Westinghouse Non-Proprietary Class 3

WCAP-17626-NP
Revision 0

August 2012

Processing of Peach Bottom Unit 2 and Unit 3 MSL Strain Gauge Data and Computation of Predicted EPU Signature

Enclosure B.6

Westinghouse

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Processing of Peach Bottom Unit 2 and Unit 3 MSL Strain Gauge Data and Computation of Predicted EPU Signature

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EXECUTIVE SUMMARY

Peach Bottom Atomic Power Stations (PBAPS2 and PBAPS3, herein referred to as "Peach Bottom Unit 2 and Peach Bottom Unit 3") are implementing an extended power uprate (EPU) to increase plant power to [

]^{a,c}

To satisfy the requirements of the United States Nuclear Regulatory Commission (NRC) Regulatory Guide 1.20, Revision 3 (Reference 2), an analysis must be performed to demonstrate the structural integrity of the steam dryer at EPU conditions. [

]^{c}

[

]^{a,c}

[

]^{a,c}

[

]^{a}

LIST OF ACRONYMS AND ABBREVIATIONS

ACM	[ ][a]
ASCII	American Standard Code for Information Interchange
BWR	boiling water reactor
CLTP	current licensed thermal power
DAS	data acquisition system
DS	downstream (for Figures only)
EIC	electrical interference check
EPU	extended power uprate
EPU*1.02	102 percent of extended power uprate
FFT	fast Fourier transform
HPCI	high-pressure coolant injection
MSL	main steam line
NRC	Nuclear Regulatory Commission
OEM	original equipment manufacturer
PCF	[ ][a]
PBAPS	Peach Bottom Atomic Power Stations
PSD	power spectral density
RRP	reactor recirculation pump
RSD	replacement steam dryer
SIA	Structural Integrity Associates, Inc.
SNR	signal-to-noise ratio
SRV	safety relief valve
SSV	safety spring valve
US	upstream (for Figures only)

1 BACKGROUND AND INTRODUCTION

[

]a,c

Previous industry experience with boiling water reactors (BWRs) has shown that increasing the steam flow through the MSLs to implement an EPU may lead to amplified acoustic loads on the steam dryer, which may negatively affect the structural integrity of the component. [

]c

NRC Regulatory Guide 1.20, Revision 3 (Reference 2), contains requirements for demonstrating the structural integrity of the steam dryer at power levels higher than CLTP. [

]a,c

[

]a,b,c

[

]a,b,c

[

]a,b,c

[

]a,c

2 SUMMARY OF PREVIOUS WORK

2.1 ACOUSTIC SCREENING

[

]^{a,b,c}

Table 2-1 [	]^{a,c}
[	
	]^{b}

2.2 SUBSCALE TESTING

[

]^{a,b}

2.3 PLANT DATA RECORDINGS

[

]^{a,c}

[ ]a,c (2-1)

[ ]a,c (2-2)

Where,

[

]a,c

Figure 2-1 Schematic of MSL [ ]a,b,c

[

]a,c

[

]c

2.4 DATA ACQUISITION

[

]a,c

[

]a,c

Table 2-2 summarizes the data collected during [

]b

Table 2-3 summarizes the data collected during [

]b

[

]a,b,c

Table 2-2 Dates and Times of Peach Bottom Unit 2 Data Recording

Recording	% CLTP	Filename	Date	Time

b

Table 2-3 Dates and Times of Peach Bottom Unit 3 Data Recording

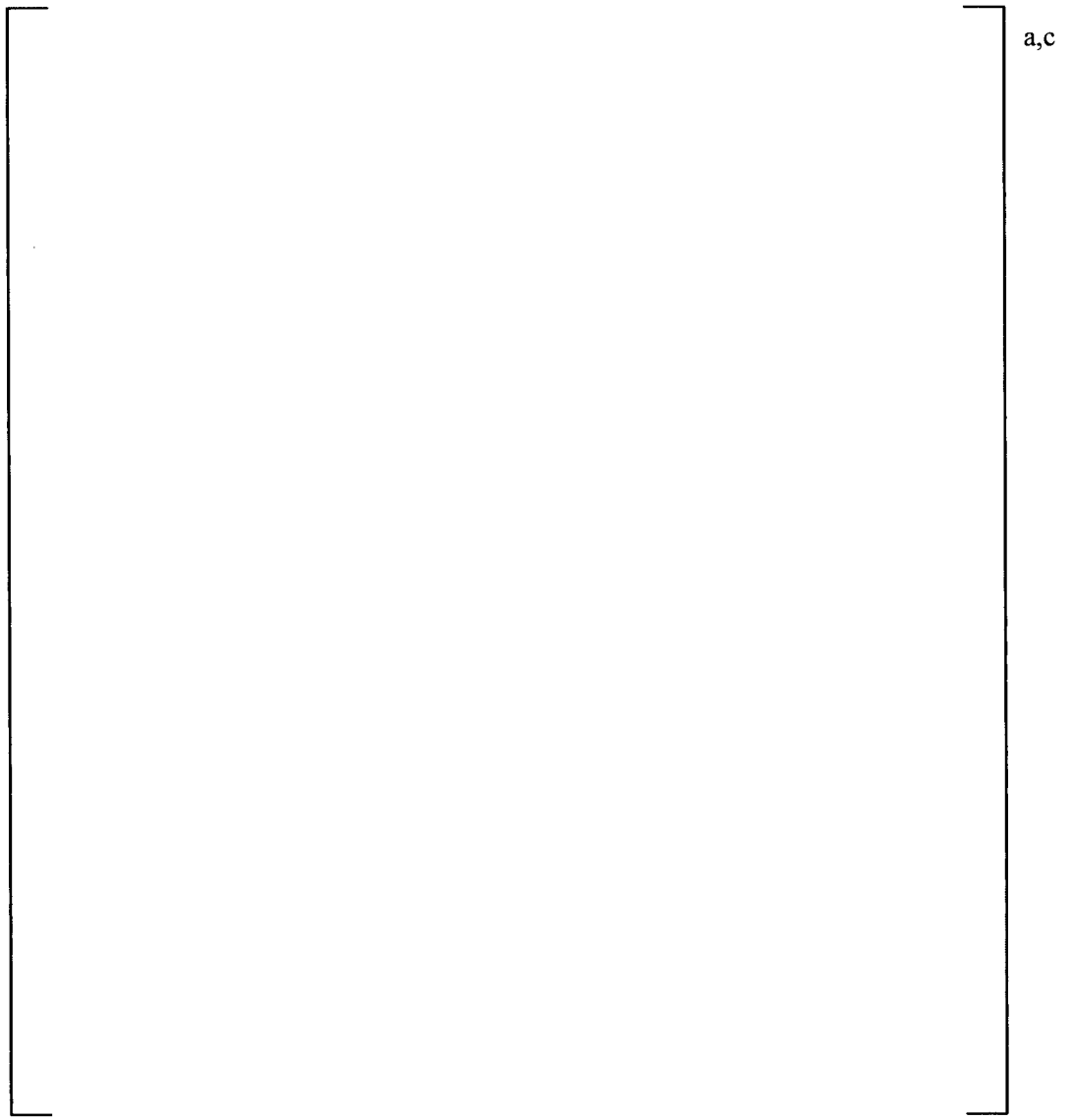
Recording	% CLTP	Filename	Date	Time

b

3 DATA PROCESSING PLAN AND RESULTS

[

]^{a,c}



a,c

Figure 3-1 Signal Processing Methodology Flowchart for [ ]^{a,c}

3.1 RAW DATA

[

]a,c

3.2 STRAIN-TO-PRESSURE CONVERSION

The strain to pressure conversion is shown in Box 4 of Figure 3-1. [

]a,c

[ ]a,c (3-1)

where,

[

]a,c


a,c

Figure 3-2 Pipe Mode Diagram, N= [0, 4]

[

]a,c

[

]a,c

[ ]^{a,c} (3-2)

where,

[

]^{a,c}

[

]^{a,c}

3.3 NARROW-BAND FILTERING

Narrow-band filtering is shown in Box 7 of Figure 3-1. [

]^{a,c}

[

]^{a,c}

3.4 COHERENCE FILTERING

[

]^{a,c} A brief description of the filtering is given in this section.

[

]^{a,c}

[ ]^{a,c} (3-3)

where,

[

]^{a,c}

[

]^{a,c}

[ ]^{a,c} (3-4)

where,

[

]^{a,c}

[ ]^{a,c} (3-5)

[ ]^{a,c} (3-6)

where,

[

]^{a,c}

[ ]^{a,c} (3-7)

[ ]^{a,c} (3-8)

[

]^{a,c}

[ ]^{a,c} (3-9)

[ ]^{a,c} (3-10)

Where

[ ]^{a,c}

[

]^{a,c}

[

]a,c

3.5 COMPUTATION OF THE PREDICTED EPU SIGNAL

[

]a,c

[

]a,c

4 INPUTS TO SIGNAL PROCESSING AND ASSUMPTIONS

4.1 INPUTS

[

]^{a,c}

[

]^{a,c}

4.2 ASSUMPTIONS

1. [

]^{a,c}

2. [

]^{a,c}

3. [

]^{a,c}

4. [

]^{a,c}

5. [

]^{a,c}

6. The acoustic speed in steam is assumed to be 1484.3 ft/s.

5 DISCUSSION OF RESULTS

5.1 RAW DATA EVALUATION

In fall 2010, [

]^{b}

In fall 2011, [

]^{a,b}

[

]^{a,c}

[

]^{b}

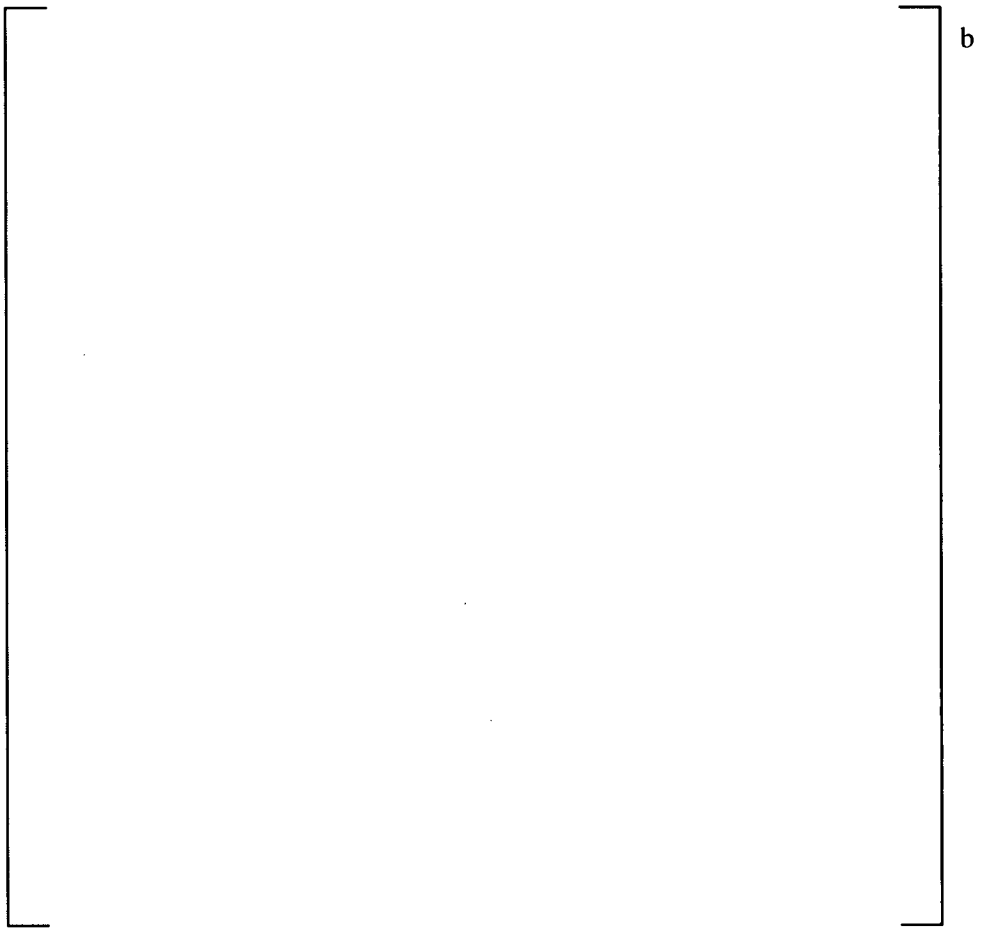


Figure 5-1 [ ]b

5.1.1 Unit 3

[

]b

5.2 STRAIN-TO-PRESSURE CONVERSION

[

]a,c

5.2.1 Unit 2

[

]a,b,c

Table 5-1 Summary of [ ]a,c

MSL	LOC	Channel				Mean

b

5.2.2 Unit 3

[

]a,c

[

]a,b

Table 5-2 Summary of [ ]a,c						
MSL	LOC	Channel				Mean

b

5.3 FILTERING

[

]a,c

[

]a,b

5.3.1 Unit 2

[

]b

Table 5-3 Peach Bottom Unit 2, Notch Filters, [ ]b				
Filter Order	Low Freq	High Freq	Filter Type	Reason

b

Table 5-4 Peach Bottom Unit 2, Notch Filters, [ ]^{b}				
Filter Order	Low Freq	High Freq	Filter Type	Reason

b

5.3.2 Unit 3

[

]^{b}

Table 5-5 Peach Bottom Unit 3, Notch Filters, [ ]^{b}				
Filter Order	Low Freq	High Freq	Filter Type	Reason

b

Table 5-6 Peach Bottom Unit 3, Notch Filters, [ ]^{b}				
Filter Order	Low Freq	High Freq	Filter Type	Reason

b

5.4 COHERENCE FILTERING

[

]^{a,c}

[ ]^{b}

b

Figure 5-2 Unit 2 Coherence Values [ ]^{a,c}

[

]^{a,b,c}

[ ] a,b,c

Figure 5-3 Unit 2 US and DS Coherence Filters

[ ]a,c

[

]a,b

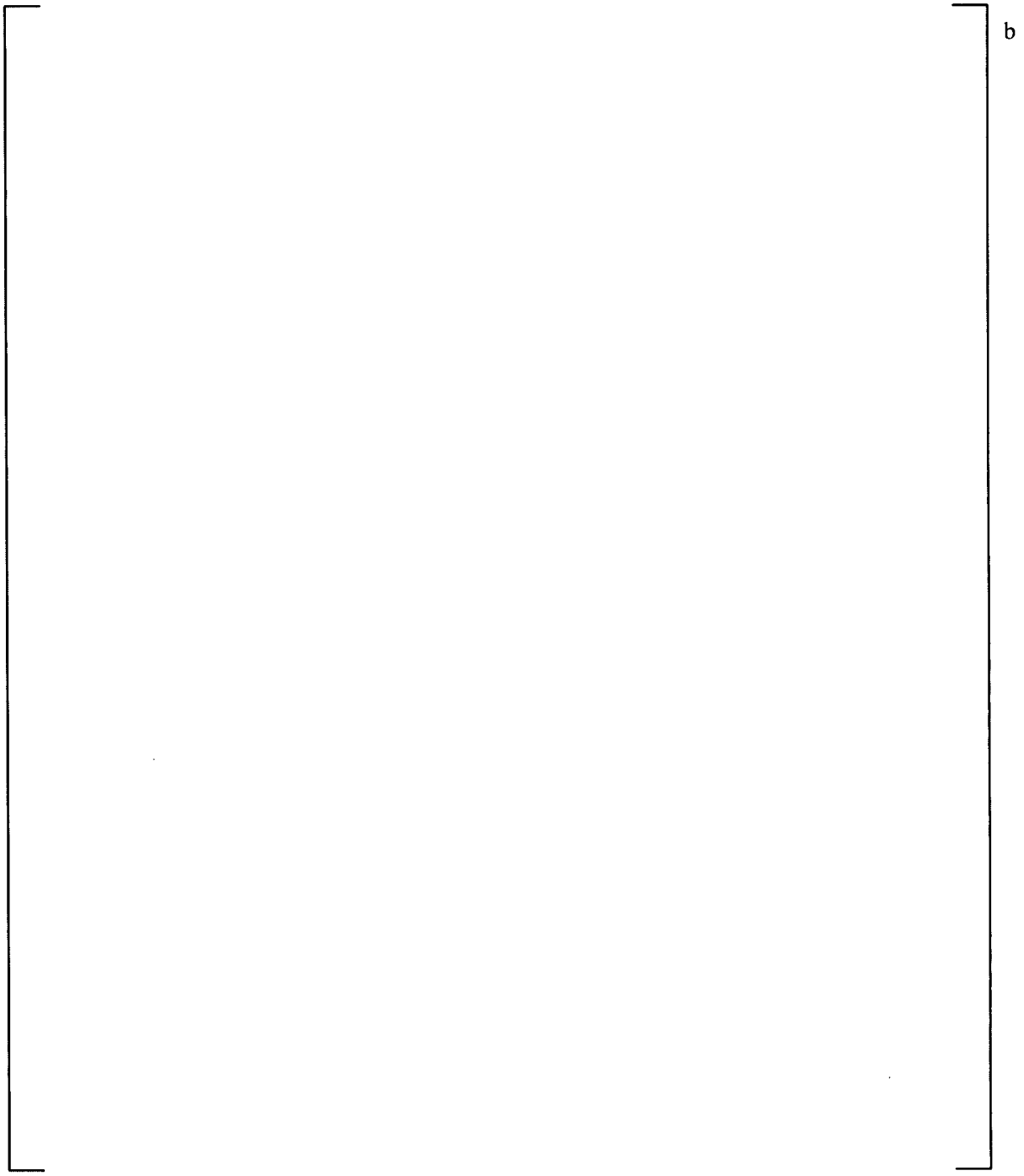


Figure 5-4 Unit 2 Basic and Coherent CLTP Signatures

5.4.1 Unit 3

[ ]^{b}

Figure 5-5 Unit 3 Coherence Values [ ]^{a,c}

[

]^{a,b,c}

a,b,c

Figure 5-6 Unit 3 US and DS Coherence

[ ]a,c

[

]a,b

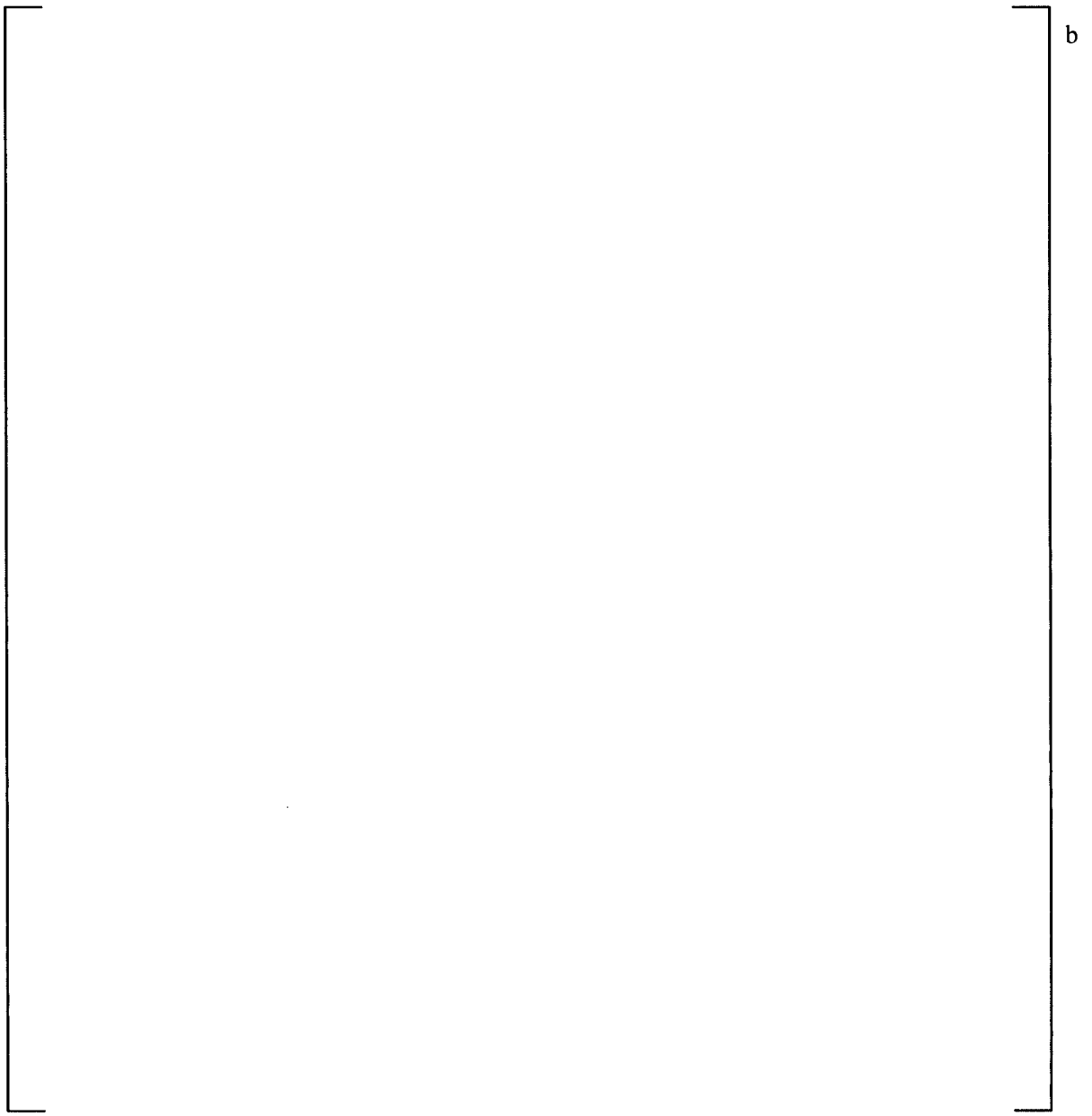


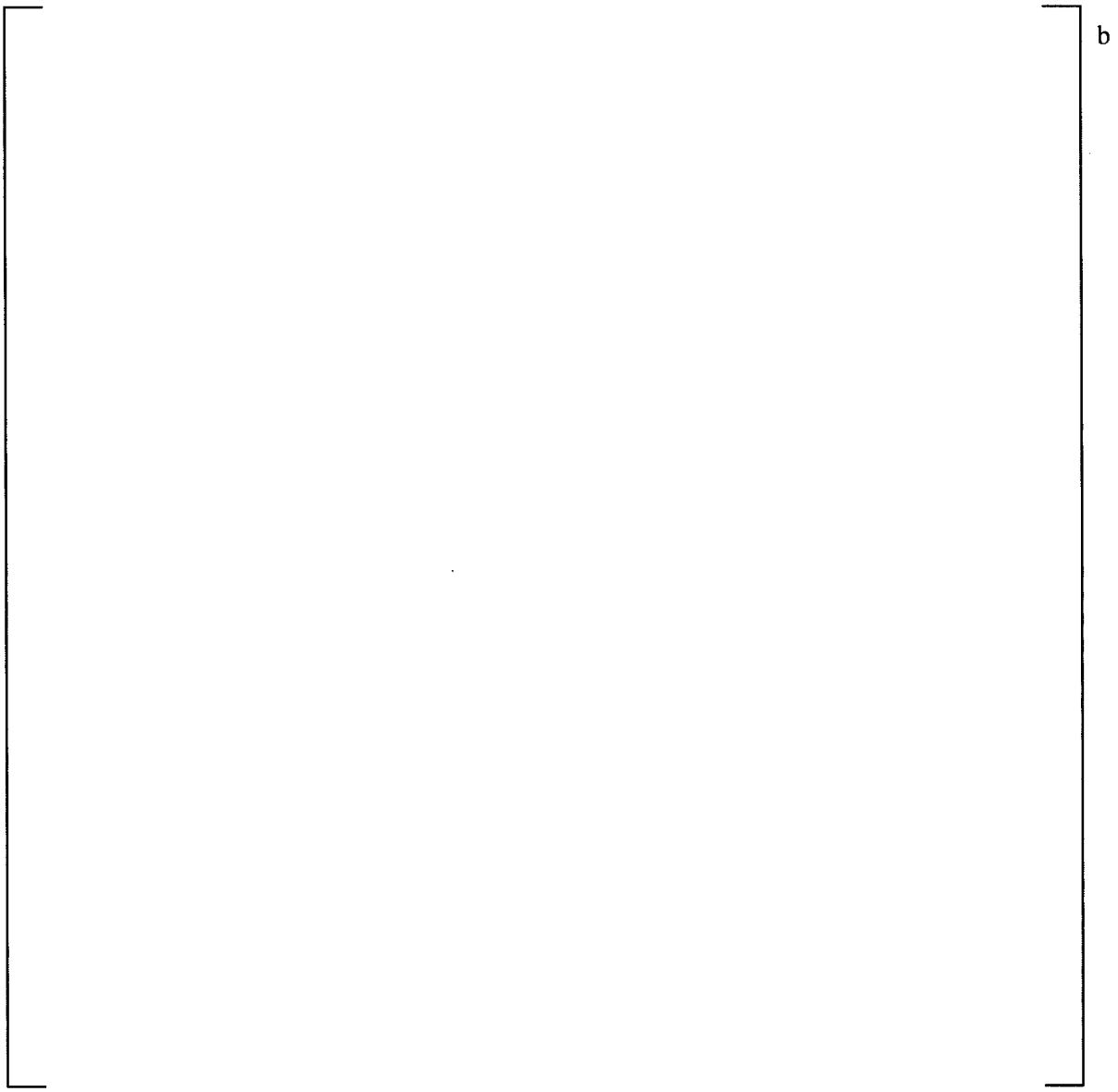
Figure 5-7 Unit 3 Basic and Coherent Unit 3 CLTP Signatures

5.5 CLTP SIGNATURE

5.5.1 Unit 2

Figure 5-8 shows the comparison between the upstream and downstream data for each of the Unit 2 MSLs. [

]^{a,b,c}



b

Figure 5-8 Unit 2 Upstream and Downstream Coherent Signatures

5.5.2 Unit 3

Figure 5-9 shows the comparison between the upstream and downstream data for each of the MSLs.
[

]^{a,b,c}

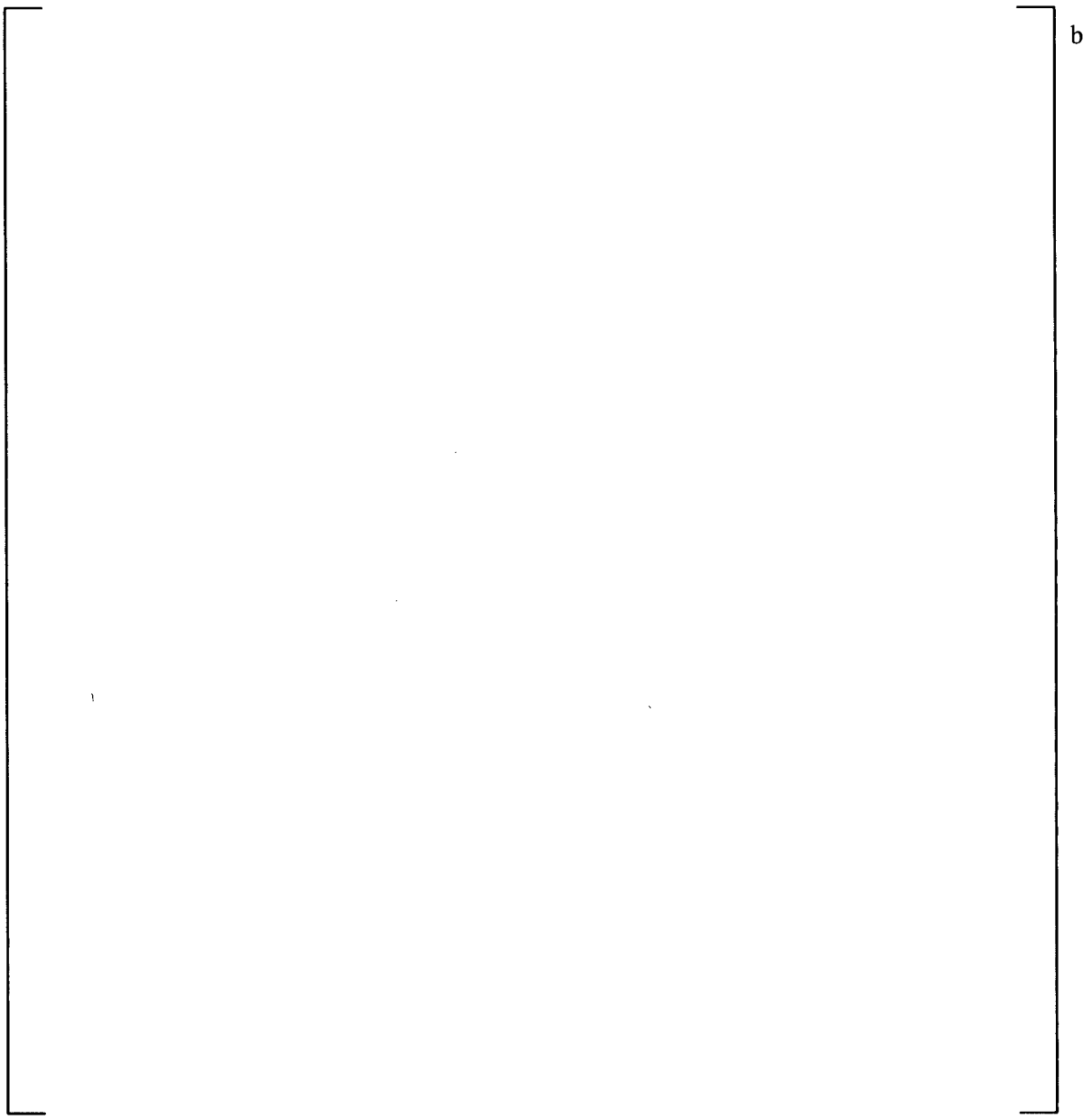


Figure 5-9 Unit 3 Upstream and Downstream Coherent Signatures

5.6 EPU*1.02 SIGNAL COMPUTATION

[

]a,c

5.6.1 Unit 2

Figure 5-10 through Figure 5-17 show the [

]a,b

b

Figure 5-10 Unit 2 CLTP and Predicted EPU*1.02 Signal, MSL A US

Figure 5-11 Unit 2 CLTP and Predicted EPU*1.02 Signal, MSL A DS

Figure 5-12 Unit 2 CLTP and Predicted EPU*1.02 Signal, MSL B US

Figure 5-13 Unit 2CLTP and Predicted EPU*1.02 Signal, MSL B DS

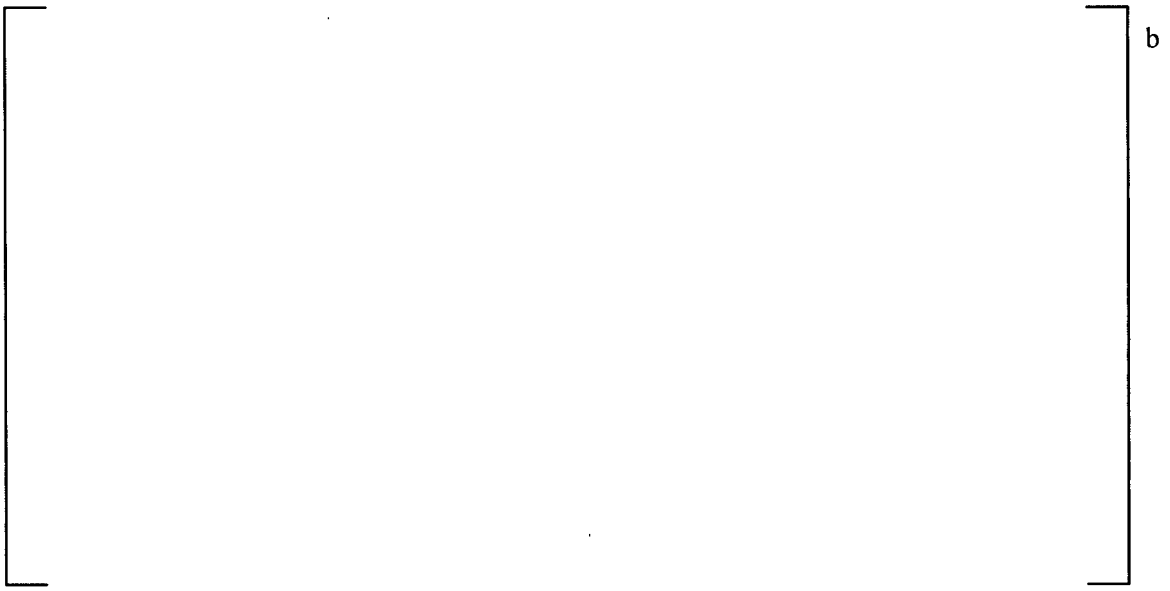


Figure 5-14 Unit 2 CLTP and Predicted EPU*1.02 Signal, MSL C US

Figure 5-15 Unit 2 CLTP and Predicted EPU*1.02 Signal, MSL C DS

Figure 5-16 Unit 2 CLTP and Predicted EPU*1.02 Signal, MSL D US

Figure 5-17 Unit 2 CLTP and Predicted EPU*1.02 Signal, MSL D DS

5.6.2 Unit 3

Figure 5-18 through Figure 5-25 show the Unit [

]^{a,b}

Figure 5-18 Unit 3 CLTP and Predicted EPU*1.02 Signal, MSL A US

Figure 5-19 Unit 3 CLTP and Predicted EPU*1.02 Signal, MSL A DS

Figure 5-20 Unit 3 CLTP and Predicted EPU*1.02 Signal, MSL B US

Figure 5-21 Unit 3 CLTP and Predicted EPU*1.02 Signal, MSL B DS

Figure 5-22 Unit 3 CLTP and Predicted EPU*1.02 Signal, MSL C US

Figure 5-23 Unit 3 CLTP and Predicted EPU*1.02 Signal, MSL C DS

Figure 5-24 Unit 3 CLTP and Predicted EPU*1.02 Signal, MSL D US

Figure 5-25 Unit 3 CLTP and Predicted EPU*1.02 Signal, MSL D DS

6 CONCLUSIONS

[

]^{a,c}

The processing steps that define this methodology and that are described in this document can be summarized as follows:

1. [ ]^{a,c}

2. [ ]^{a,c}

3. [ ]^{a,c}

4. [ ]^{a,c}

[ ]^{a,c}

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