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Calorimetric Uncertainty Evaluation Non-Proprietary Version

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1.0 PURPOSE

This analysis determines the overall calorimetric uncertainty associated with plant computer application XC105. The analysis accounts for the instrument uncertainties associated with the independent variables that have the largest impact on the calculation of calorimetric power. These variables are:

- Feedwater Flow
- Feedwater Temperature
- Steam Generator Pressure
- Steam Generator Moisture Carryover
- Steam Generator Blowdown Flow
- Steam Generator Blowdown Temperature

This analysis combines the individual instrument uncertainties associated with the independent variables to determine the overall calorimetric uncertainty. The individual contributions to the power uncertainty are combined using a statistical summation to determine the total power measurement uncertainty. This approach is consistent with the methods described in ANSI/ISA-67.04.01-2000, "Setpoints for Nuclear Safety-Related Instrumentation" (Reference 2.3)

This calculation is applicable for use with the CROSSFLOW ultrasonic feedwater flow measurement system.

2.0 REFERENCES

The following are references used in developing this document.

2.1 OPPD Production Engineering Division Procedure, "Calculation Preparation, Review and Approval", PED Quality Procedure QP-3, Revision 3, dated 4/8/94.

2.2 OPPD Production Engineering Division Standard, "Instrument Loop Uncertainty Setpoint / Tolerance Calculation Methodology" Document Number EEI-3.

2.3 ANSI/ISA-67.04.01-2000, "Setpoints for Nuclear Safety-Related Instrumentation"

2.4 FC06898, "Steam Generator Pressure and Feedwater Temperature Instrument Uncertainty Analysis", Rev.0

2.5 FC06907, "Steam Generator Blowdown Flow and Temperature Instrument Uncertainty Analysis" Rev.0

2.6 Basic Engineering Data Collection and Analysis, Vardeman/Jobe.

2.7 "Steam Generator Moisture Carryover Test Results", CE-18074-2087 dated August 14,1986.

2.8 Calculation FC06091, "Uncertainties Report for Fort Calhoun Station Secondary Calorimetric".

2.9 "Applied Numerical Analysis", Sixth Edition, Curtis F. Gerald and Patrick O. Wheatley

2.10 "Improved Flow Measurement Accuracy using Crossflow Ultasonic Flow Measurement Technology", CENPD-397-P-A Rev.01.

2.11 "Upgraded ERFCS Functional Requirements Specification", Rev.1.02.20.02.

2.12 ASME Steam Tables

3.0 ASSUMPTIONS AND GIVEN CONDITIONS

The following assumptions and given conditions (A&GC) are used in development of this calculation.

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4.0 METHOD OF CALCULATION

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4.1 ENERGY AND FLOW EQUATIONS

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4.1.1 STEAM GENERATOR ENERGY EQUATION (XC101/XC102)

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4.1.2 STEAM GENERATOR FEEDWATER FLOW EQUATION (XC088/XC089)

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4.1.3 STEAM GENERATOR BLOWDOWN FLOW EQUATION (XC086/XC087)

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4.2 CALCULATION OF CALORIMETRIC UNCERTAINTIES

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4.2.1 INSTRUMENT UNCERTAINTIES

[

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4.2.2 WEIGHTING FACTORS

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4.2.3 COMBINING ERROR TERMS

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4.3 ONE SIDED 95% CONFIDENCE INTERVAL

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4.4 NSS ENERGY LOSS AND ELECTRICAL ENERGY WEIGHTING FACTORS

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5.1 INPUT VARIABLES

The following values are used in this analysis to calculate weighting factors for each independent variable. The values provided are for the nominal (100%) power values of the independent variables used in the energy equation. Also provided are the incremental values used to determine the weighting factors.

5.2 EQUATIONS

5.3 WEIGHTING FACTORS

5.3.12

5.3.13

5.3.14

5.4 CALORIMETRIC UNCERTAINTY					A	B	C	D	C xD	$(AxBxCxD)^2$

5.5 NSSS ENERGY LOSS AND ELECTRICAL ENERGY WEIGHTING FACTORS

5.5.1

5.5.2

6.0 CONCLUSIONS

This calculation determined the calorimetric uncertainty based on an upgrade of feedwater flow and temperature instrumentation which is used for the XC105 calculation.[

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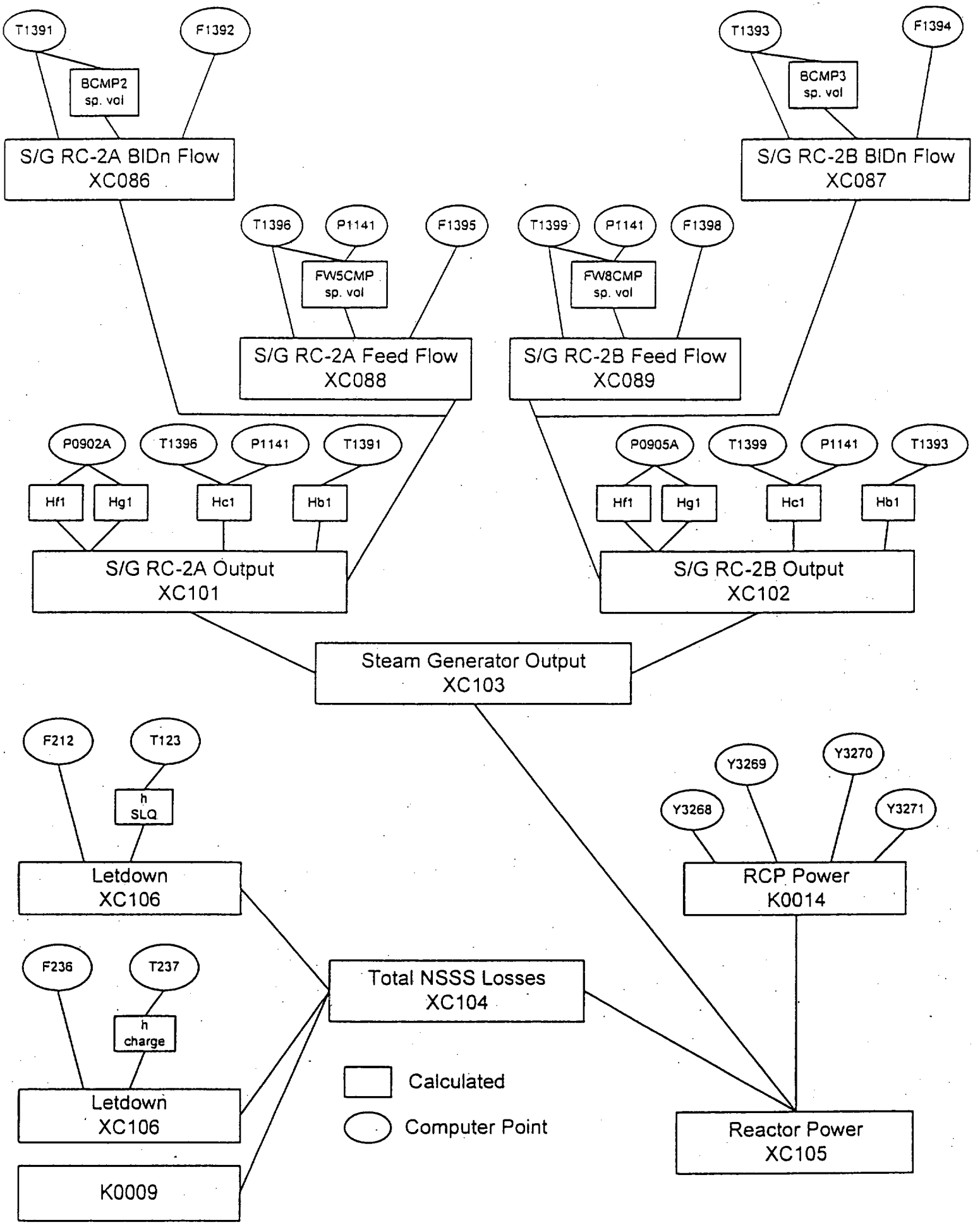
Allowable Uprate: 2%-0.3506% = 1.6494%

Based on this an uprate of 1.60% is acceptable and enveloped by this analysis.

ATTACHMENT 1



Block Diagram of XC105 Calculation

ATTACHMENT 2

35/60

Reactor Power

XC105 Values	
Time Interval	MW thermal
Real Time	1502.87
2 Minute Average	1497.52
5 Minute Average	1497.87
10 Minute Average	1498.23
30 Minute Average	1498.10
1 Hour Average	1498.24
2 Hour Average	1498.29
4 Hour Average	1498.48
8 Hour Average	1498.61

XC105 Inputs			
Parameter	Value	Units	
S/G 2A Blowdown Temperature	499.25	°F	T1391
S/G 2A Blowdown Flow	4.54	" water	F1392
S/G 2A Blowdown Flow	25,555	lb/hr	F1392C
S/G 2B Blowdown Temperature	497.25	°F	T1393
S/G Blowdown Flow	4.48	" water	F1394
S/G Blowdown Flow	25,406	lb/hr	F1394C
S/G 2A Feedwater Temperature	442.31	°F	T1396
S/G 2A Feedwater Flow	359.00	" water	F1395
S/G 2A Feedwater Flow	3,315,690	lb/hr	F1395C
S/G 2B Feedwater Temperature	441.88	°F	T1399
S/G 2B Feedwater Flow	368.50	" water	F1398
S/G 2B Feedwater Flow	3,365,500	lb/hr	F1398C
Feedwater Pressure	1,001.56	psig	P1141
S/G 2A Pressure	817.19	psia	P0902A
Regen Heat Exchanger Temperature	403.70	°F	T237
Letdown Flow	34.00	gpm	F212
S/G 2B Pressure	807.81	psia	P0905A
Charging Pump Flow	38.73	gpm	F236

ERF Display: XCF, MWT

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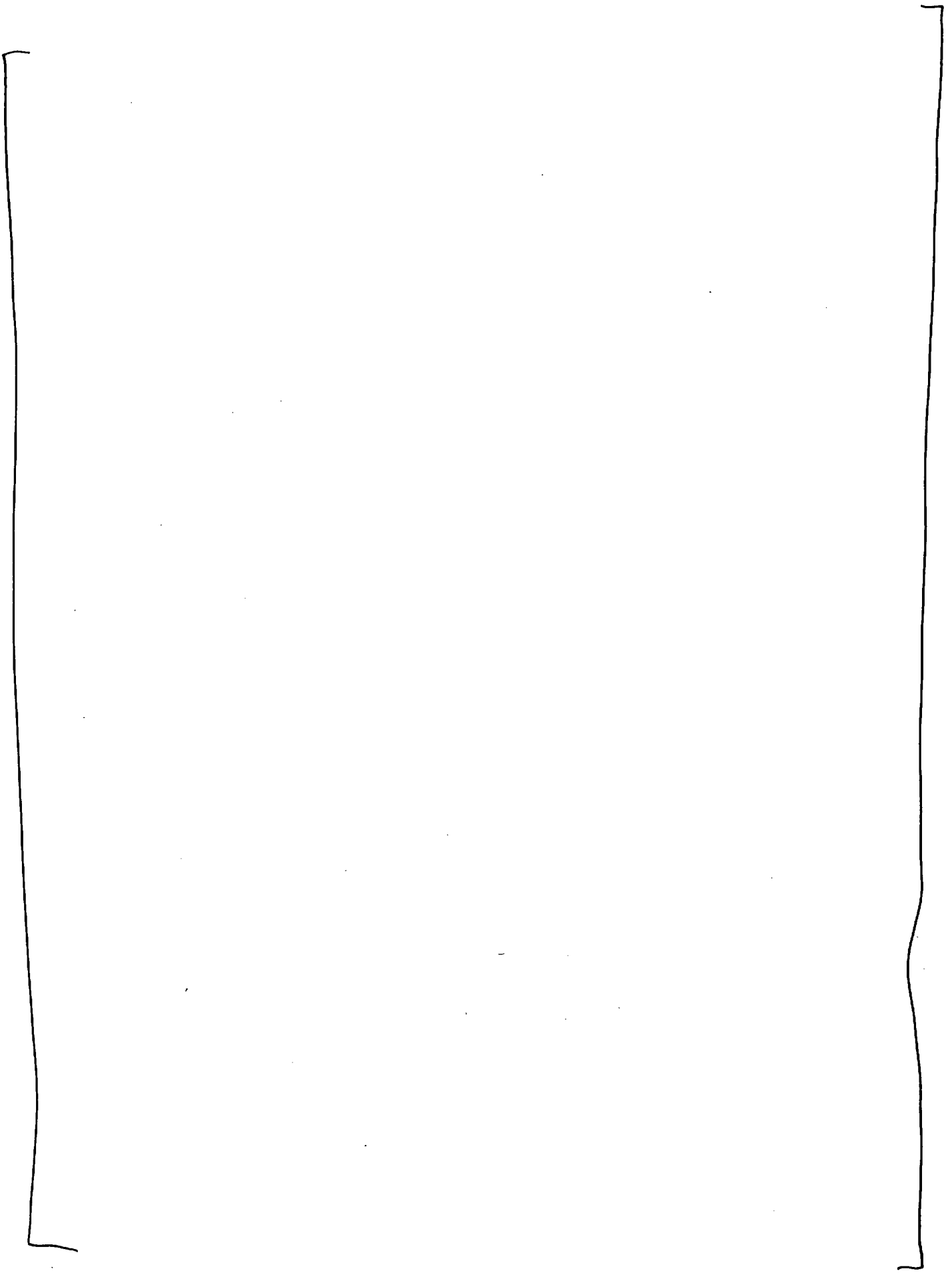
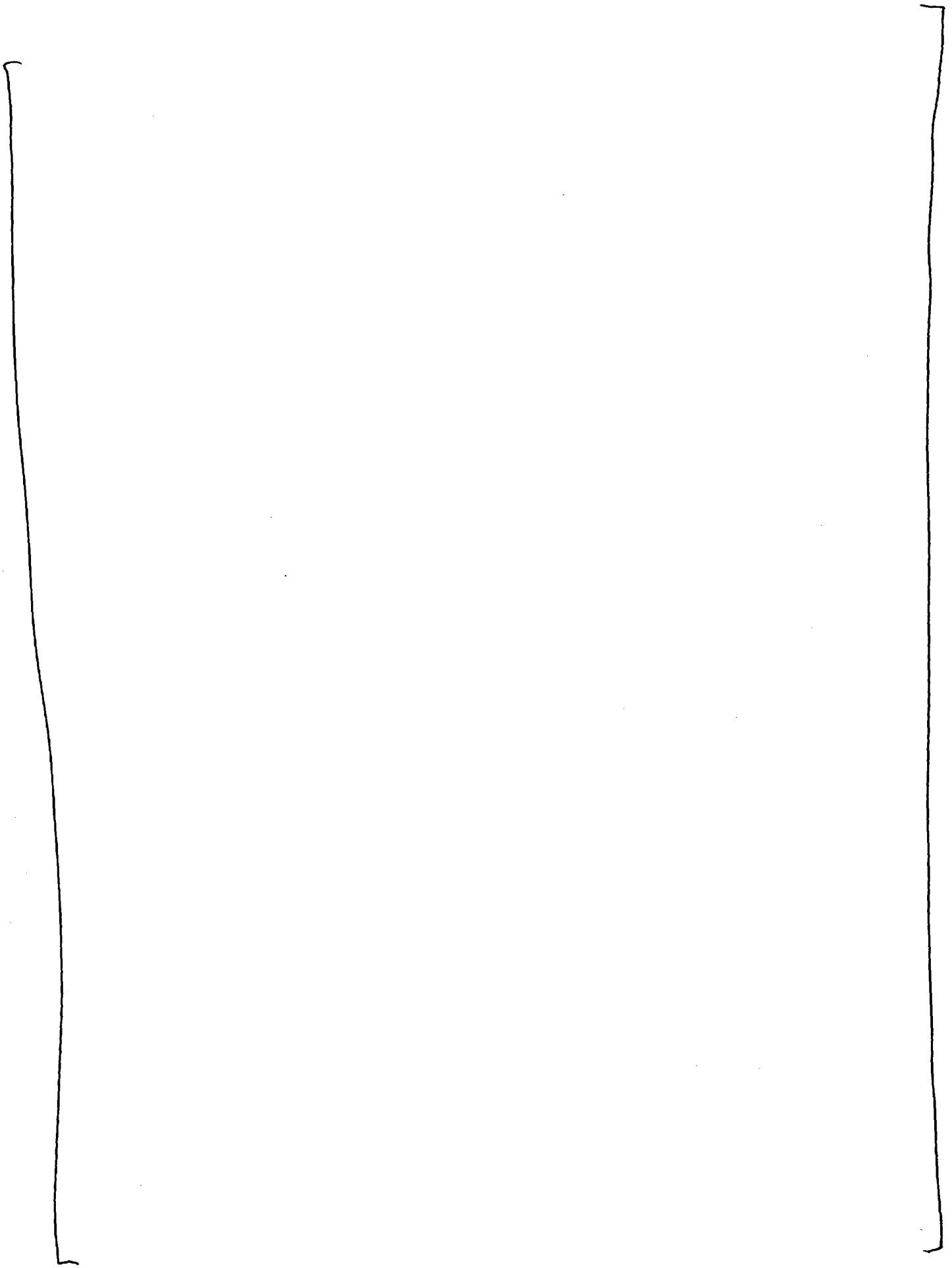
ATTACHMENT 3





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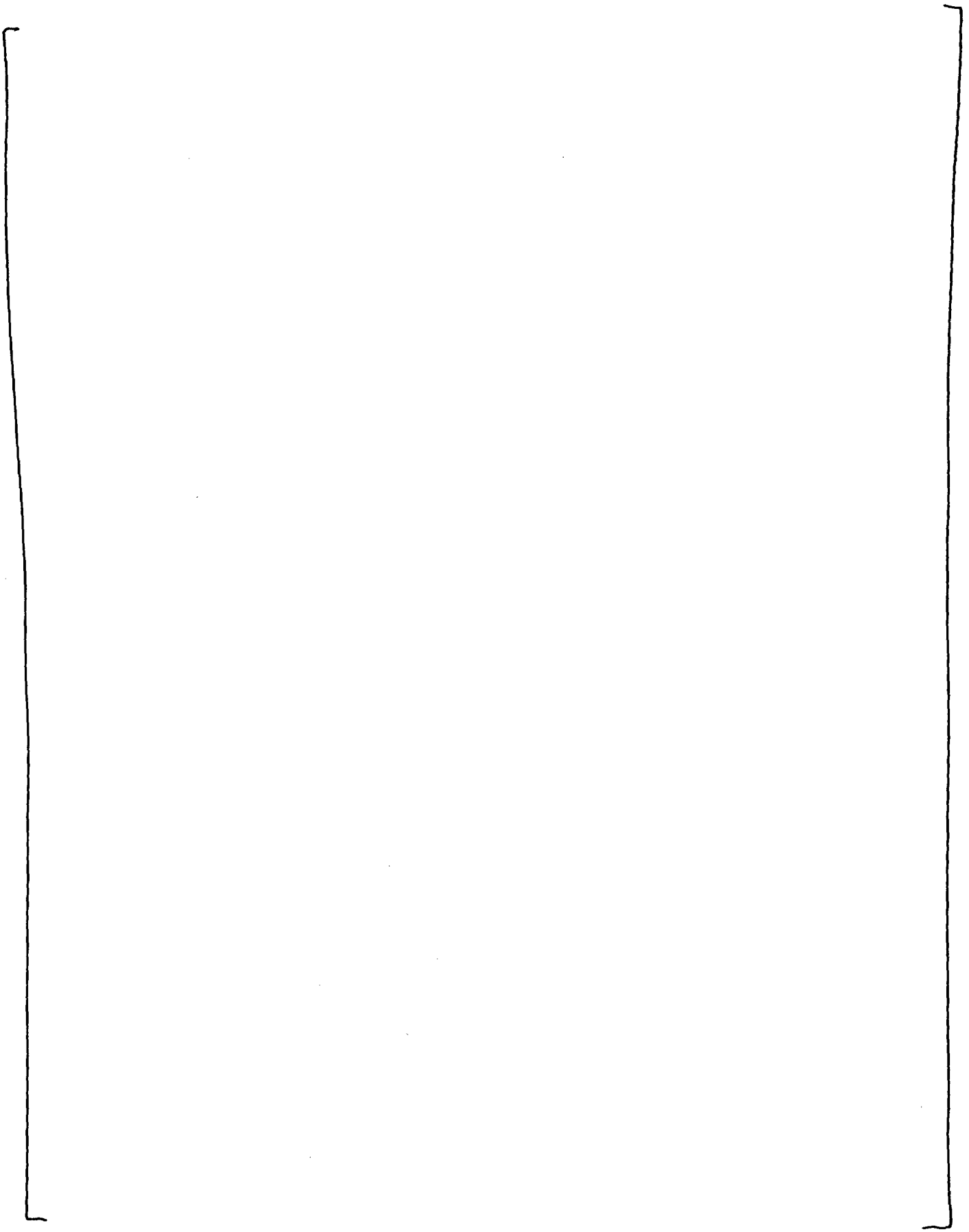

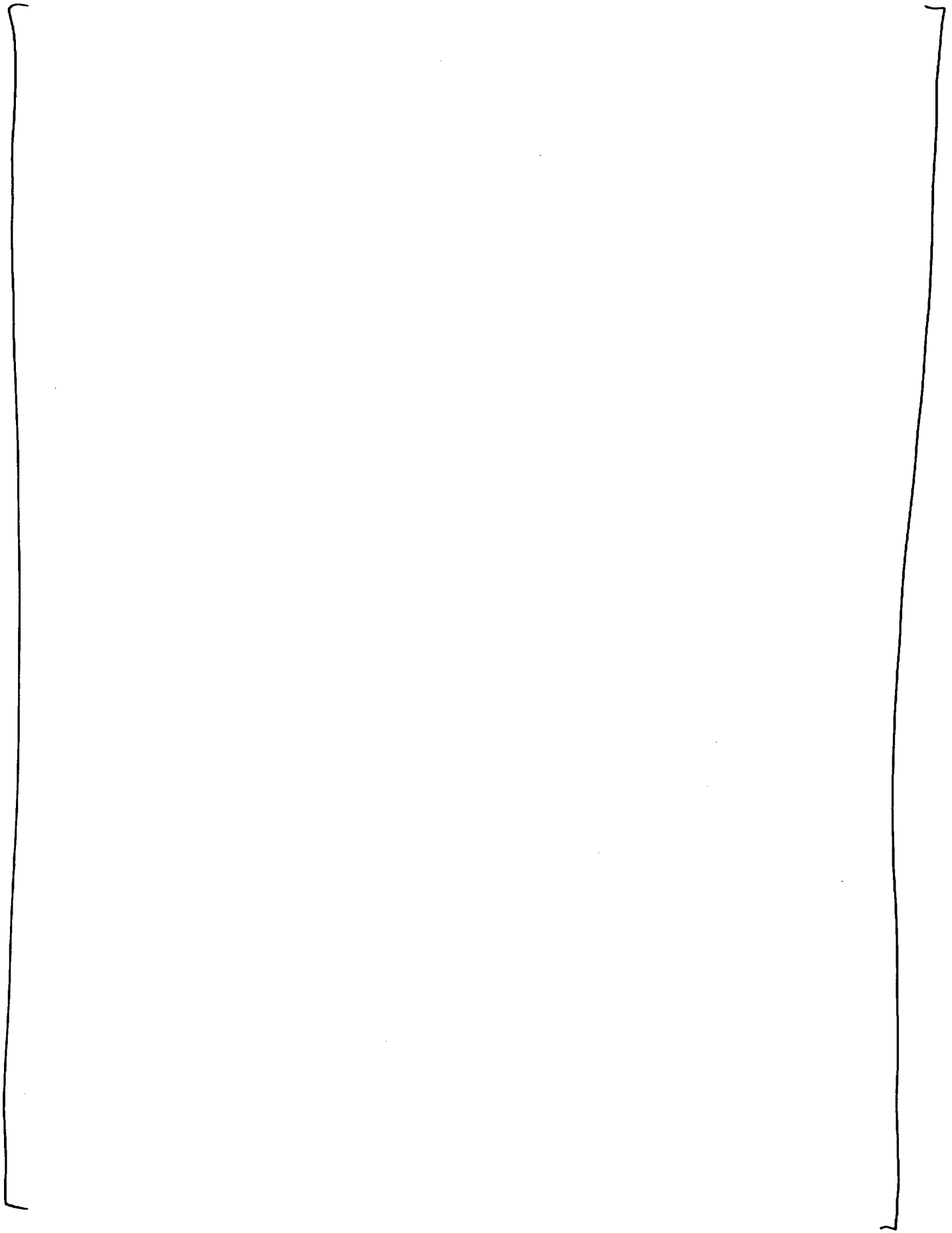

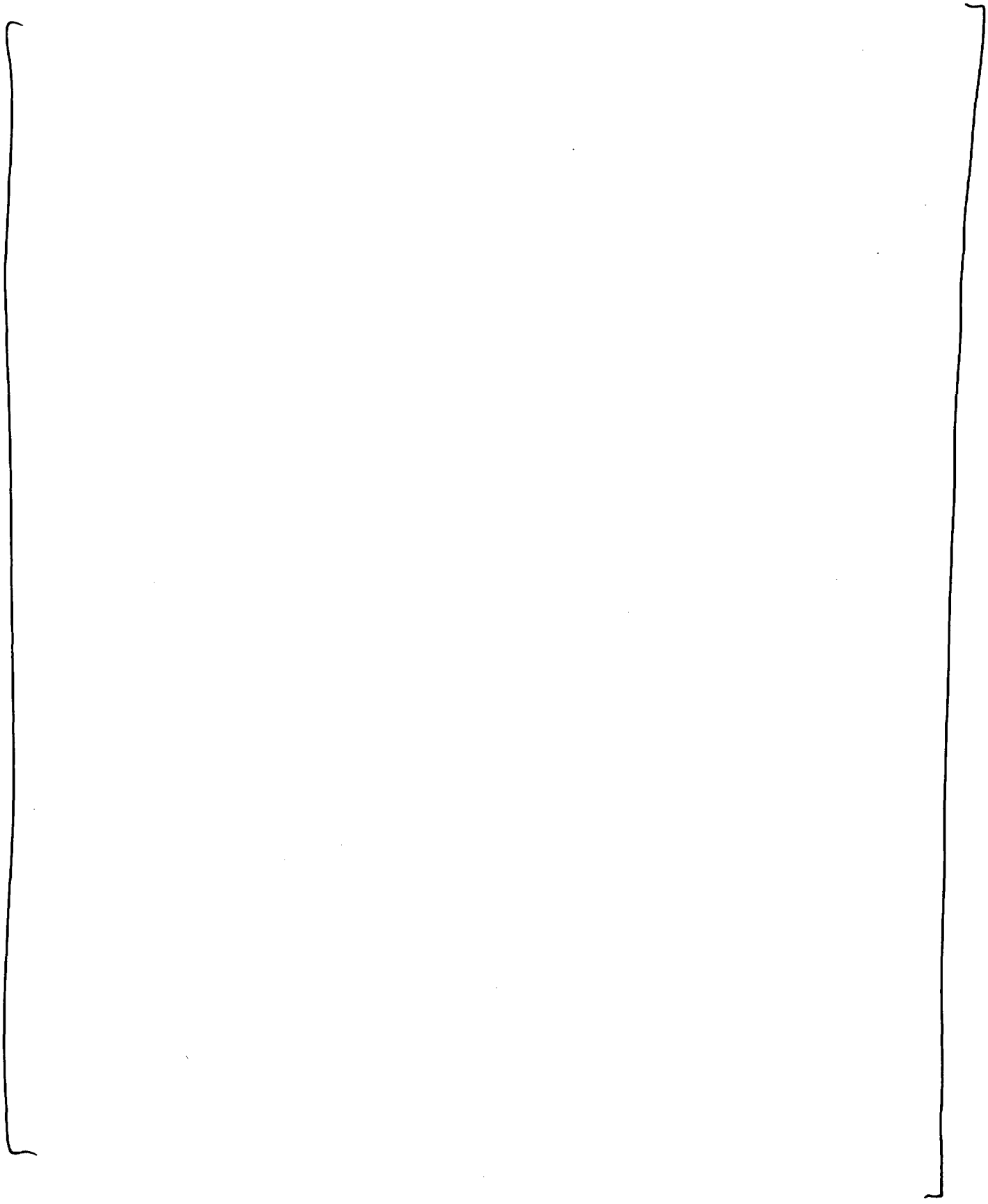

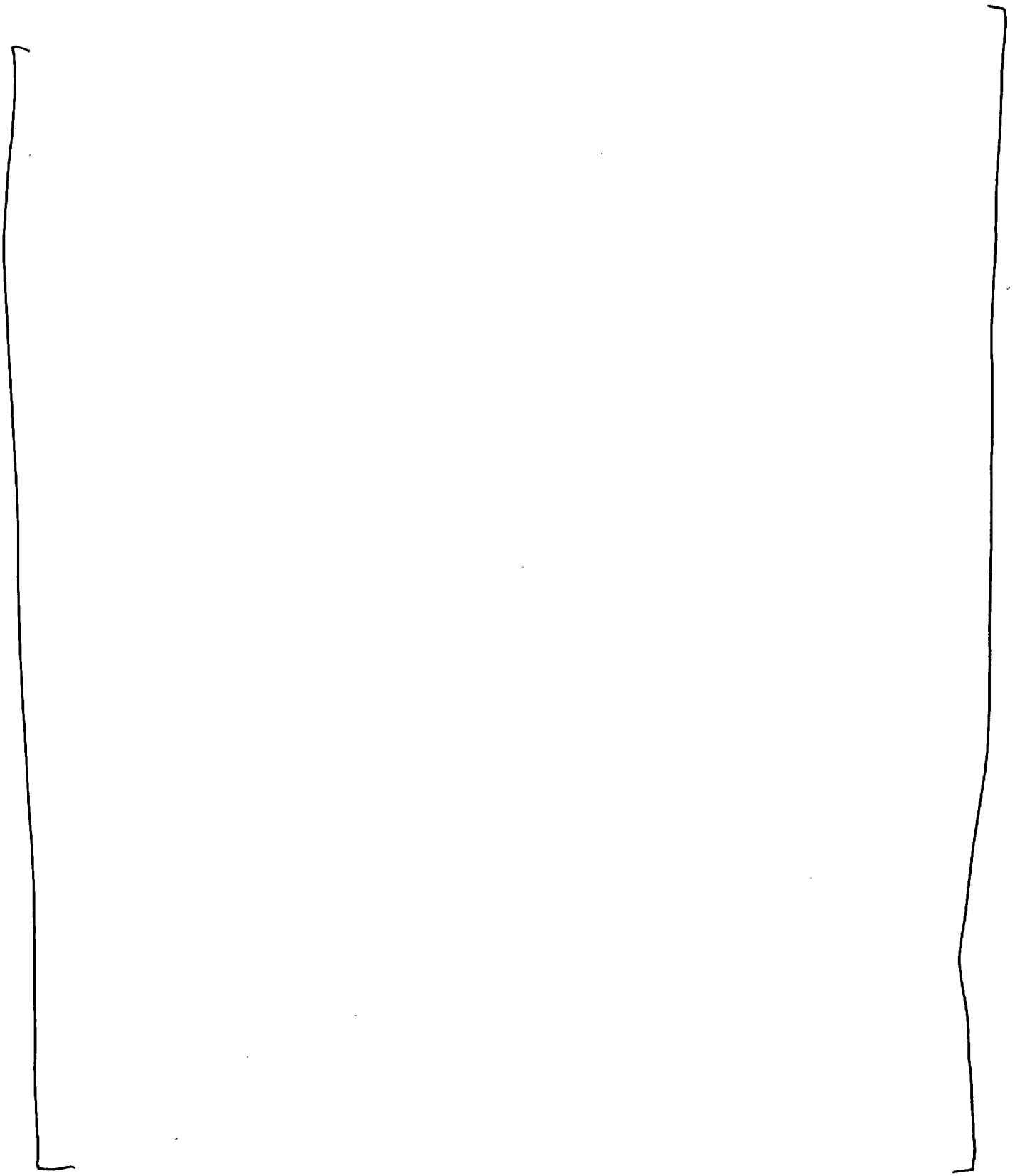

ATTACHMENT 4

ATTACHMENT 5

The following documents an independent check that was performed to verify the spreadsheet calculations made in this analysis.

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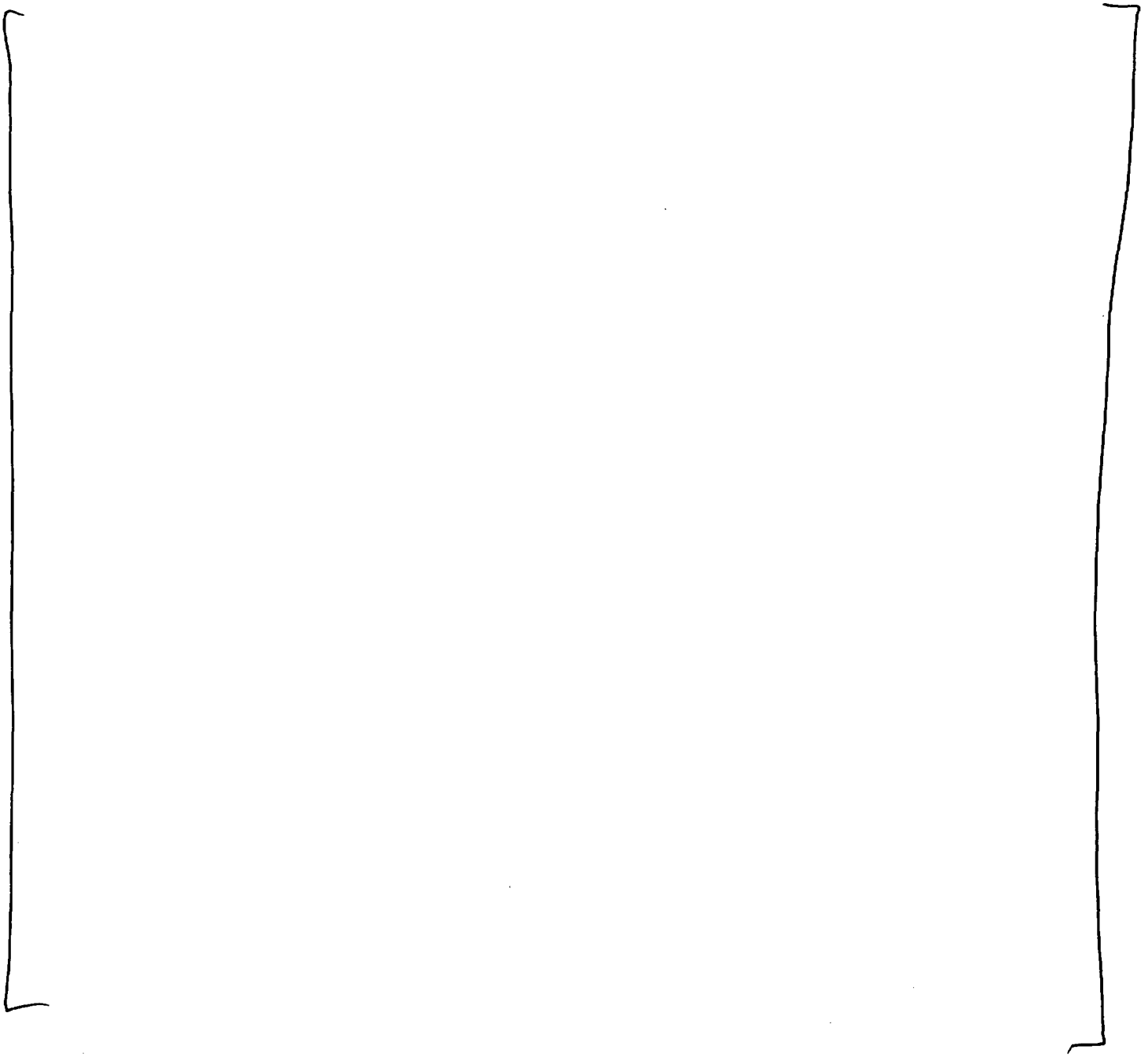

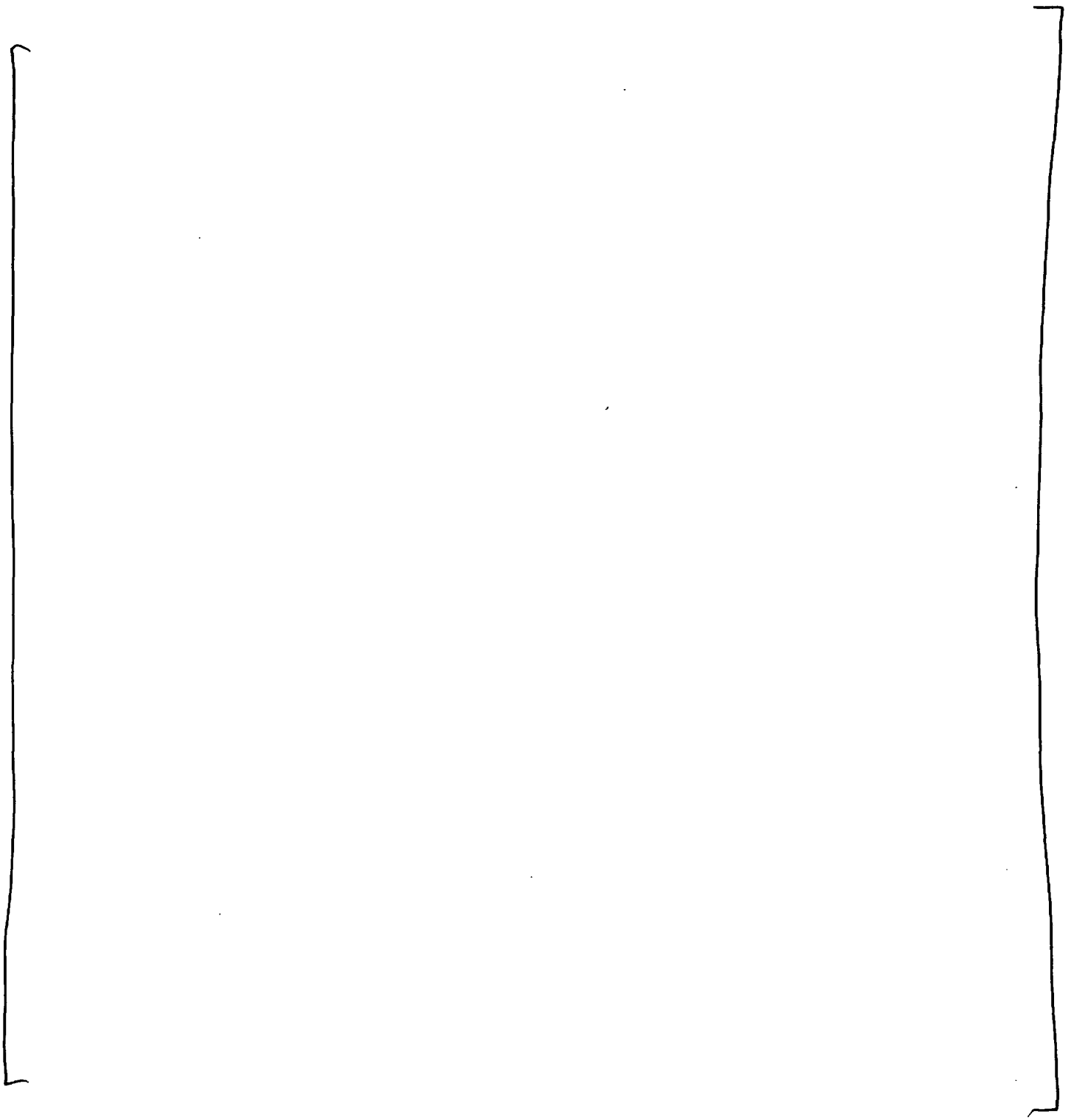

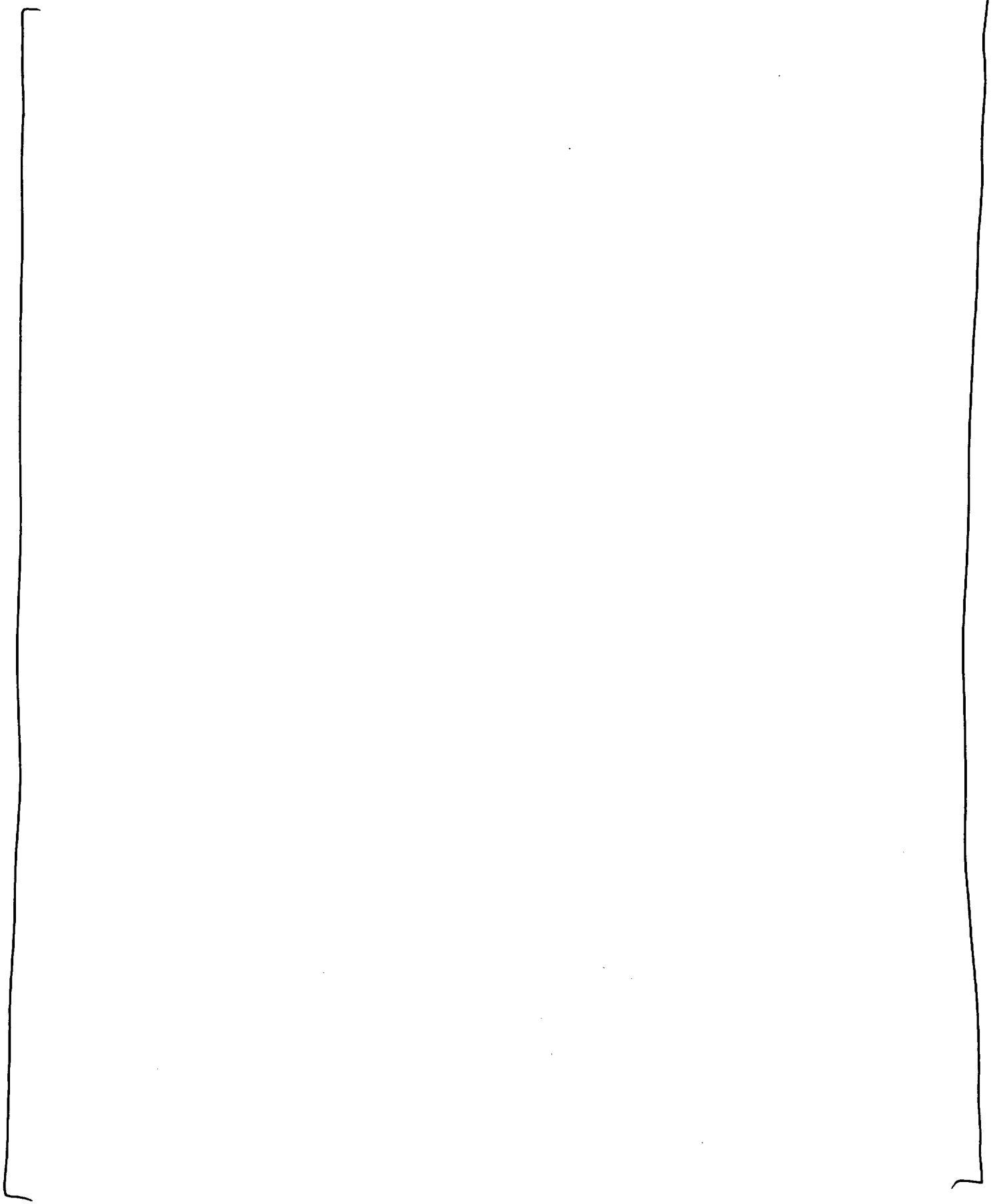

LIC-03-0122 Attachment 5

Affidavit for Calorimetric Uncertainty Evaluation

PL Integrated Services Proprietary Affidavit

I, Tim Leibel, depose and say that I am a Principal of PL Integrated Services LLC (PLIS), duly authorized to make this affidavit, and have reviewed or caused to have reviewed the information which is identified as proprietary and described below. I have personal knowledge of the criteria and procedures utilized by PLIS in designating information as a trade secret, privileged, or as confidential commercial or financial information.

This affidavit is submitted in conformance with the provisions of 10 CFR 2.790 of the Commission's regulations for withholding proprietary information. The information for which proprietary treatment is sought, and which document has been appropriately designated as proprietary, is *Calculation Number* FC-6896-P "Secondary Calorimetric Uncertainty Analysis".

Pursuant to 10 CFR 2.790(b)(4) of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information included in the document listed above should be withheld from public disclosure.

1. The information sought to be withheld from public disclosure is owned and has been held in confidence by PLIS. It consists of the information concerning the technical basis and implementation of a secondary calorimetric uncertainty analysis for the Fort Calhoun Station.

2. The information consists of methodologies for the development and implementation of a secondary calorimetric uncertainty analysis, the application of which results in substantial competitive advantage to PLIS.

3. The information is of a type customarily held in confidence by PLIS and not customarily disclosed to the public.

4. The information is being transmitted to the Commission in confidence under the provisions of 10 CFR 2.790 with the understanding that it is to be received in confidence by the Commission.

5. The information, to the best of my knowledge and belief, is not available in public sources, and any disclosure to third parties has been made pursuant to regulatory provisions or proprietary agreements that provide for maintenance of the information in confidence.

6. Public disclosure of the information is likely to cause substantial harm to the competitive position of PLIS because:

    a. A similar product or service is provided by competitors.
    b. PLIS has invested substantial funds and engineering resources in the development of this information. A competitor would have to undergo similar expense in generating equivalent information.
    c. The information consists of the technical basis and implementation of a secondary calorimetric uncertainty analysis for the Fort Calhoun Station, the application of which provides PLIS a competitive economic advantage. The availability of such information to competitors would enable them to design their product or service to better compete with PLIS, take marketing or other actions to improve their product's position or impair the position of PLIS product, and avoid developing similar technical analysis in support of their processes, methods or apparatus.

Tim Leibel
Principal
PL Integrated Services LLC

Sworn to before me this 27th day of August 2003

William J. Ponec, Notary Public

My commission expires: April 4, 2004

GENERAL NOTARY-State of Nebraska
WILLIAM J. PONEC
My Comm. Exp. April 4, 2004