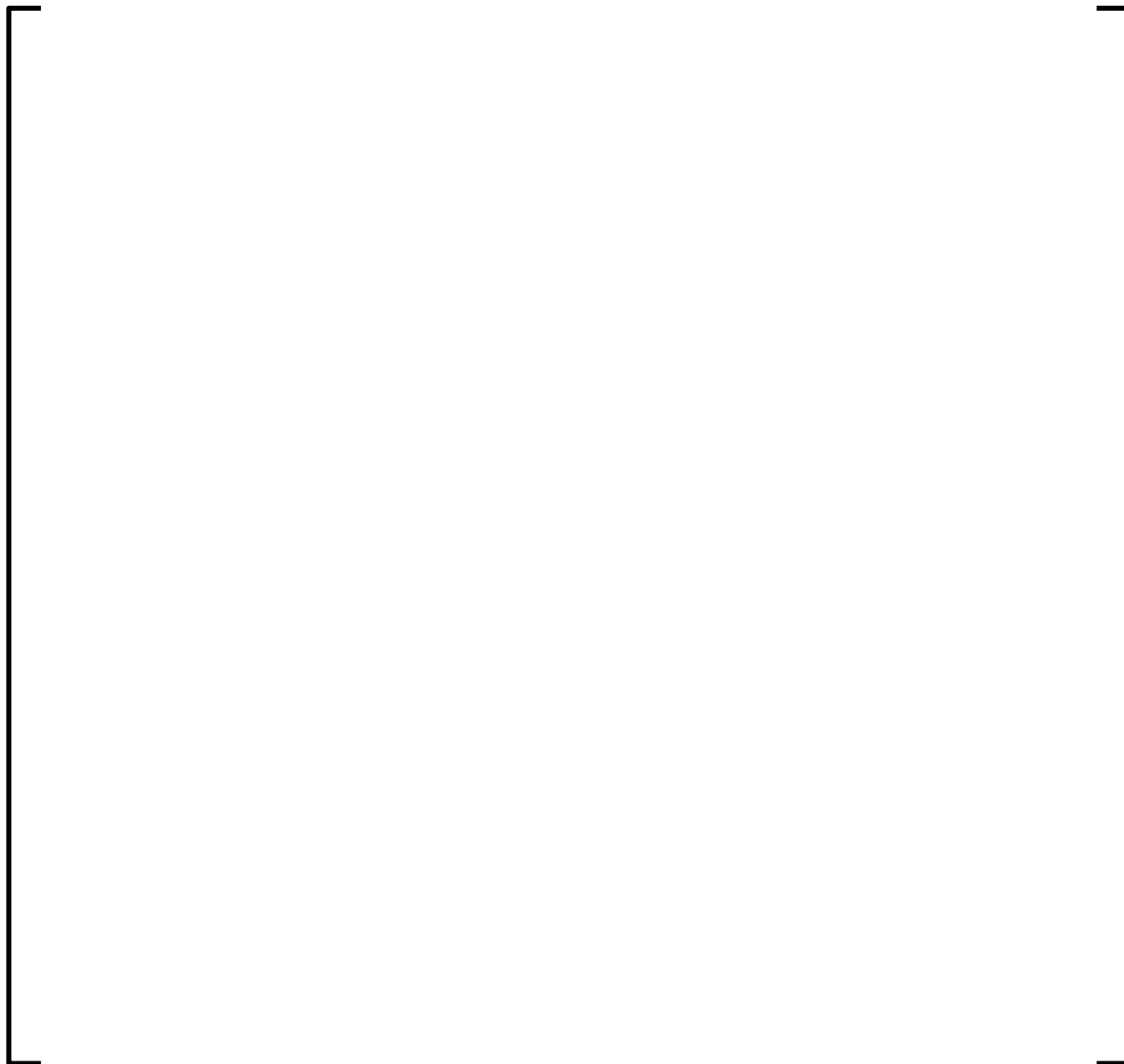


Figure A.62 Control Rod Pattern and Axial Distributions at []

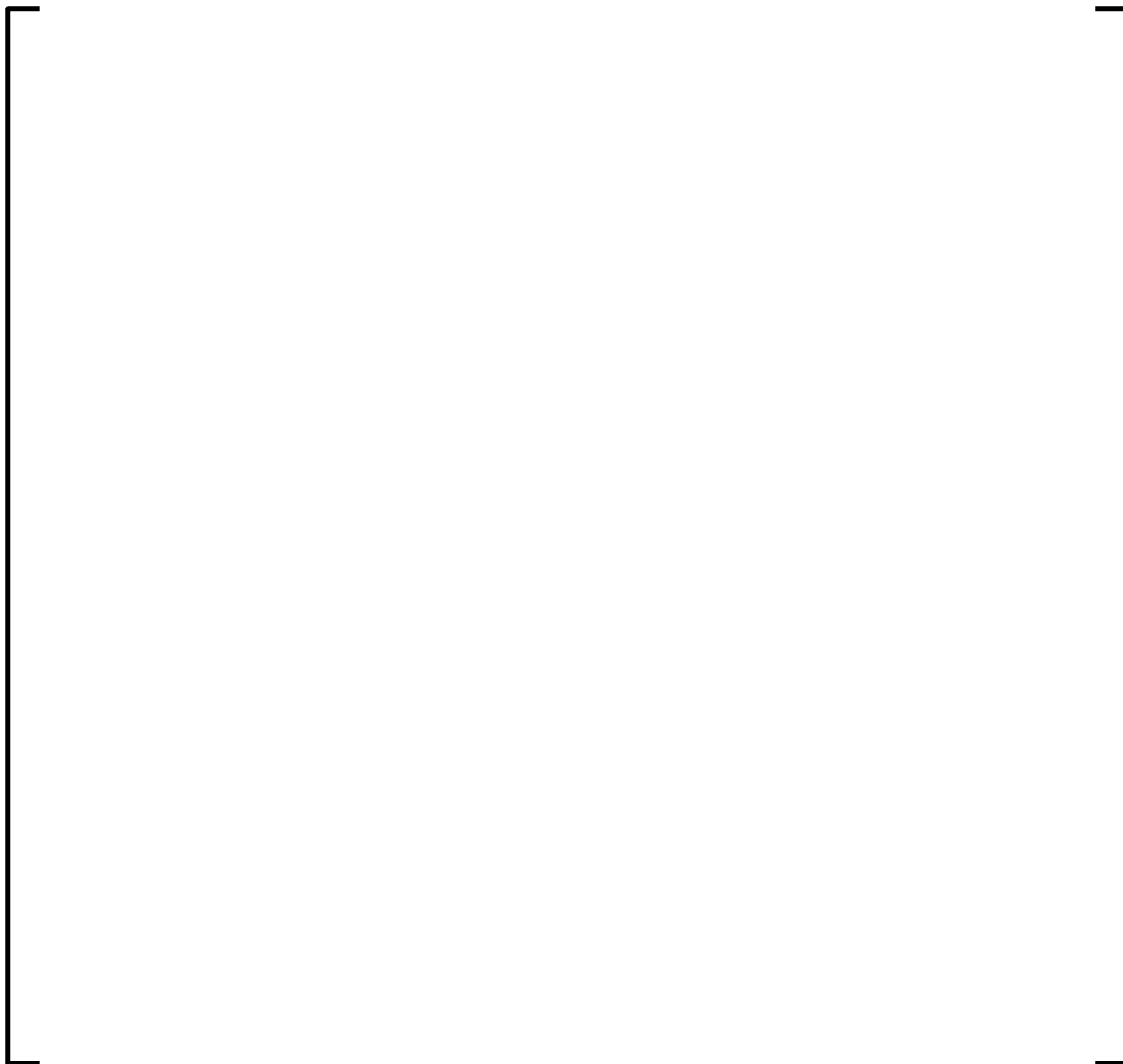


Figure A.63 Control Rod Pattern and Axial Distributions at []



Figure A.64 Control Rod Pattern and Axial Distributions at []

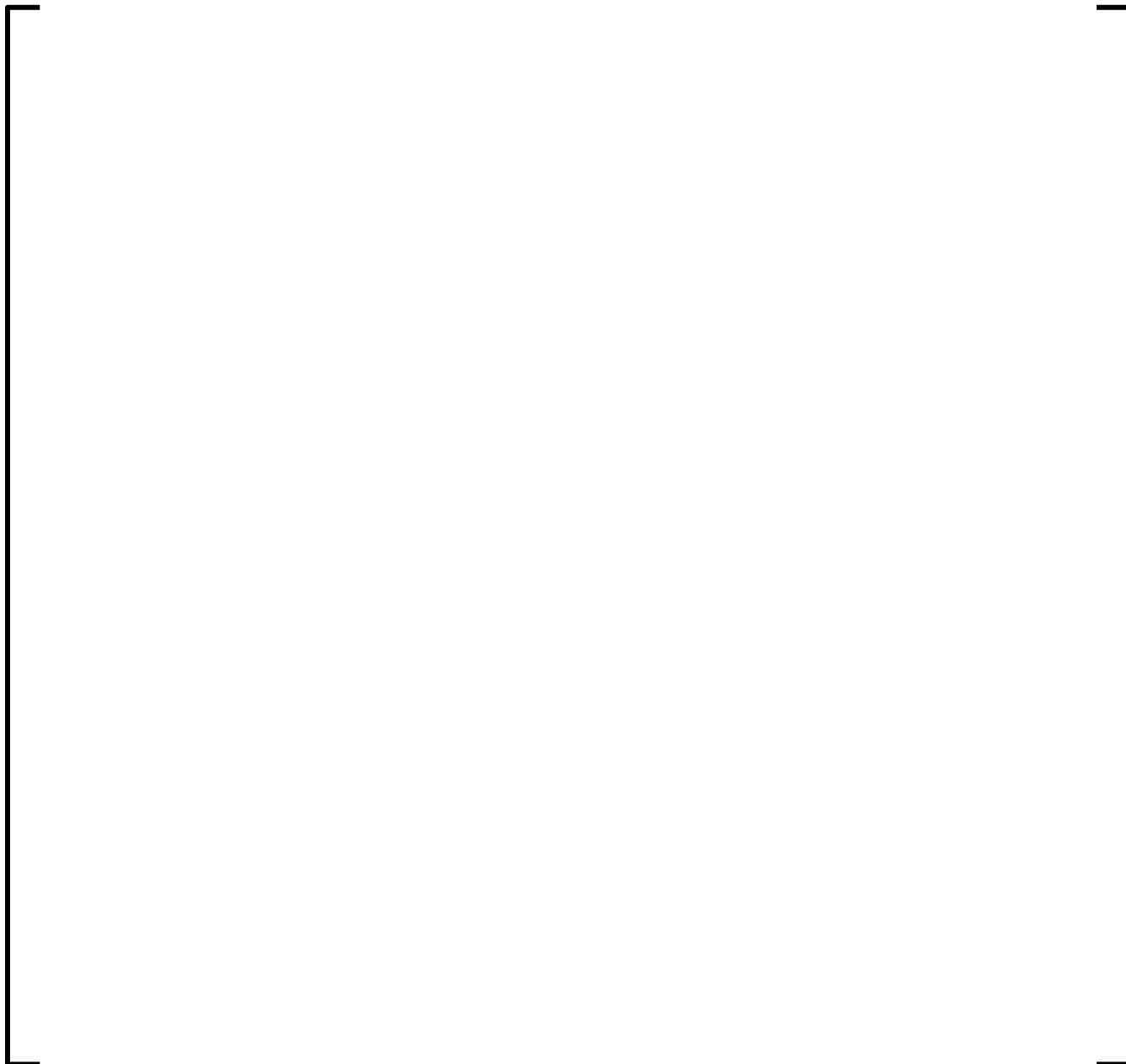


Figure A.65 Control Rod Pattern and Axial Distributions at []

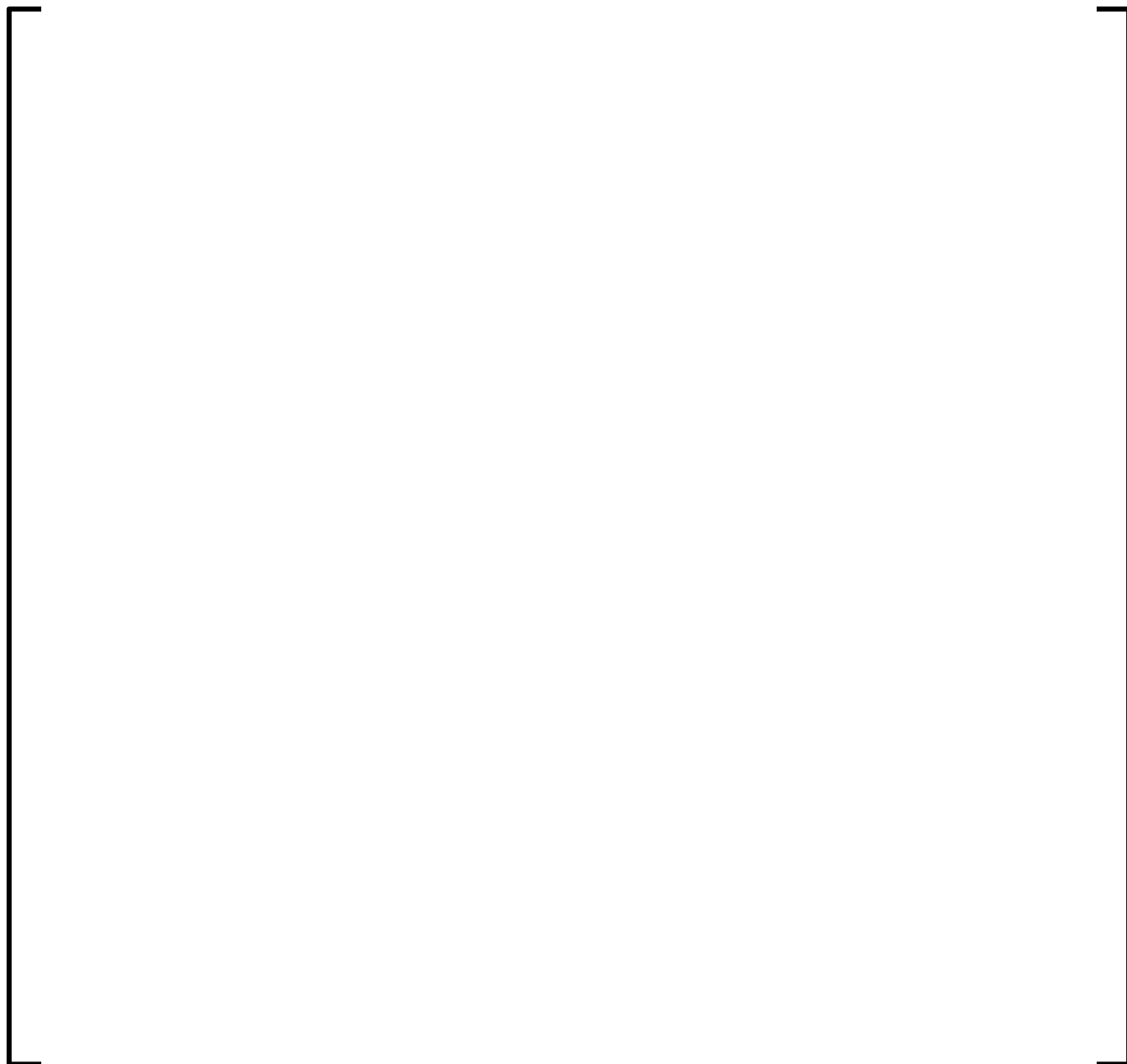


Figure A.66 Control Rod Pattern and Axial Distributions at []



Figure A.67 Control Rod Pattern and Axial Distributions at []



Figure A.68 Control Rod Pattern and Axial Distributions at []

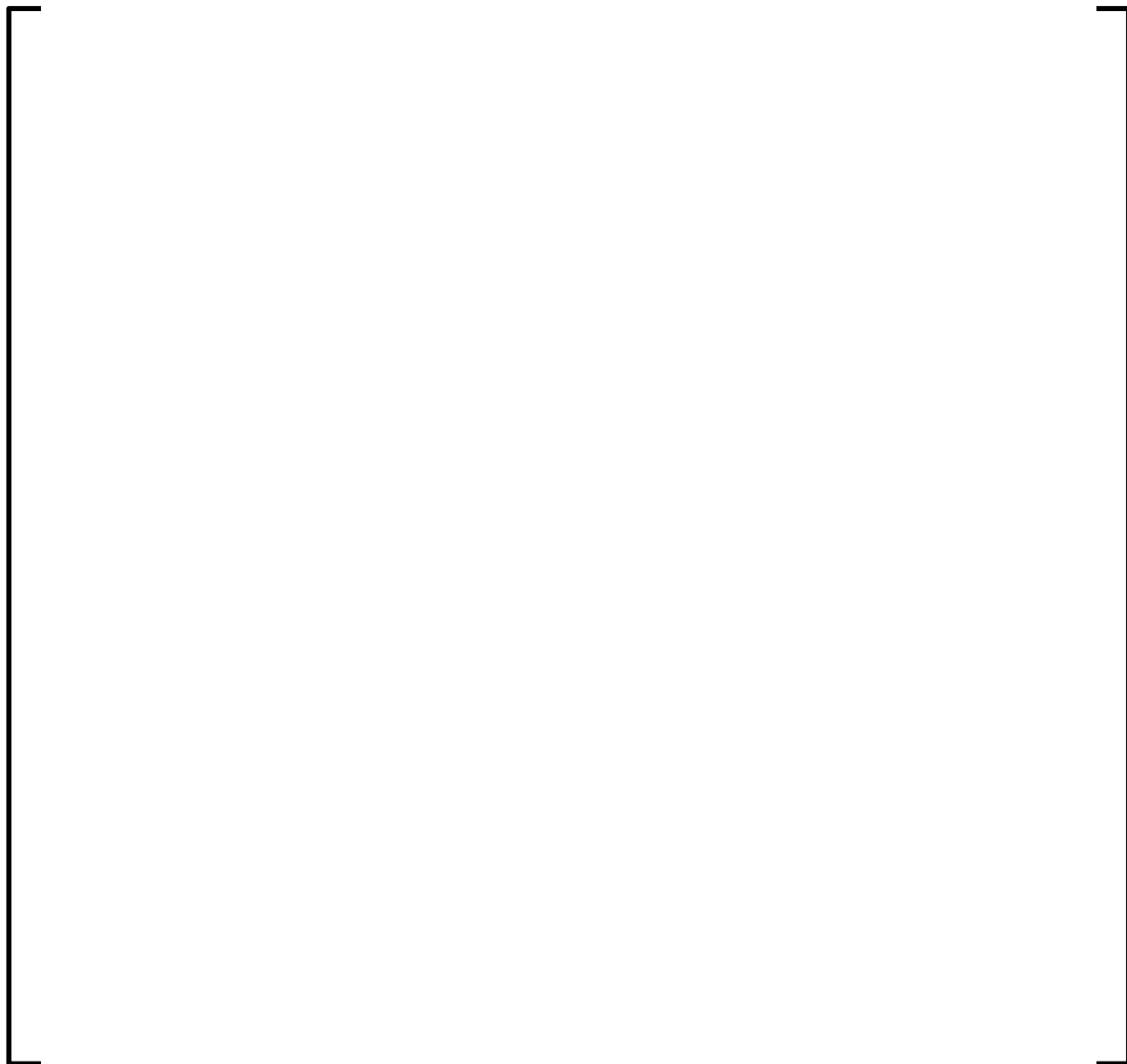


Figure A.69 Control Rod Pattern and Axial Distributions at []

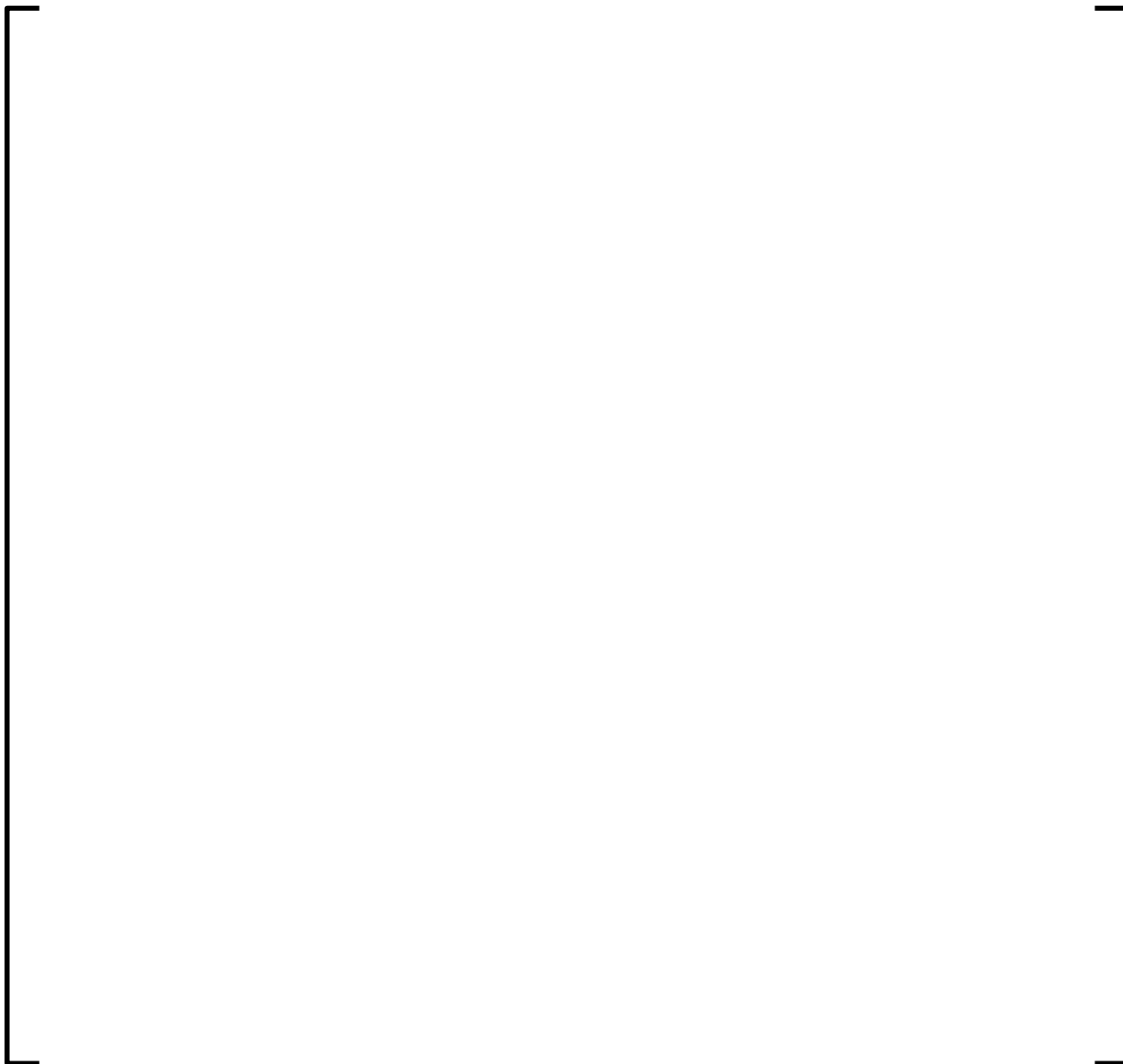


Figure A.70 Control Rod Pattern and Axial Distributions at []

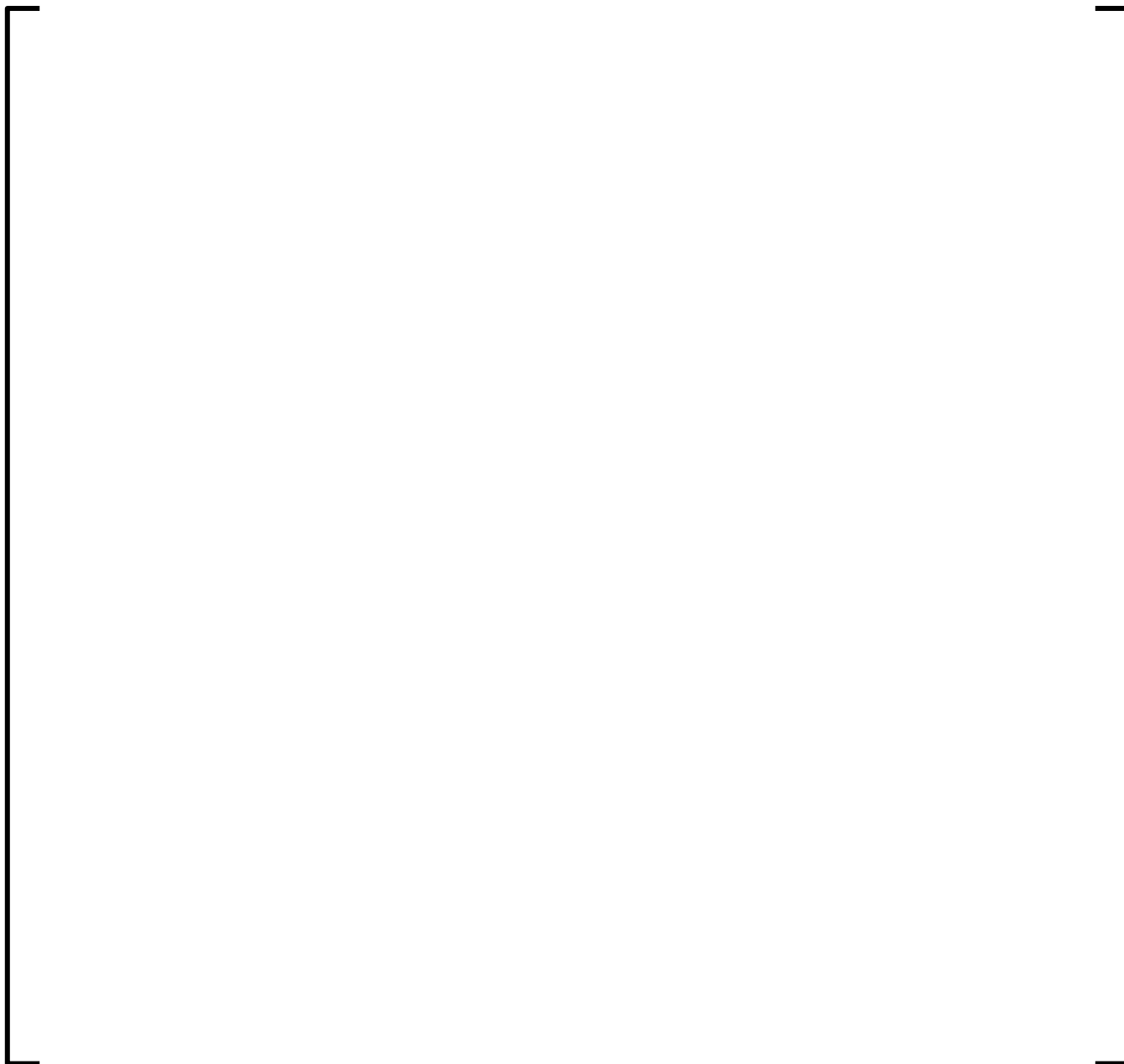


Figure A.71 Control Rod Pattern and Axial Distributions at []

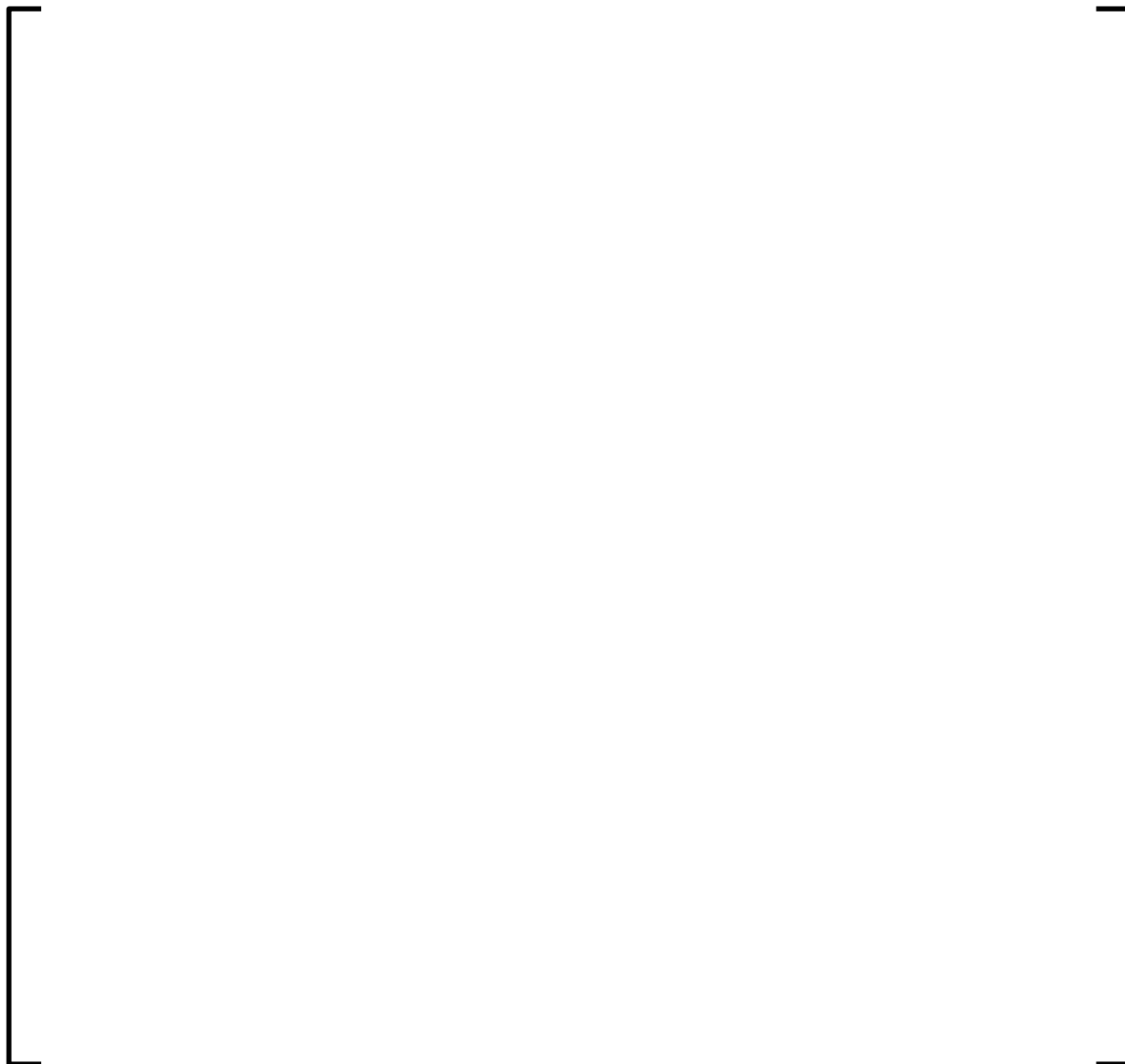


Figure A.72 Control Rod Pattern and Axial Distributions at []

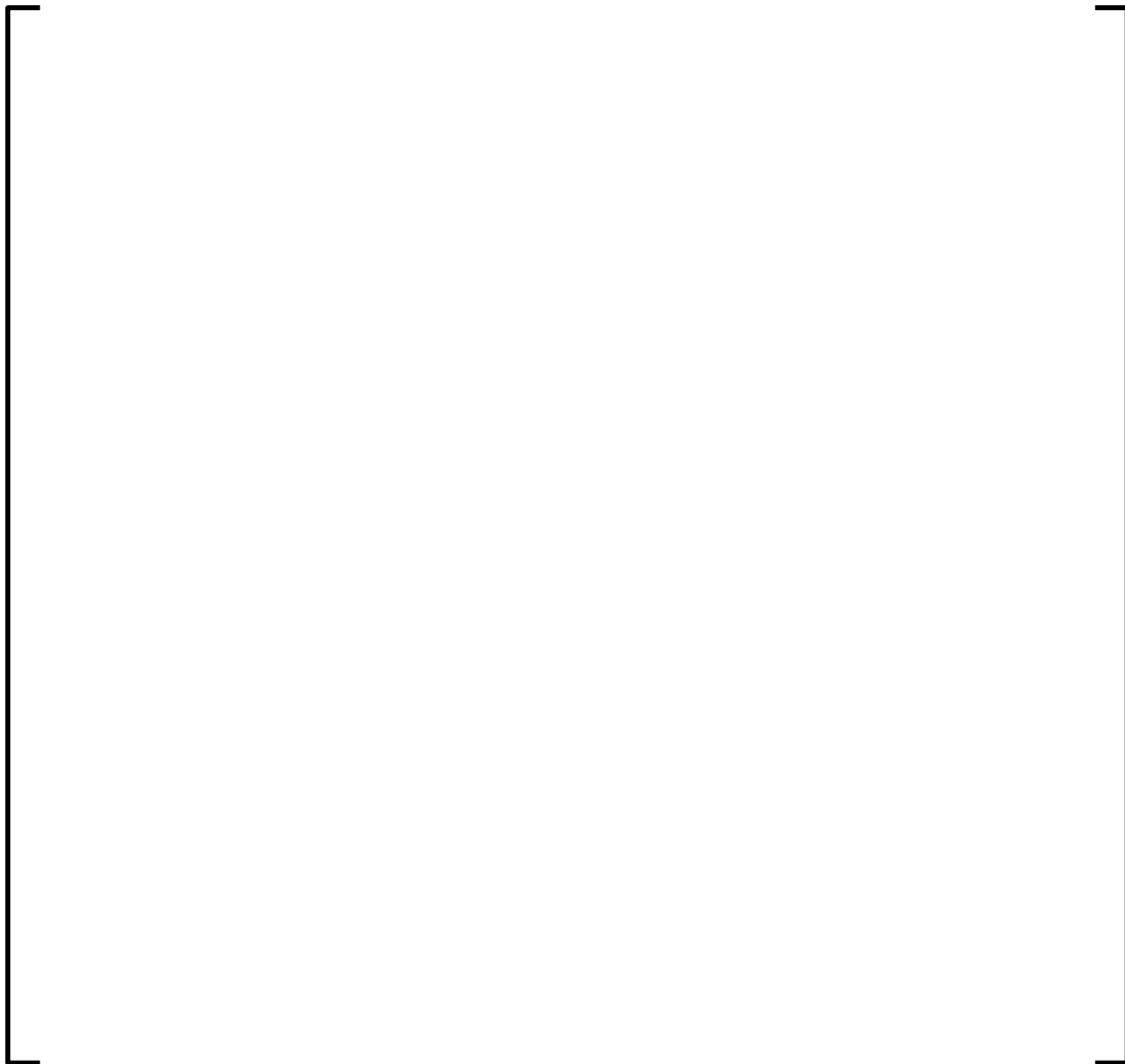


Figure A.73 Control Rod Pattern and Axial Distributions at []

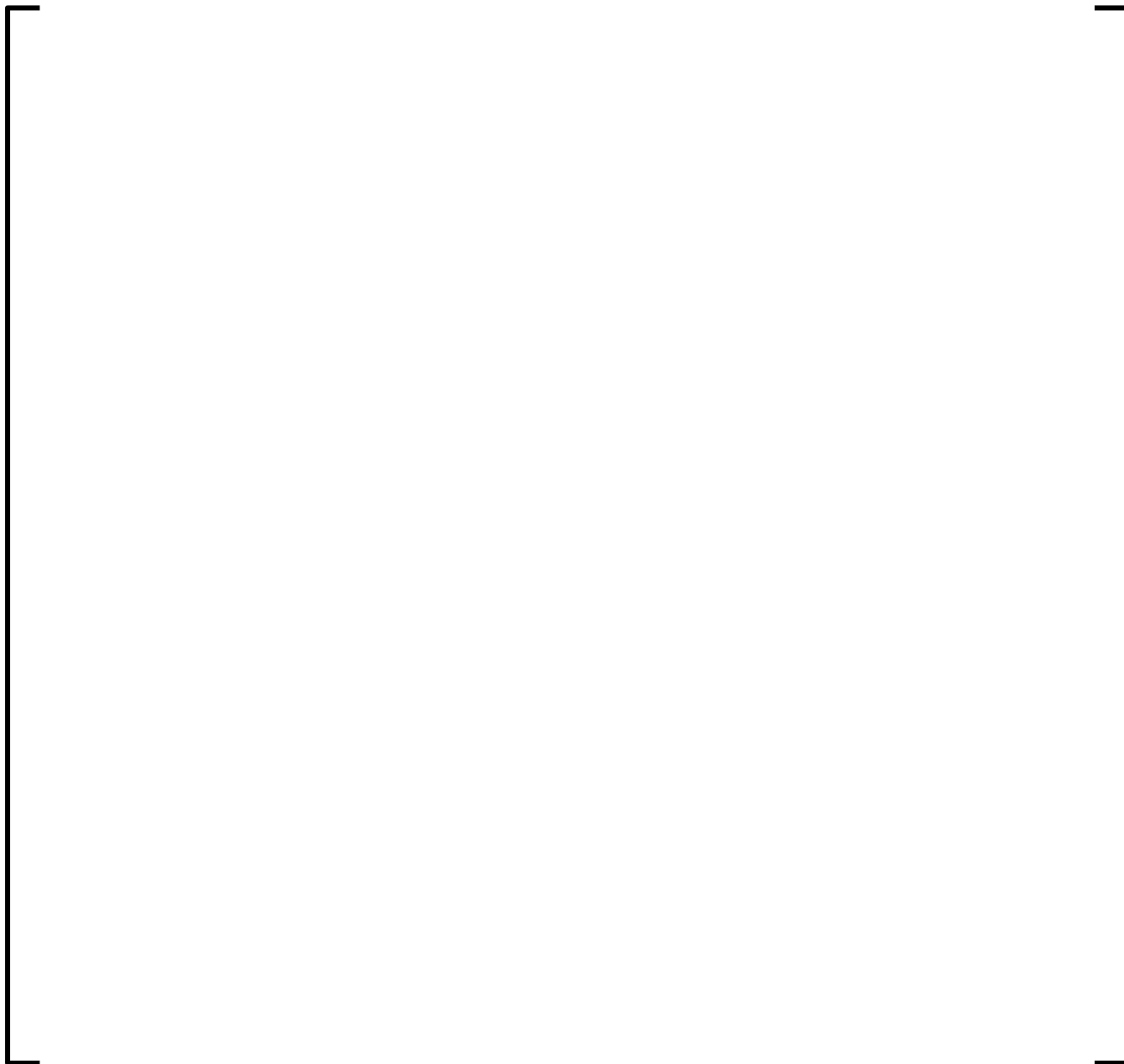


Figure A.74 Control Rod Pattern and Axial Distributions at []

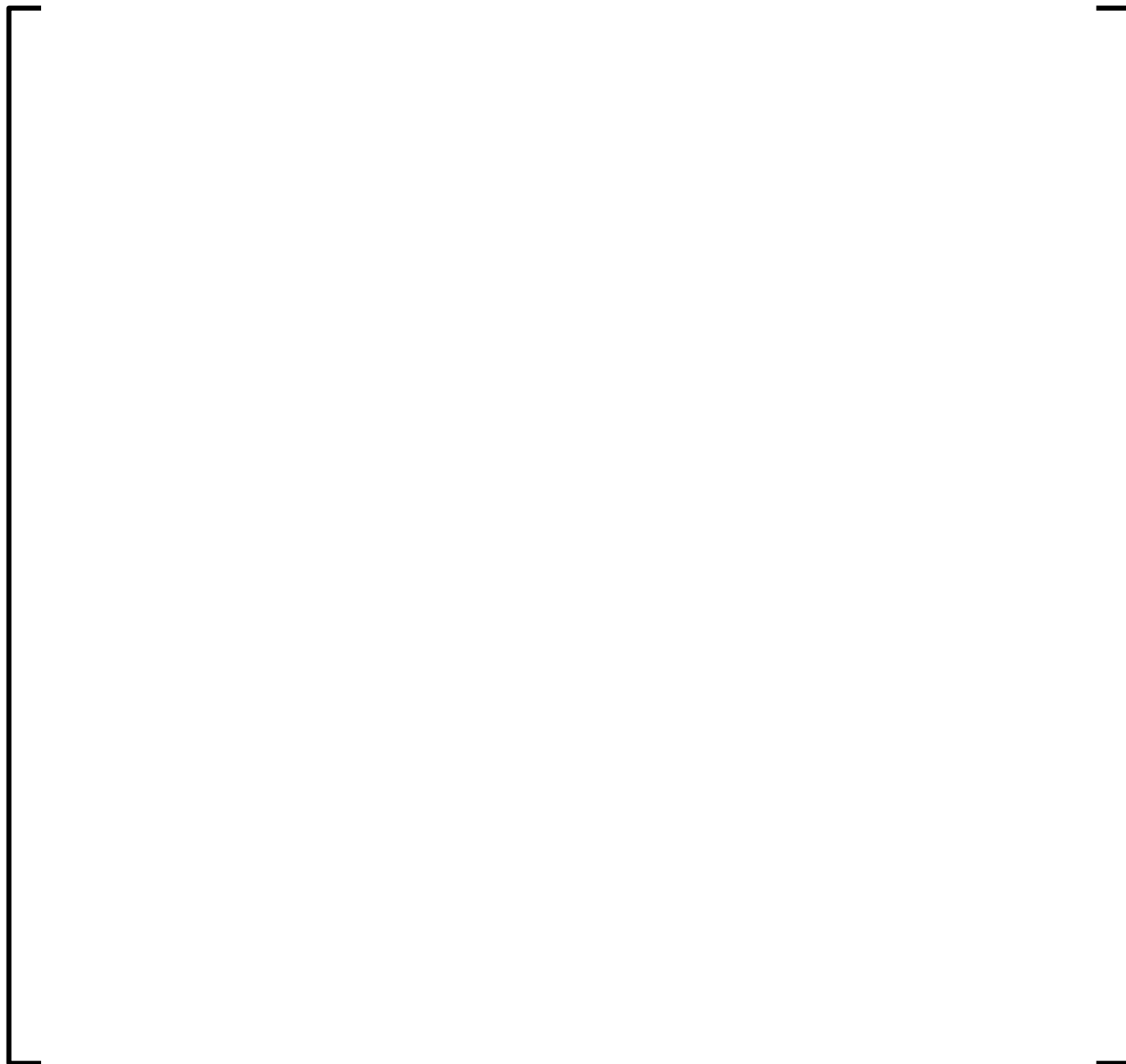


Figure A.75 Control Rod Pattern and Axial Distributions at []



Figure A.76 Control Rod Pattern and Axial Distributions at []

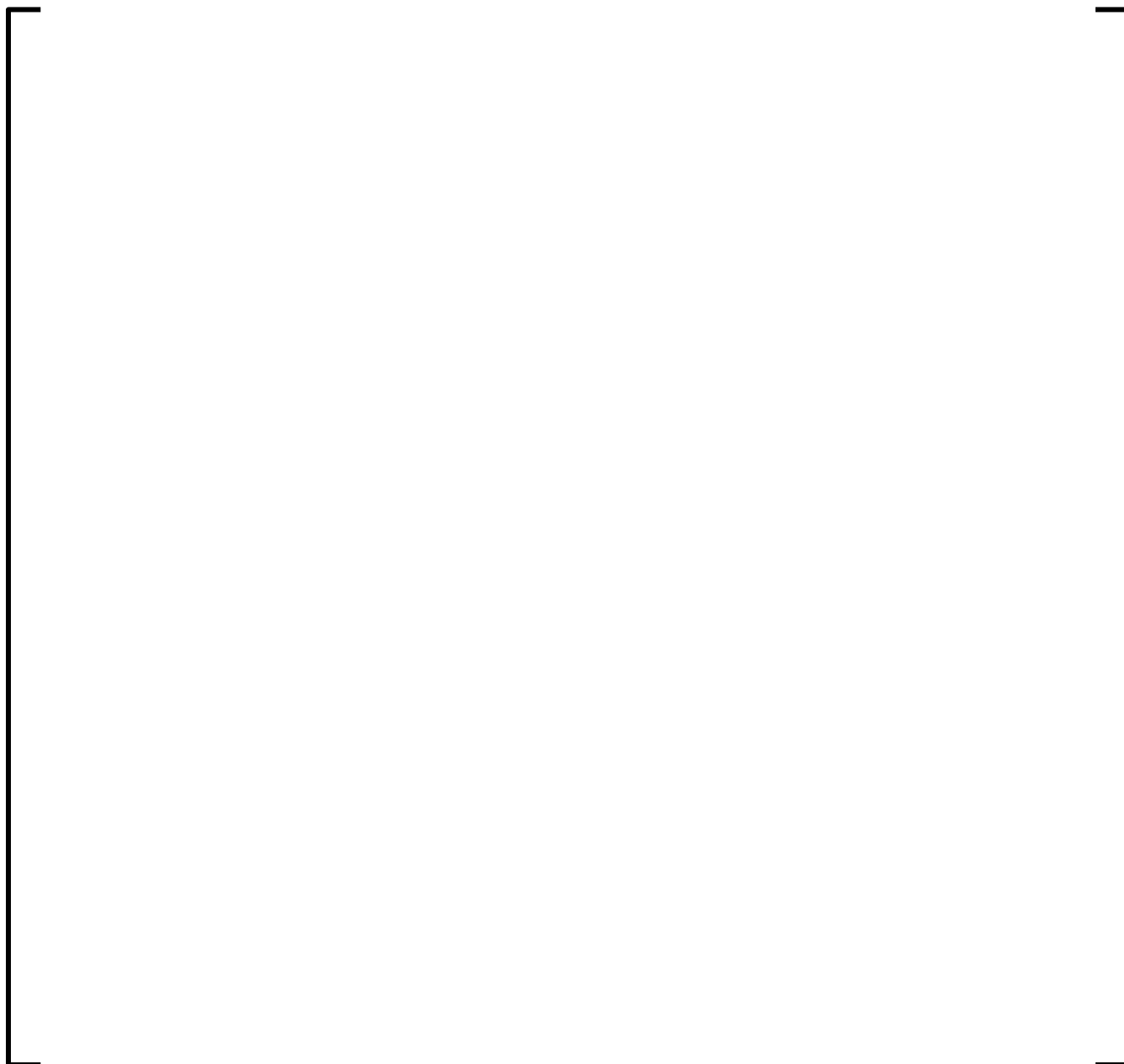


Figure A.77 Control Rod Pattern and Axial Distributions at []

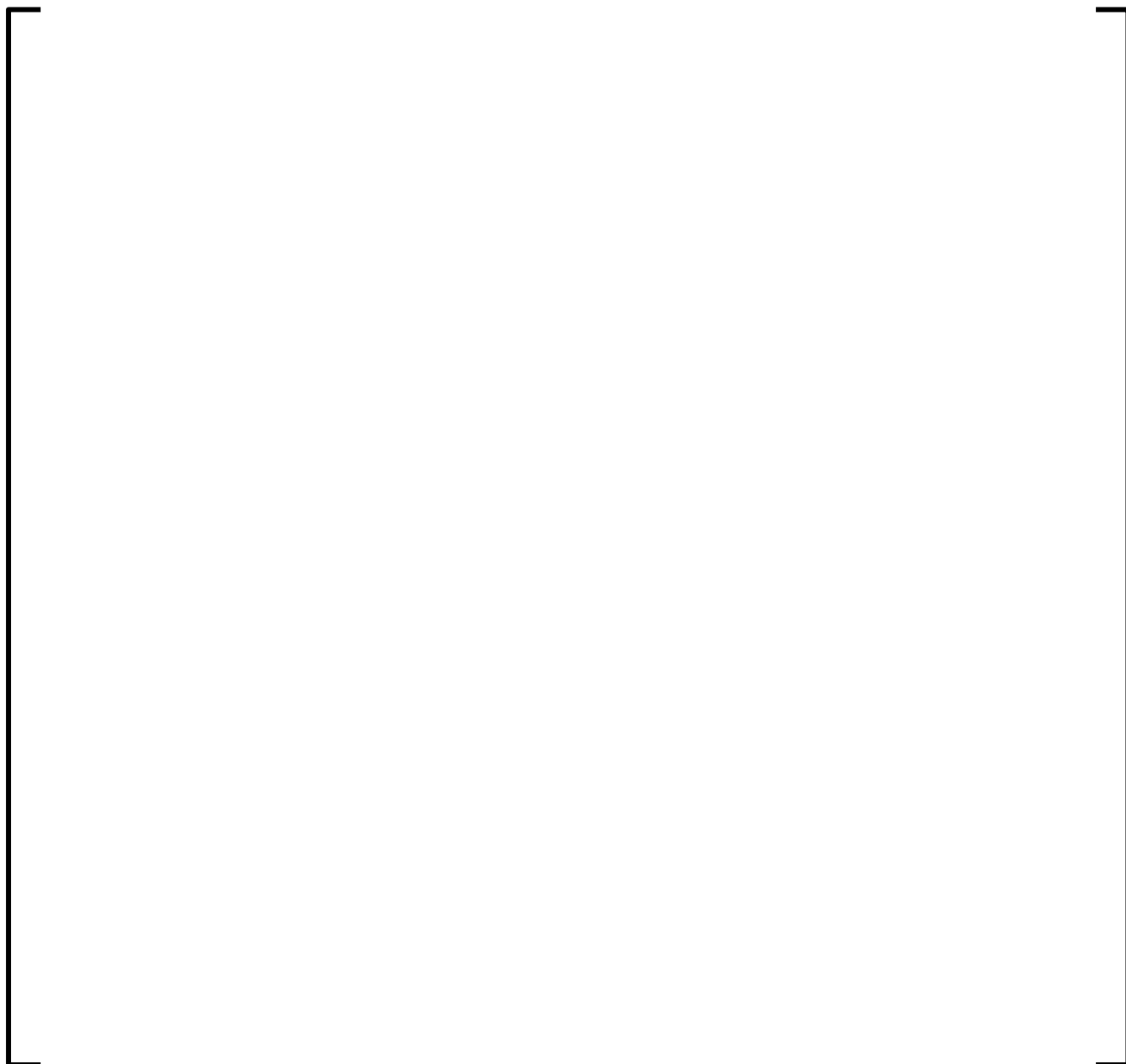


Figure A.78 Control Rod Pattern and Axial Distributions at []

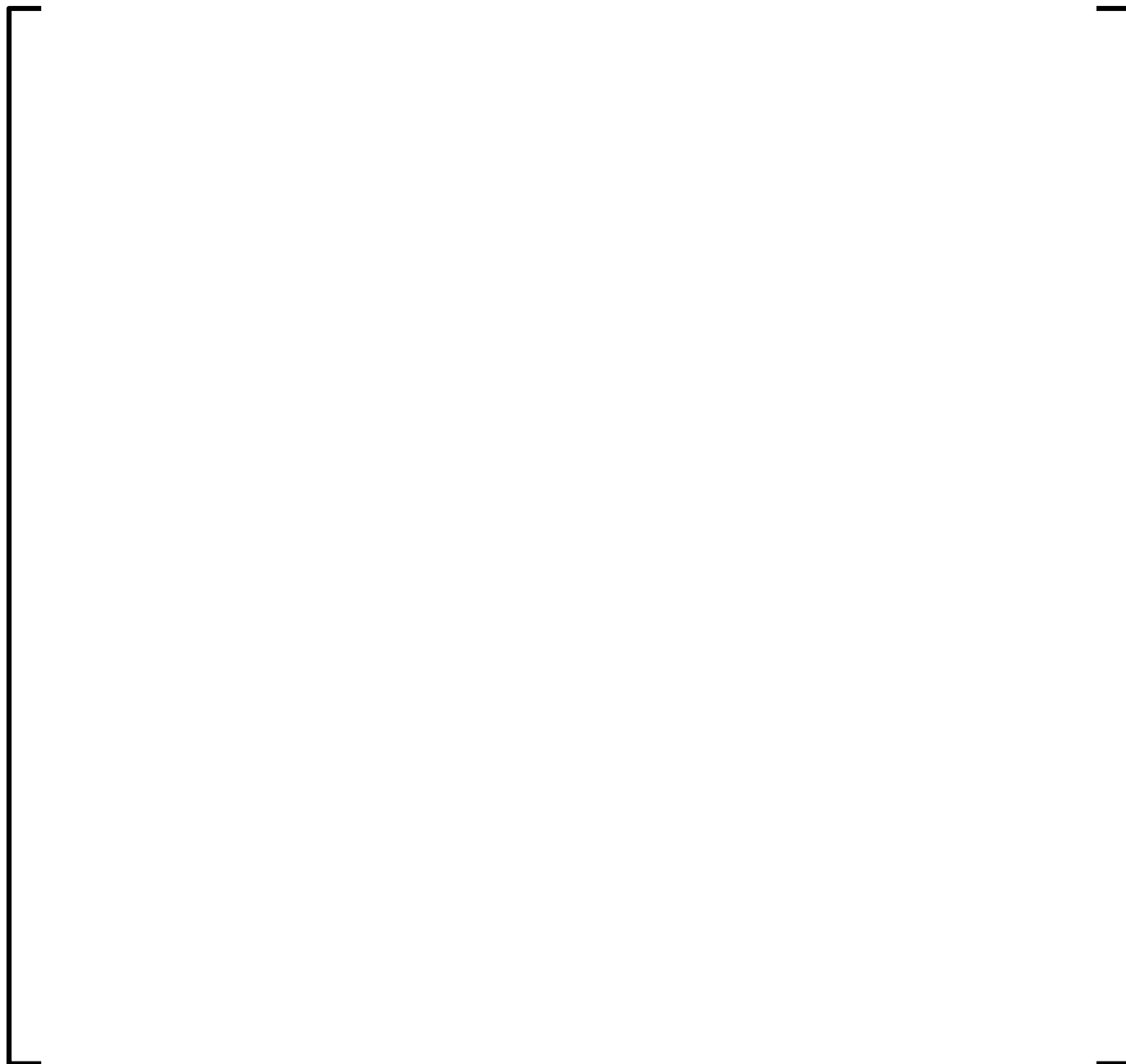


Figure A.79 Control Rod Pattern and Axial Distributions at []

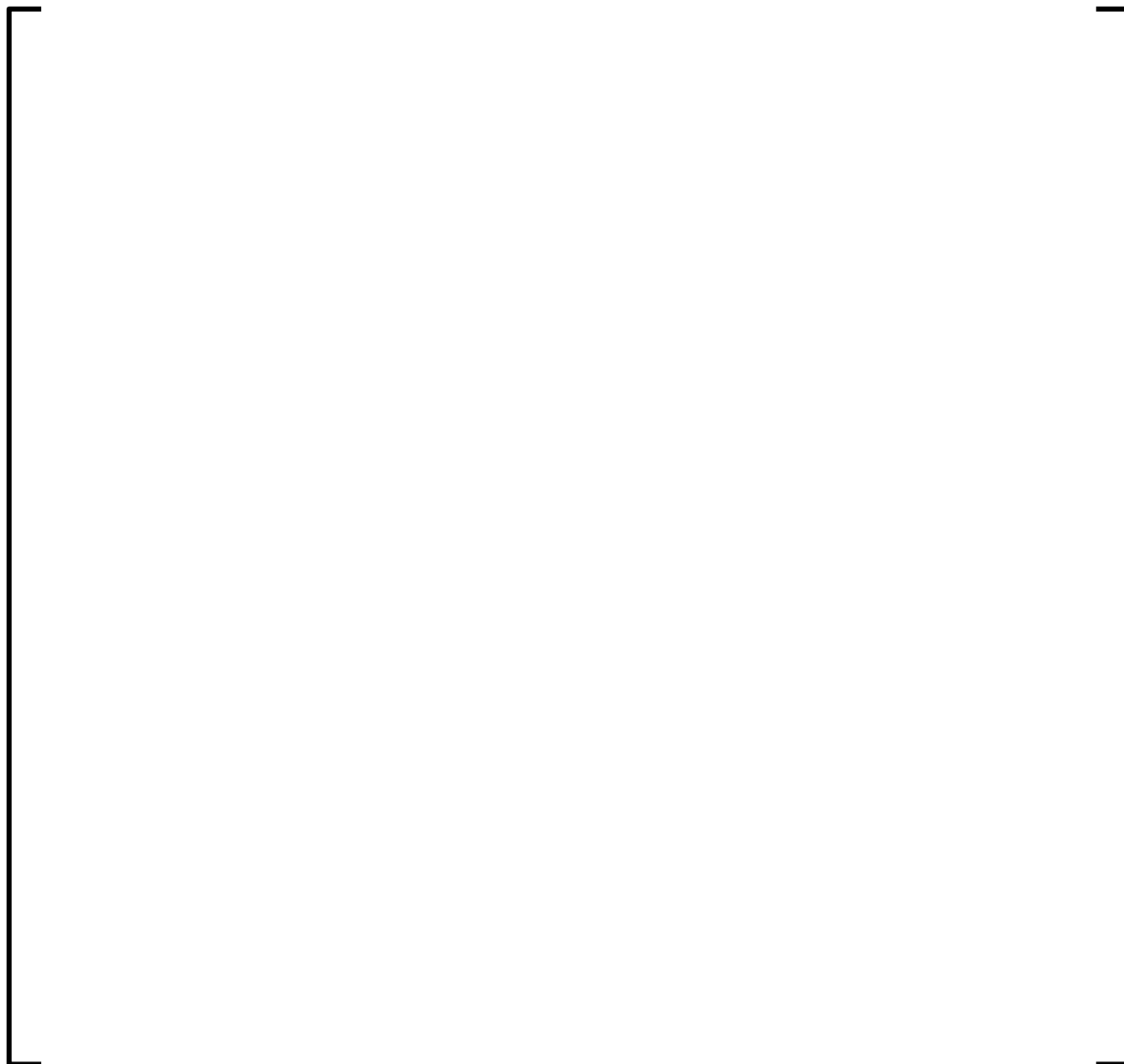


Figure A.80 Control Rod Pattern and Axial Distributions at []

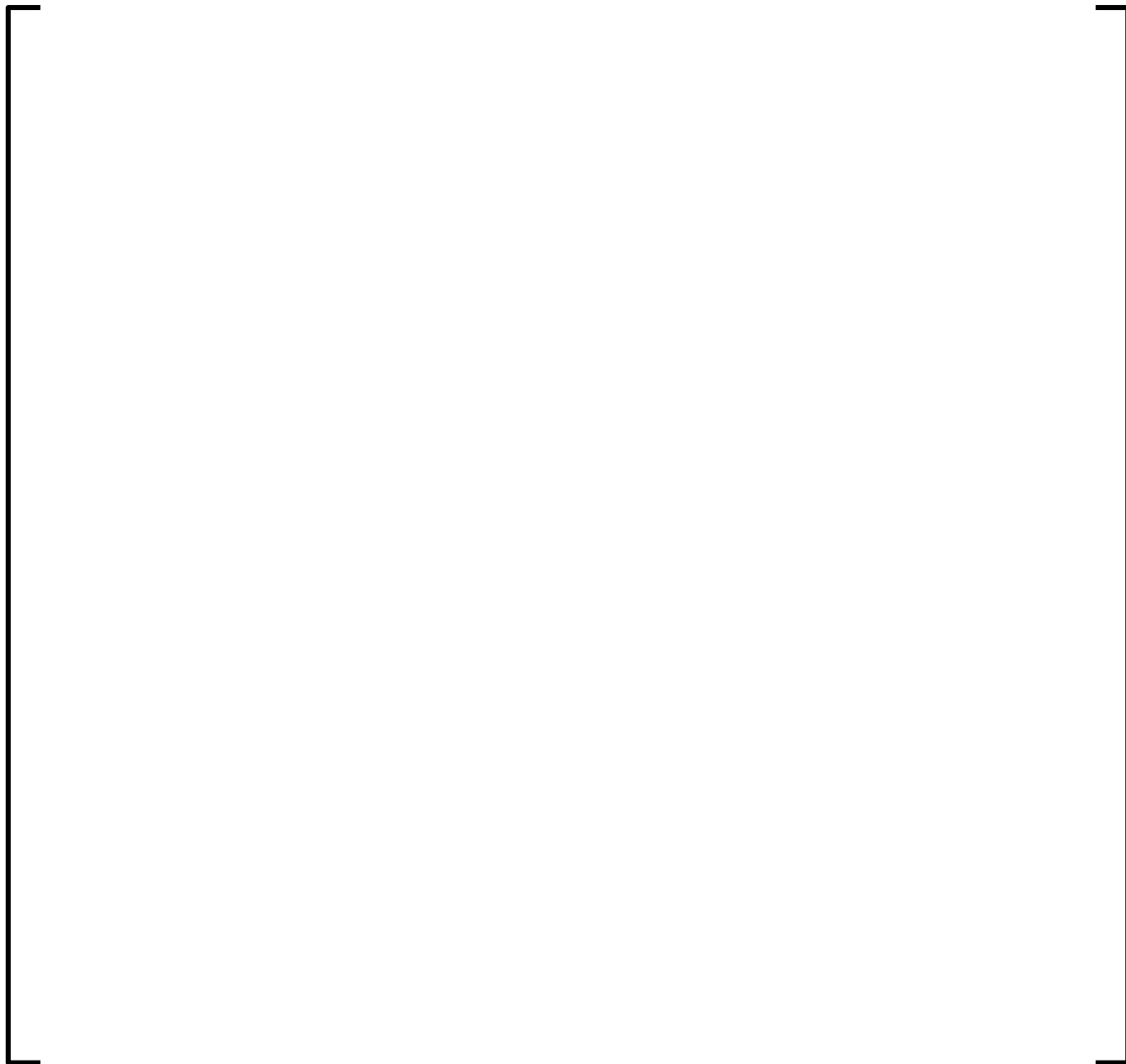


Figure A.81 Control Rod Pattern and Axial Distributions at []

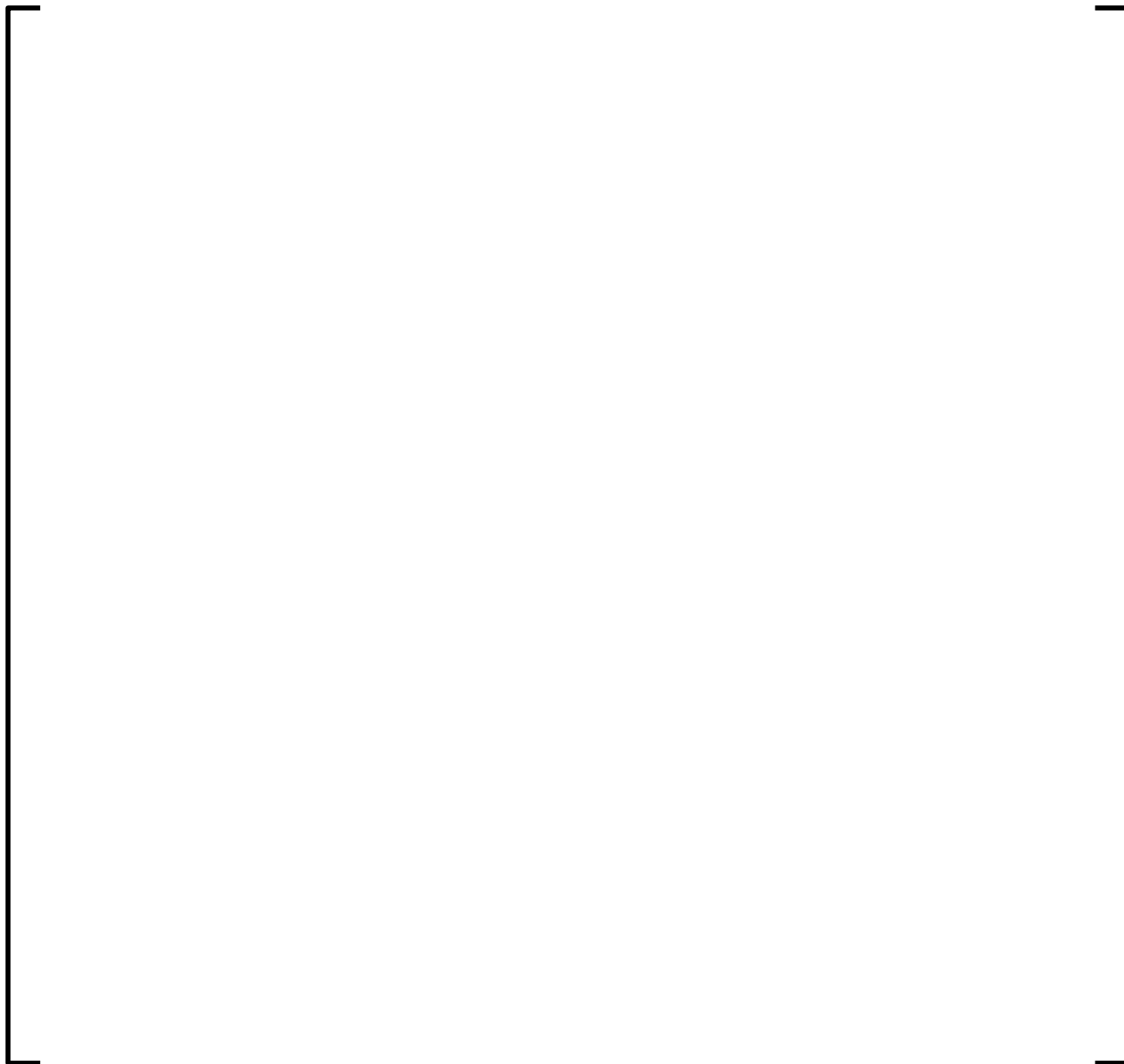


Figure A.82 Control Rod Pattern and Axial Distributions at []



Figure A.83 Control Rod Pattern and Axial Distributions at []

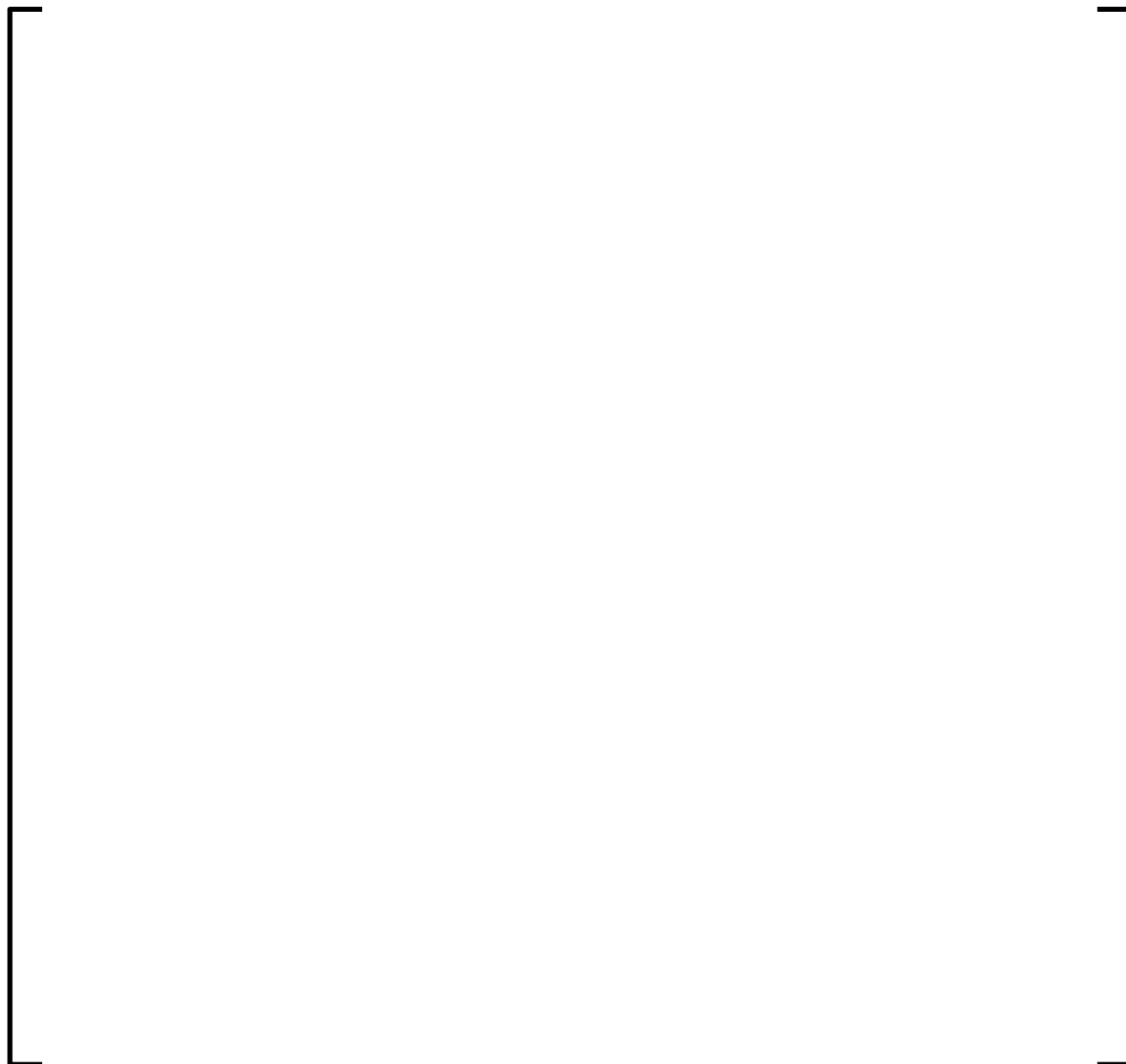


Figure A.84 Control Rod Pattern and Axial Distributions at []

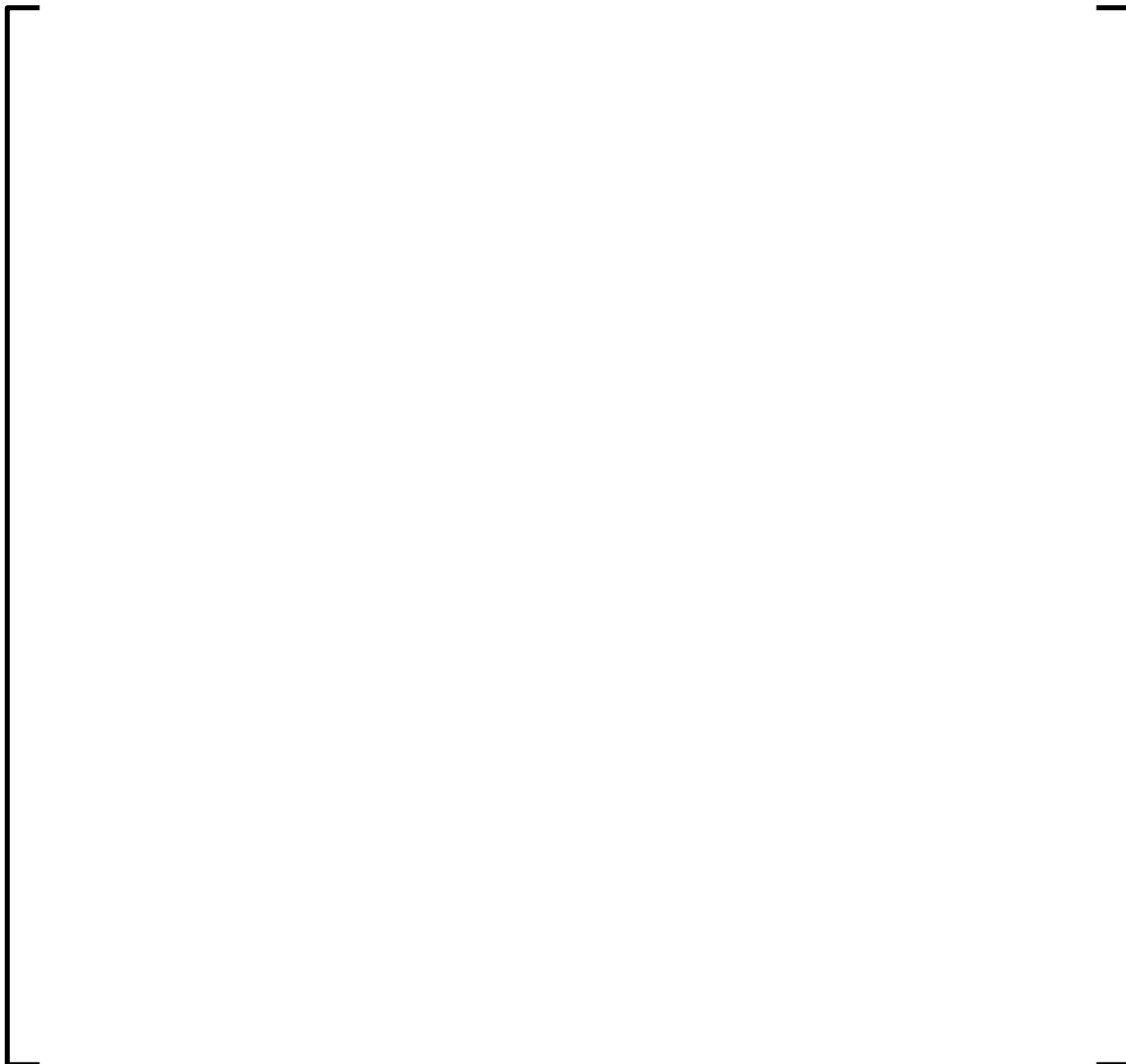


Figure A.85 Control Rod Pattern and Axial Distributions at []

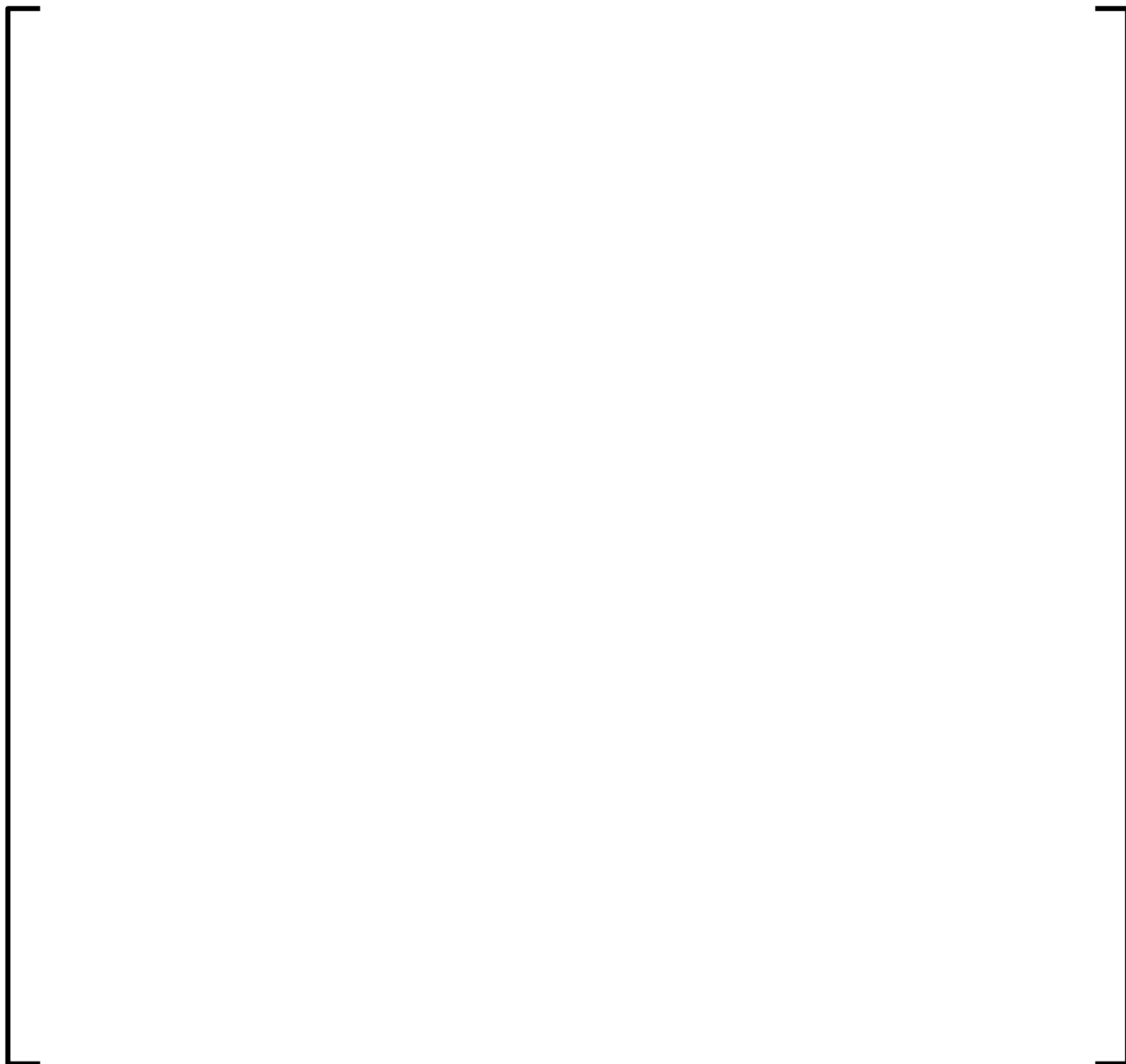


Figure A.86 Control Rod Pattern and Axial Distributions at []

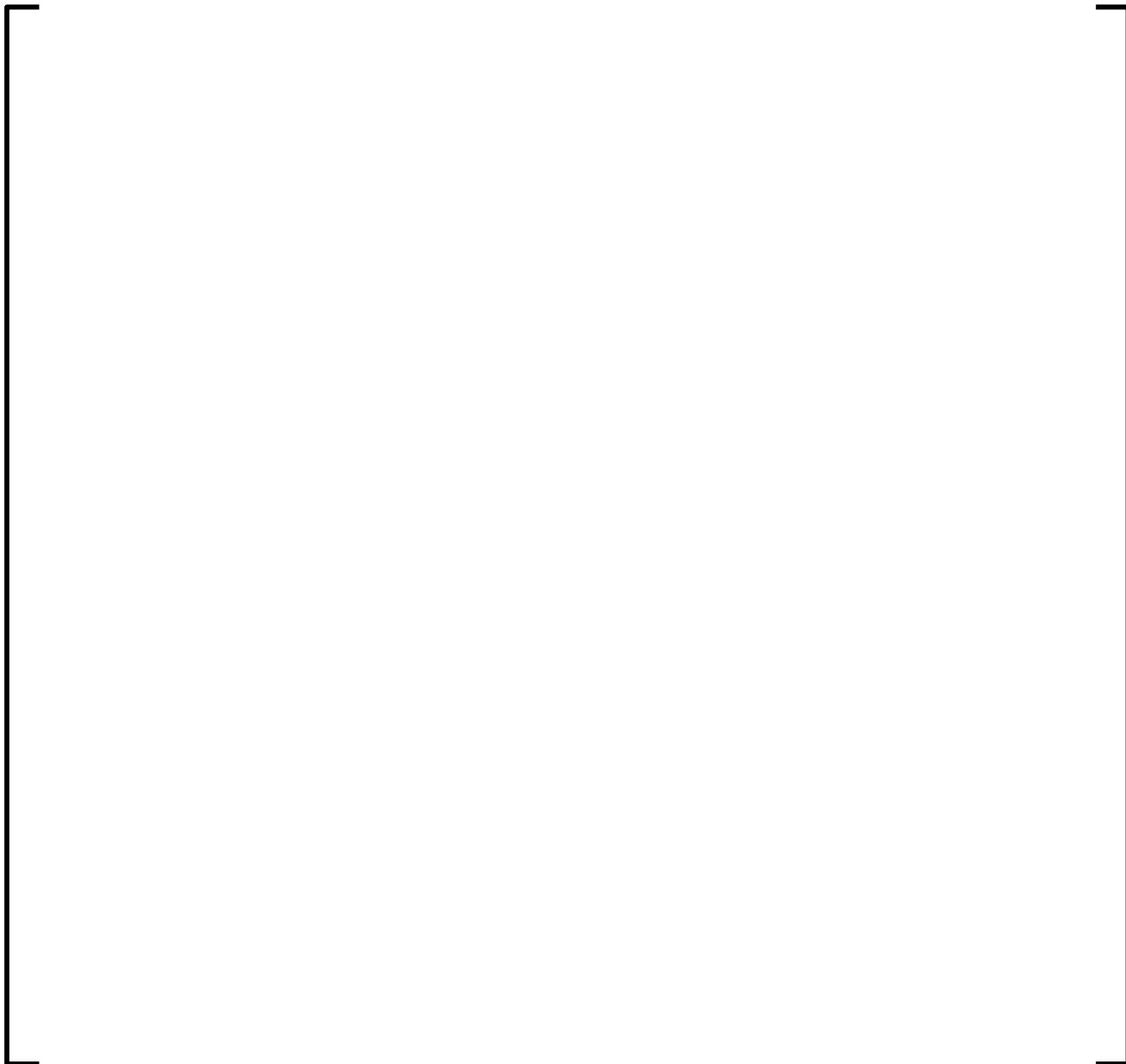


Figure A.87 Control Rod Pattern and Axial Distributions at []



Figure A.88 Control Rod Pattern and Axial Distributions at []

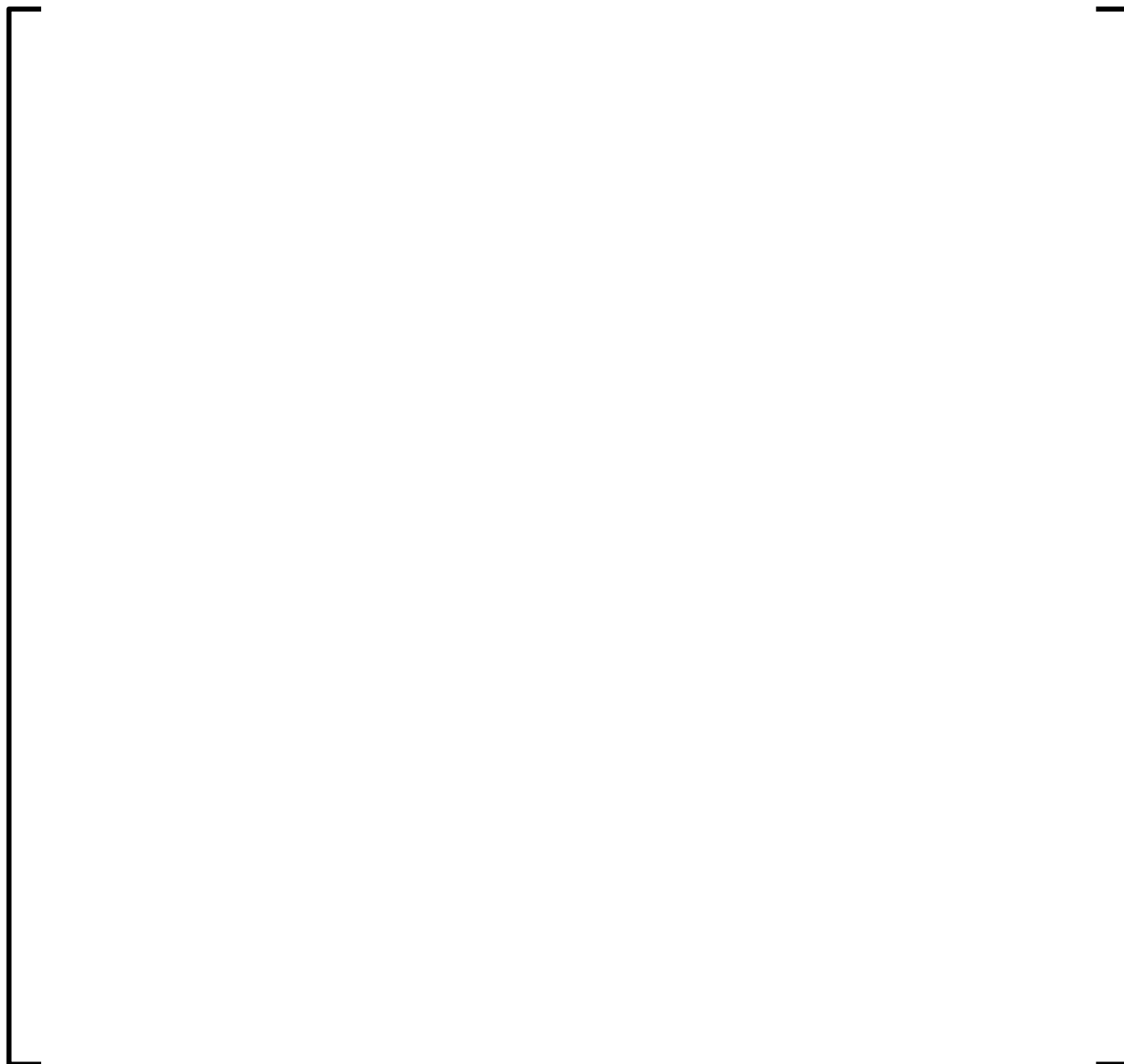


Figure A.89 Control Rod Pattern and Axial Distributions at []



Figure A.90 Control Rod Pattern and Axial Distributions at []



Figure A.91 Control Rod Pattern and Axial Distributions at []

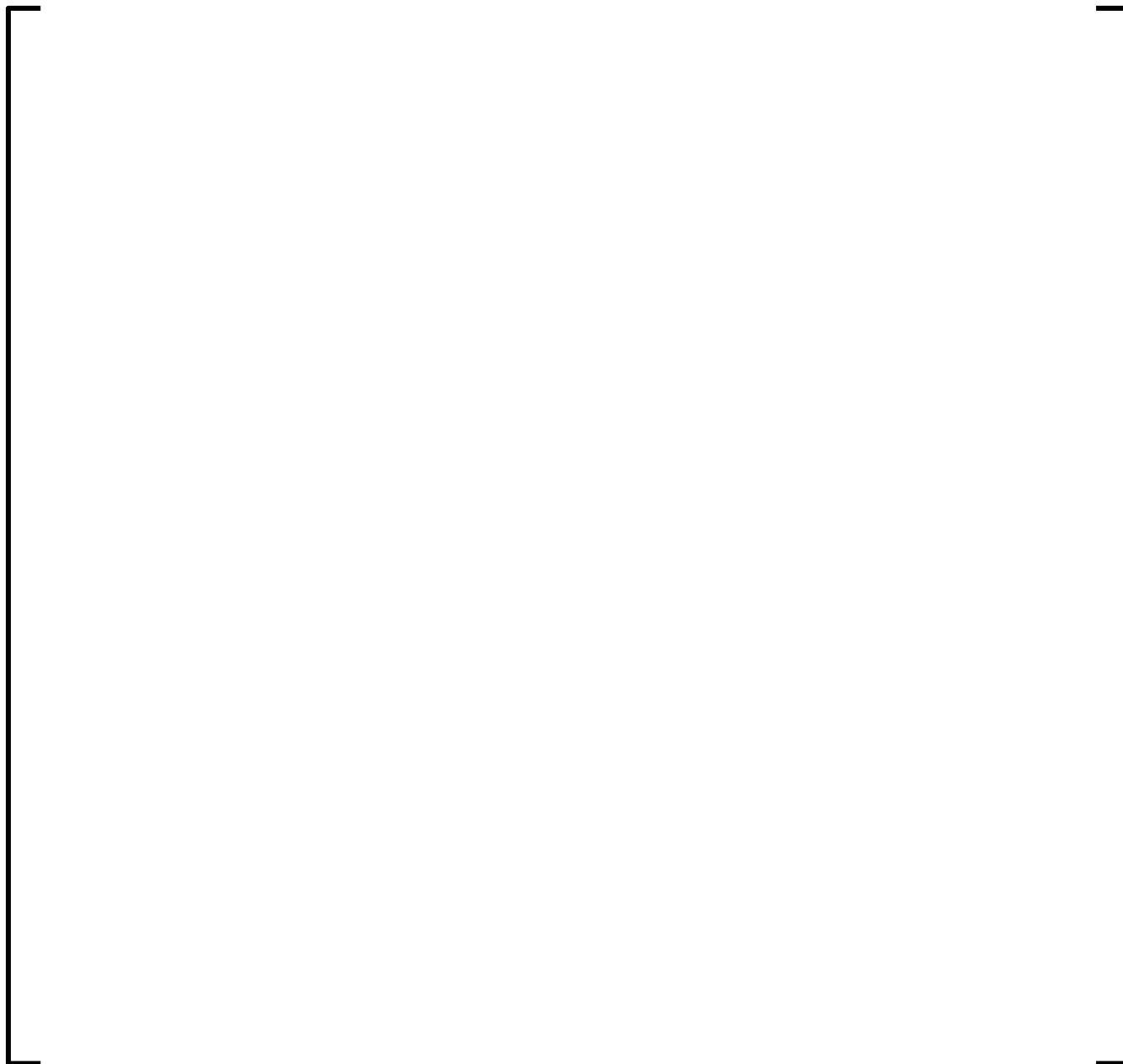


Figure A.92 Control Rod Pattern and Axial Distributions at []



Figure A.93 Control Rod Pattern and Axial Distributions at []

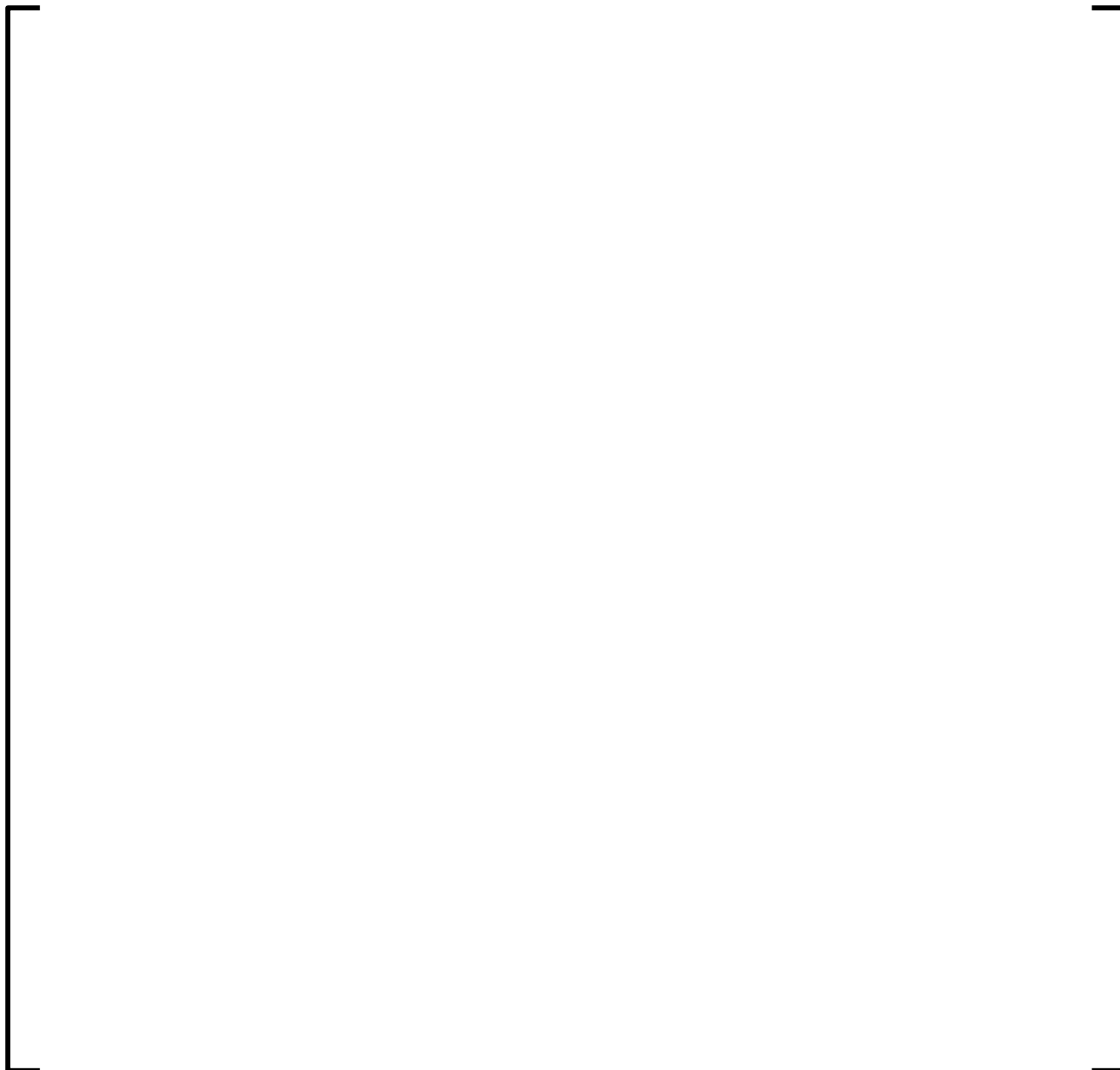


Figure A.94 Control Rod Pattern and Axial Distributions at []



Figure A.95 Control Rod Pattern and Axial Distributions at []

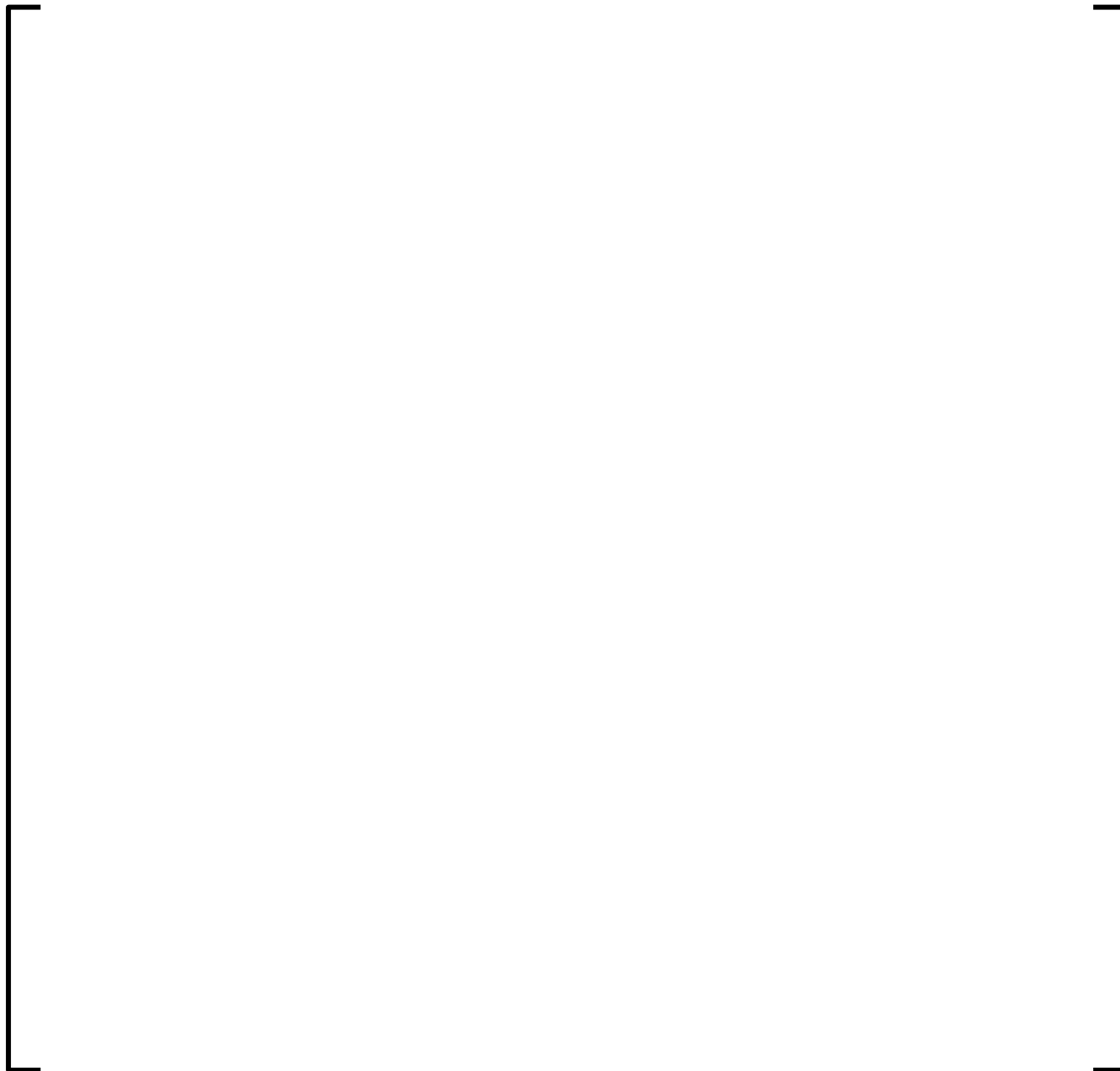


Figure A.96 Control Rod Pattern and Axial Distributions at []

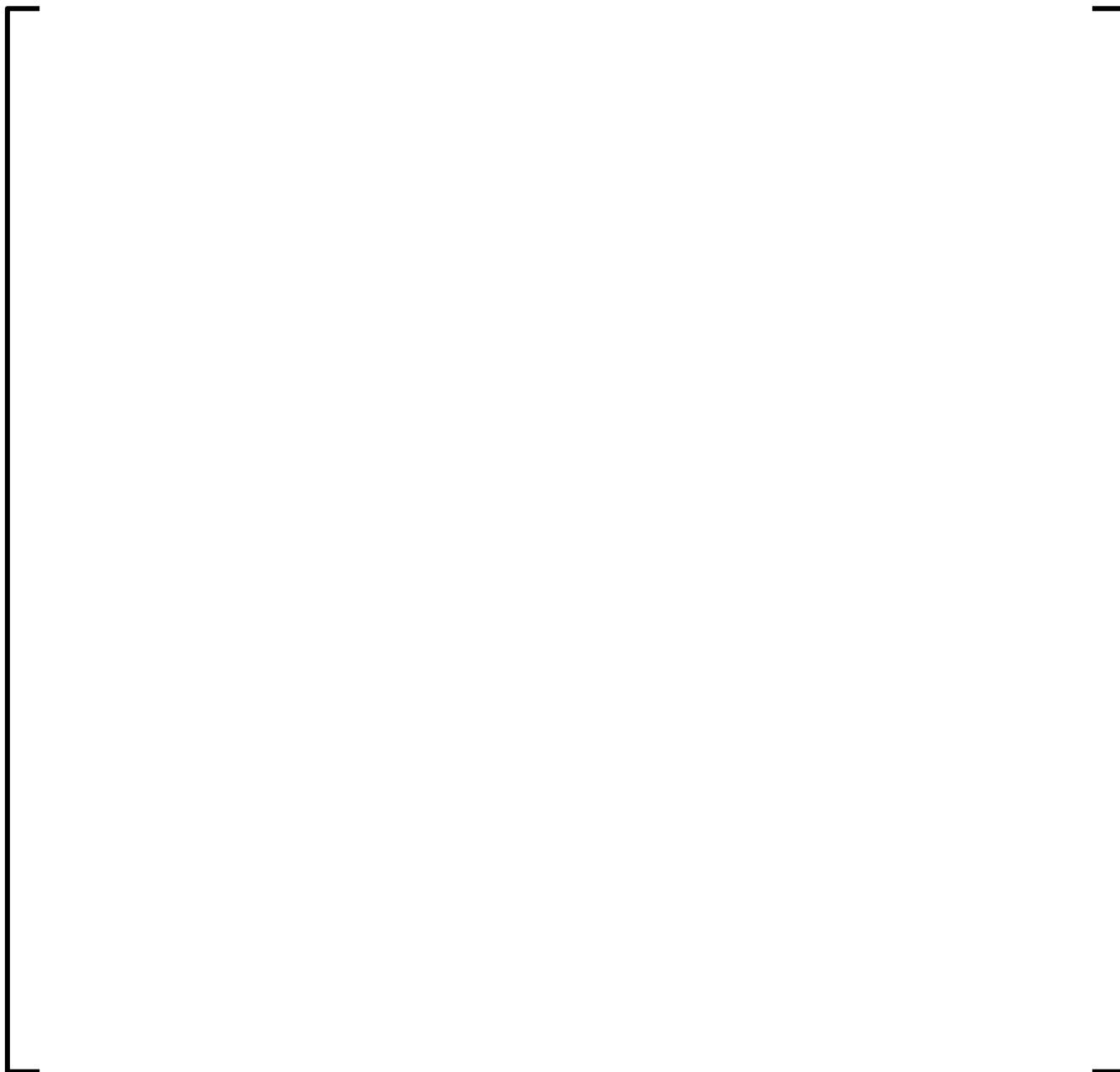


Figure A.97 Control Rod Pattern and Axial Distributions at []



Figure A.98 Control Rod Pattern and Axial Distributions at []

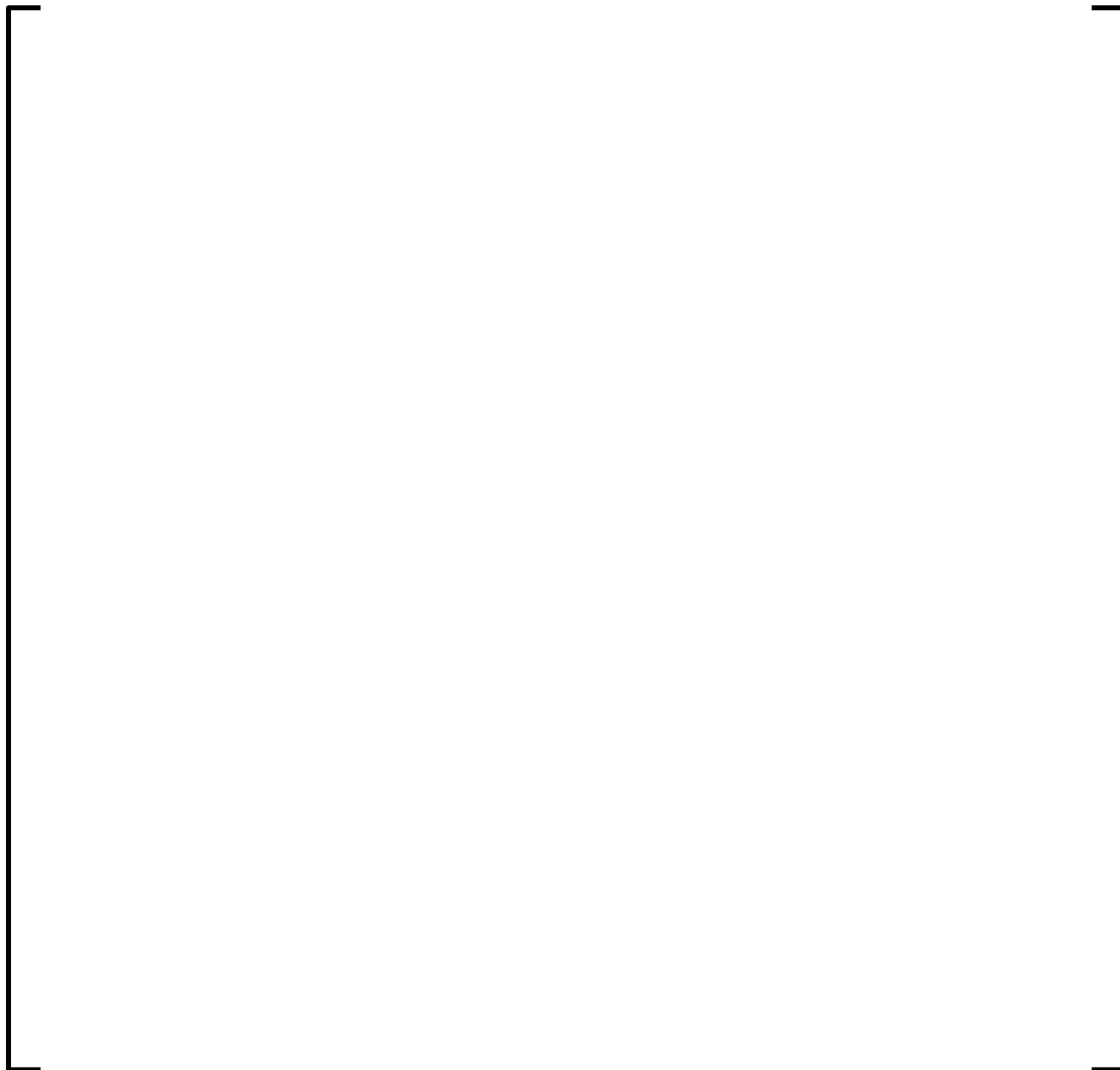


Figure A.99 Control Rod Pattern and Axial Distributions at []

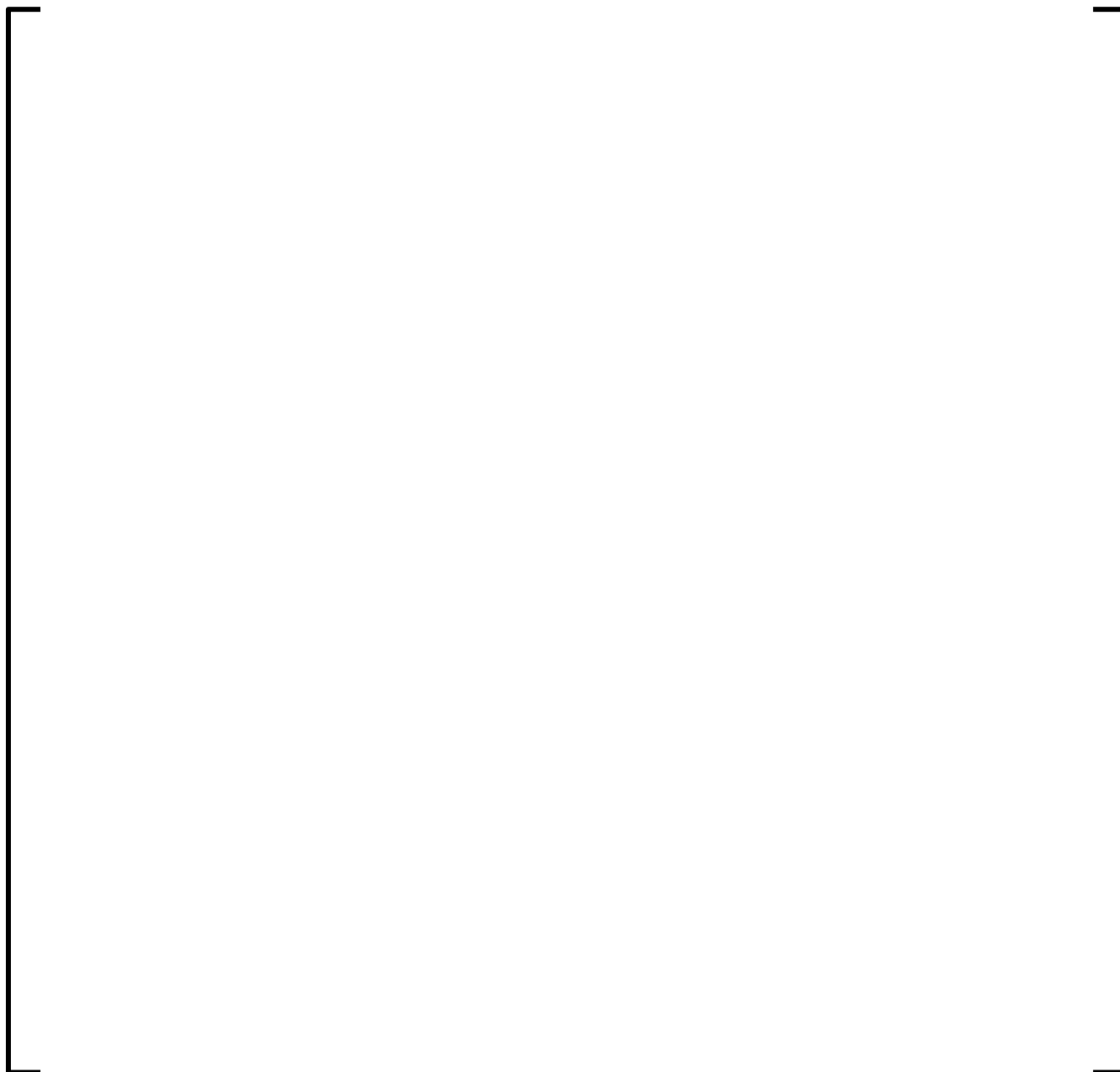


Figure A.100 Control Rod Pattern and Axial Distributions at []



Figure A.101 Control Rod Pattern and Axial Distributions at []



Figure A.102 Control Rod Pattern and Axial Distributions at []

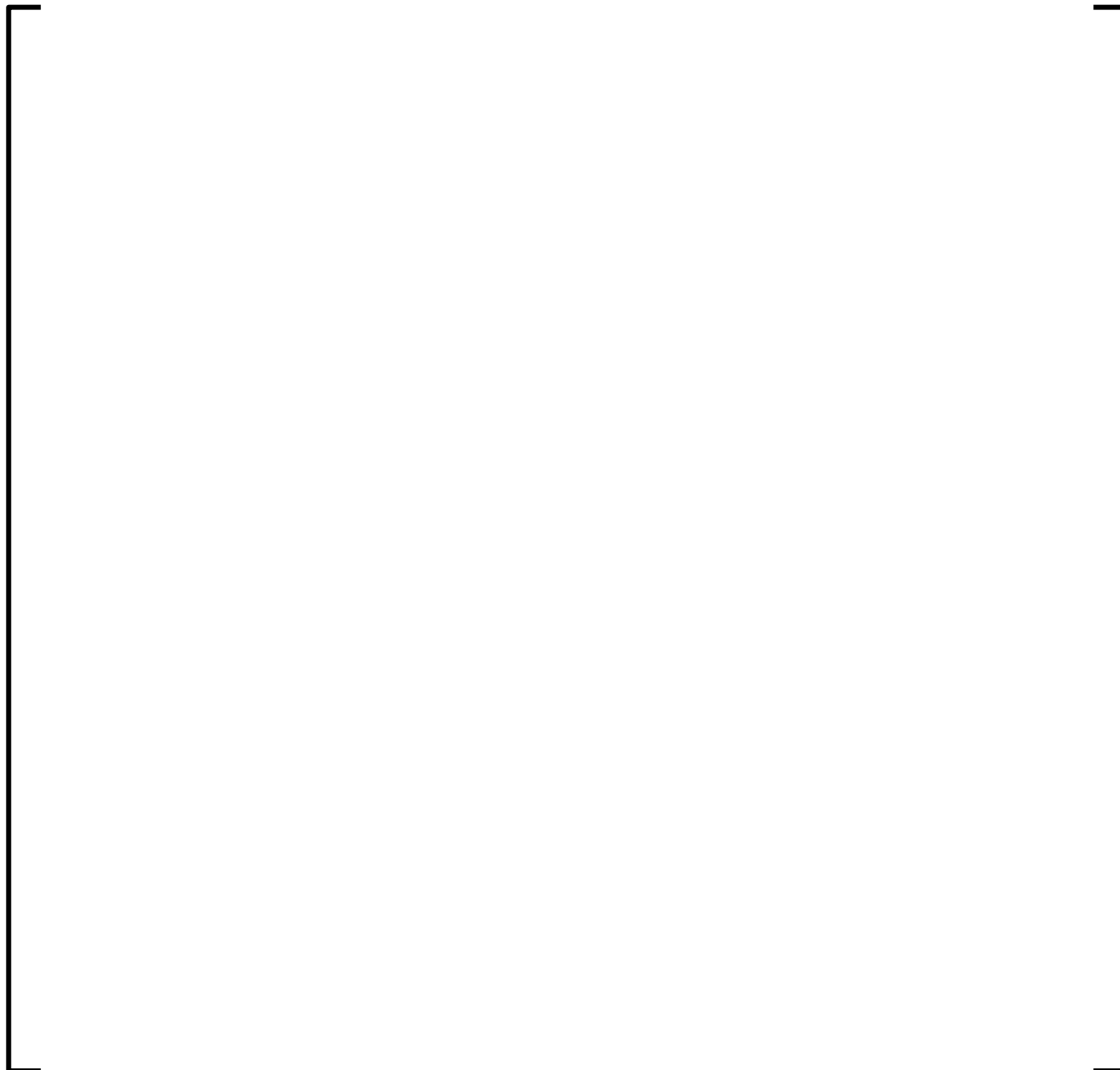


Figure A.103 Control Rod Pattern and Axial Distributions at []



Figure A.104 Control Rod Pattern and Axial Distributions at []

Figure A.105 Control Rod Pattern and Axial Distributions at []



Figure A.106 Control Rod Pattern and Axial Distributions at []

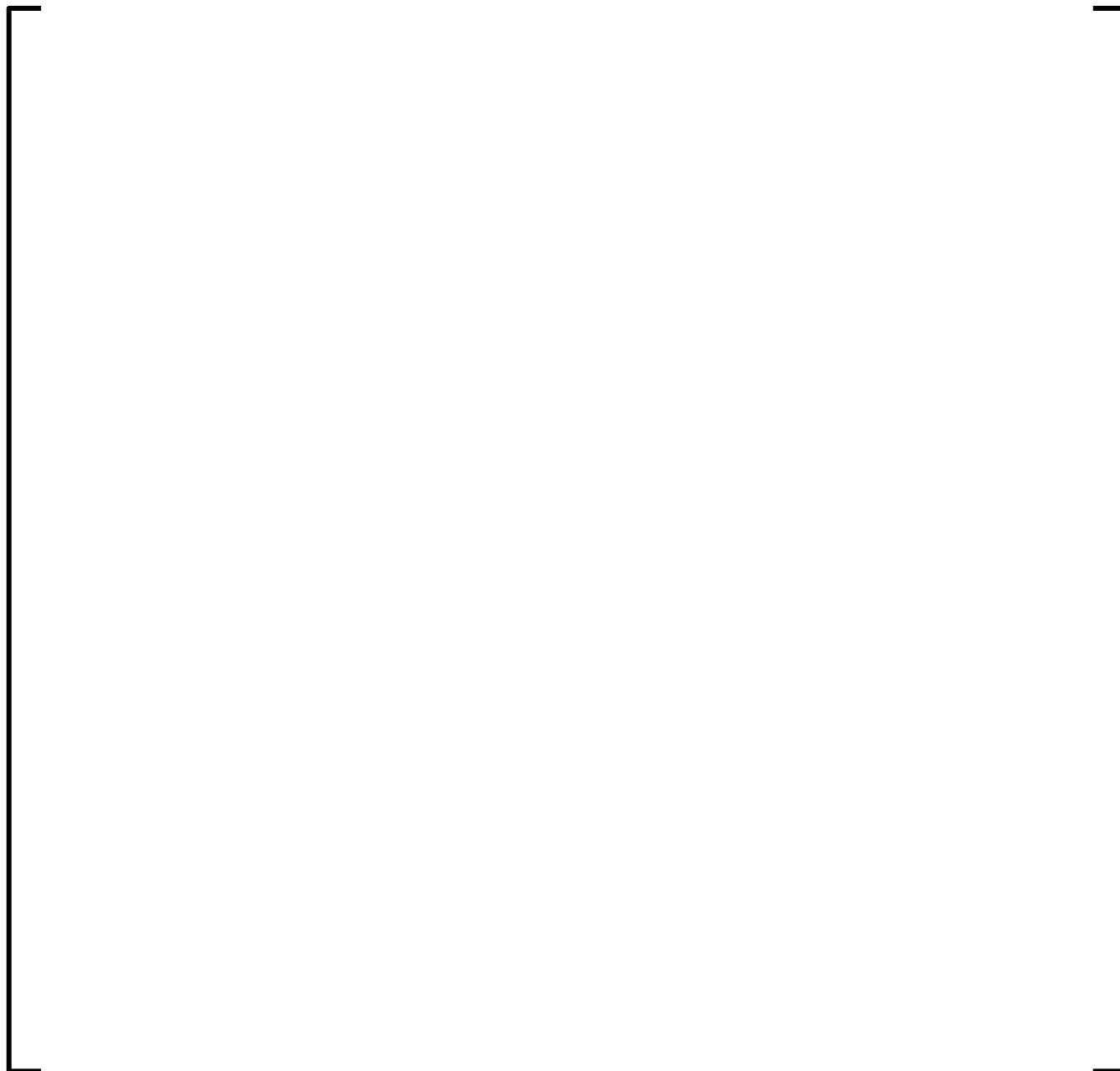


Figure A.107 Control Rod Pattern and Axial Distributions at []

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**Appendix B Elevation Views of the Susquehanna Unit 2 Cycle 21 Fresh Reload
Batch Fuel Assemblies**

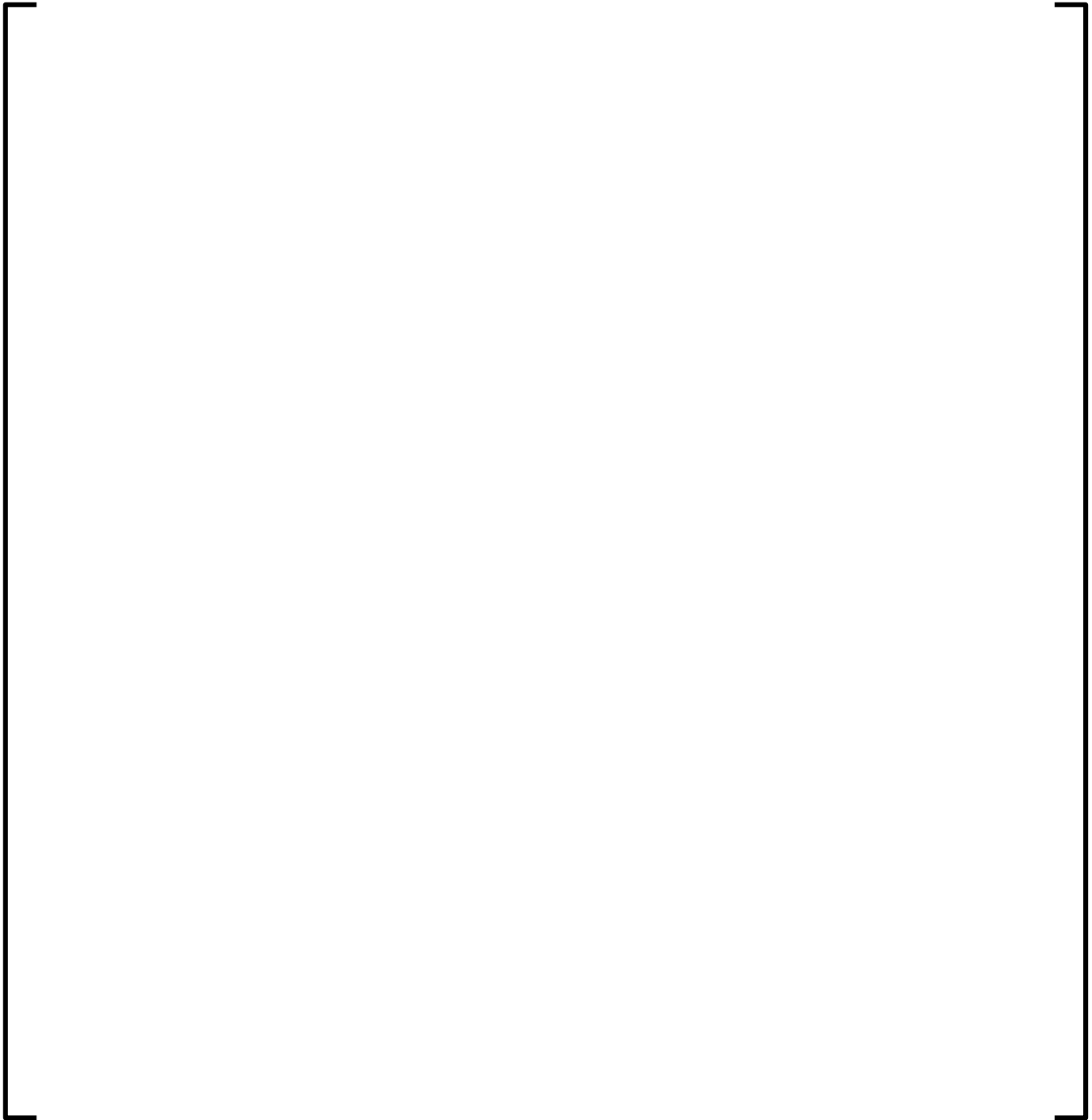


Figure B.1 Elevation View for the Fresh Fuel Reload Batch SUS2-21
[Fuel Assembly Design]



Figure B.2 Elevation View for the Fresh Fuel Reload Batch SUS2-21
[Fuel Assembly Design]

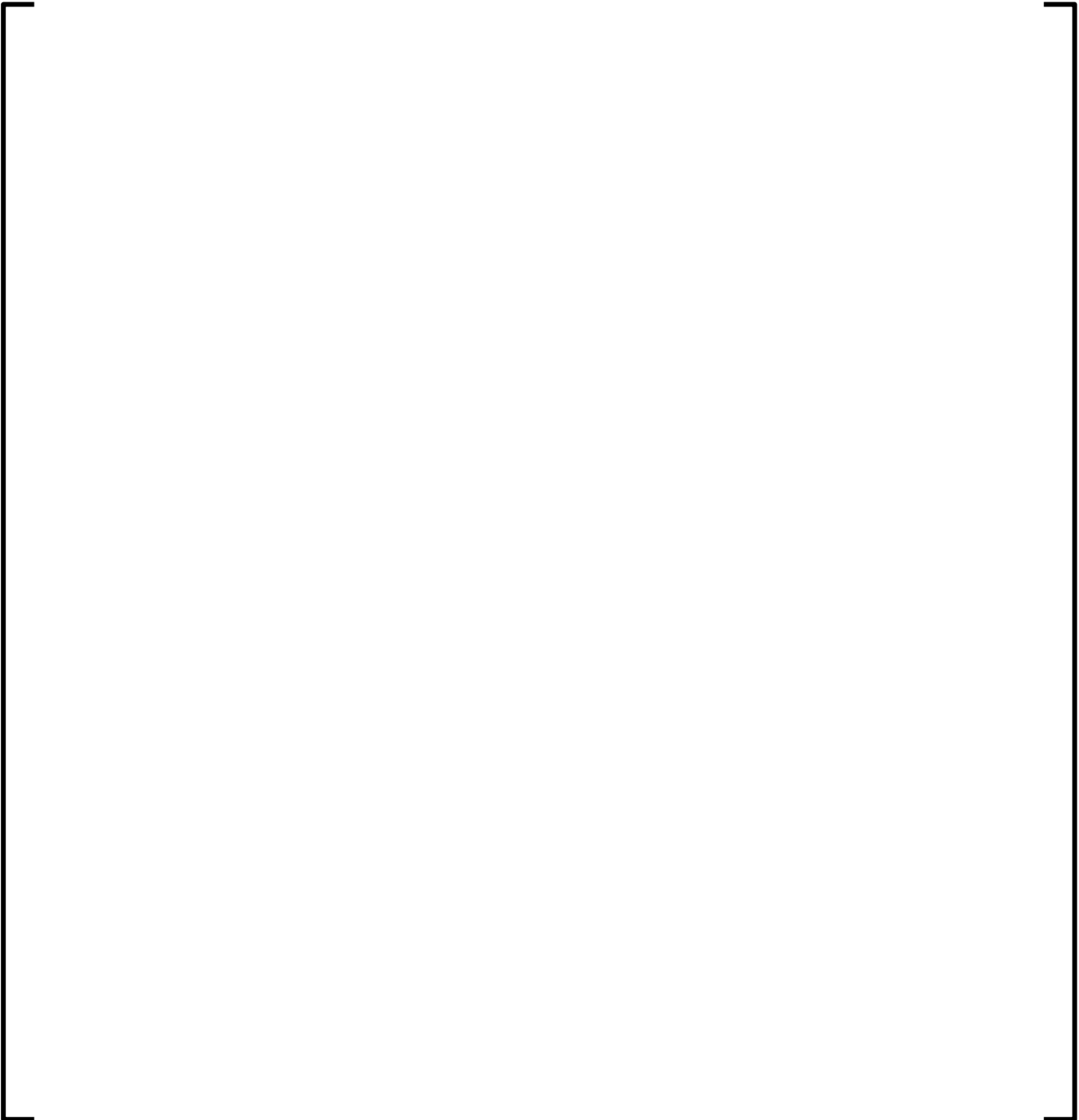


Figure B.3 Elevation View for the Fresh Fuel Reload Batch SUS2-21
[Fuel Assembly Design]

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Appendix C Susquehanna Unit 2 Cycle 21 Fresh Fuel Locations

Table C.1 Reload Fuel Identification and Locations []

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Table C.2 Reload Fuel Identification and Locations []

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Table C.3 Reload Fuel Identification and Locations []

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Appendix D Susquehanna Unit 2 Cycle 21 Radial Exposure and Power Distributions

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[

Figure D.1 BOC Exposure Distribution []

Figure D.2 EOC Exposure Distribution []

[

[

Figure D.3 Radial Power Distribution at [

Figure D.4 Radial Power Distribution at [

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**Appendix E Susquehanna Unit 2 Cycle 20 EOC Projection Control Rod
Patterns and Core Average Axial Power and Exposure Distributions**

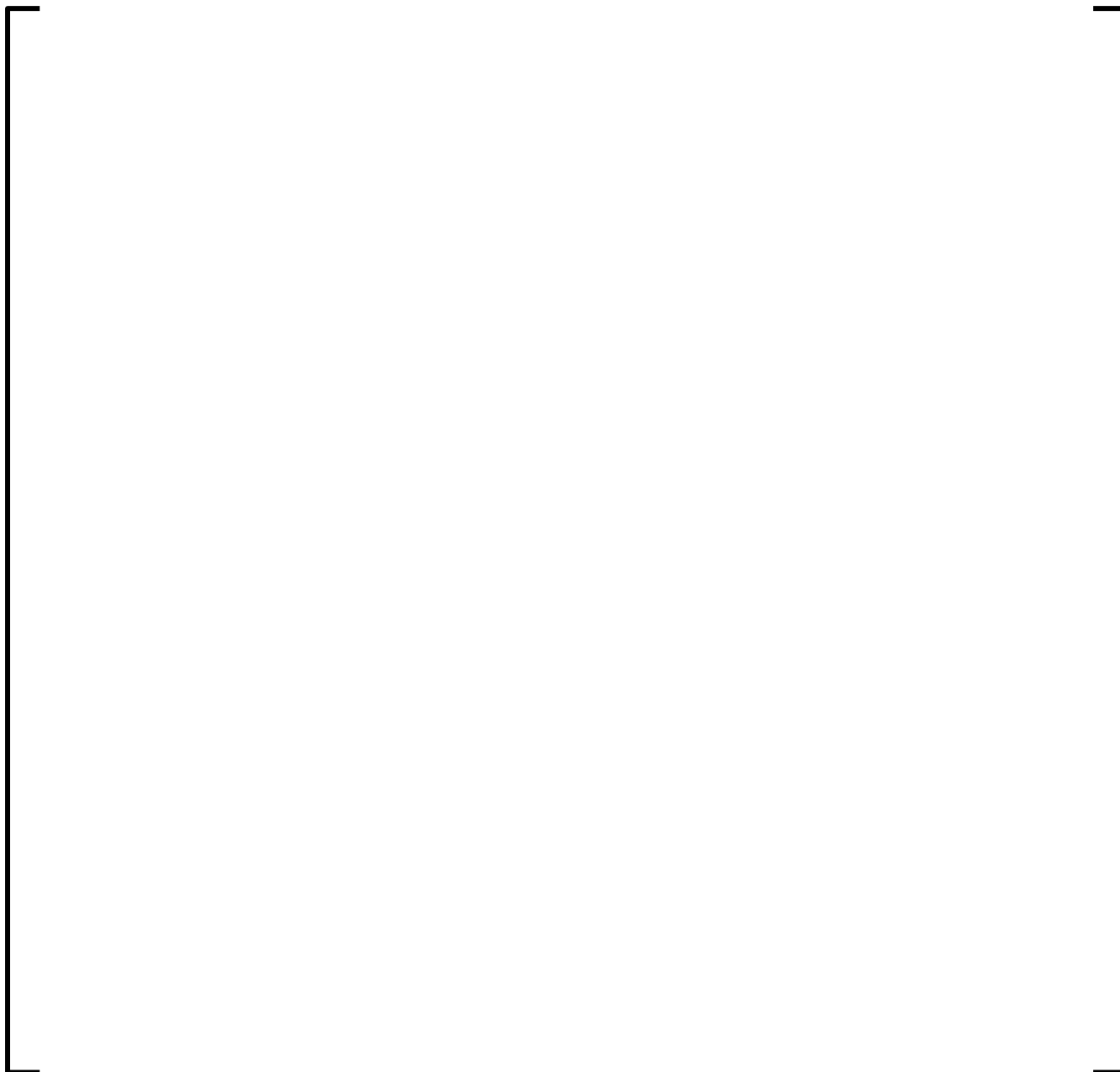


Figure E.1 Cycle 20 Control Rod Pattern and Axial Distributions at
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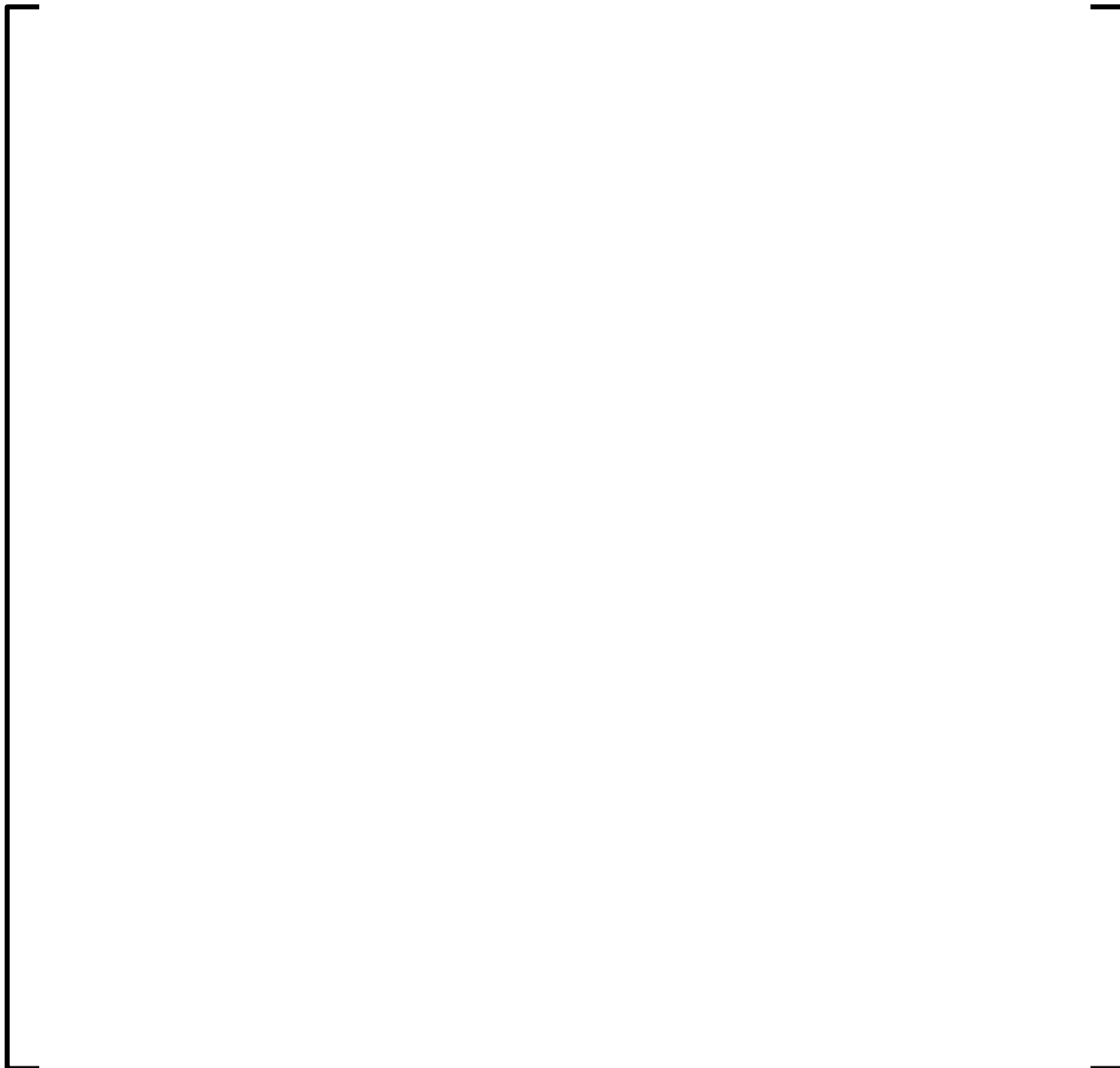


Figure E.2 Cycle 20 Control Rod Pattern and Axial Distributions at
[]



Figure E.3 Cycle 20 Control Rod Pattern and Axial Distributions at
[]

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**Framatome Affidavit for ANP-3826P,
“Susquehanna Unit 2 Cycle 21
Fuel Cycle Design Report”**

AFFIDAVIT

1. My name is Alan B. Meginnis. I am Manager, Product Licensing, for Framatome Inc. and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by Framatome to determine whether certain Framatome information is proprietary. I am familiar with the policies established by Framatome to ensure the proper application of these criteria.

3. I am familiar with the Framatome information contained in the report ANP-3826P, Revision 0, "Susquehanna Unit 2 Cycle 21 Fuel Cycle Design Report," dated March 2020 and referred to herein as "Document." Information contained in this Document has been classified by Framatome as proprietary in accordance with the policies established by Framatome for the control and protection of proprietary and confidential information.

4. This Document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by Framatome and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in this Document be withheld from public disclosure. The request for withholding of proprietary information is made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by Framatome to determine whether information should be classified as proprietary:

- (a) The information reveals details of Framatome's research and development plans and programs or their results.
- (b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.
- (c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for Framatome.
- (d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for Framatome in product optimization or marketability.
- (e) The information is vital to a competitive advantage held by Framatome, would be helpful to competitors to Framatome, and would likely cause substantial harm to the competitive position of Framatome.

The information in the Document is considered proprietary for the reasons set forth in paragraphs 6(b), 6(d) and 6(e) above.

7. In accordance with Framatome's policies governing the protection and control of information, proprietary information contained in this Document have been made available, on a limited basis, to others outside Framatome only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. Framatome policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

Alan Meginnis
Alan Meginnis

STATE OF WASHINGTON)
) ss.
COUNTY OF BENTON)

SUBSCRIBED before me this 26th day of March, 2020.

Katherine Kerr
Katherine Kerr
NOTARY PUBLIC, STATE OF WASHINGTON
MY COMMISSION EXPIRES: 9/12/2022

