ENCLOSURE 10

WESTINGHOUSE REPORT WCAP-17540-NP, REVISION 0
MONTICELLO REPLACEMENT STEAM DRYER PROGRAM
ACOUSTIC LOAD DEFINITION METHODOLOGY

55 pages follow

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Monticello Replacement Steam Dryer Program Acoustic Load Definition Methodology

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Monticello Replacement Steam Dryer Program Acoustic Load Definition Methodology

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ACRONYMS

Acronym	Definition
ACE	acoustic circuit enhanced
ACM	acoustic circuit model
BWR	boiling water reactor
CFD	computational fluid dynamics
CLTP	current licensed thermal power
DAS	data acquisition system
EPU	extended power uprate
FEM	finite element model
IR	inner radius
MNGP	Monticello Nuclear Generating Plant
MSL	main steam line
NRC	Nuclear Regulatory Commission (U.S.)
OEM	original equipment manufacturer
OR	outer radius
PSD	power spectral density
RMS	root mean square
RPV	reactor pressure vessel
RSD	replacement steam dryer
SCF	strain correction factor
SRV	safety relief valve

1 EXECUTIVE SUMMARY

Monticello Nuclear Generating Plant (MNGP) underwent a replacement steam dryer (RSD) program during the spring 2011 refueling outage. MNGP replaced the original equipment manufacturer (OEM) steam dryer with a Westinghouse design. [

]^{a}

[

]^{c}

[

]^{c}

In summary, the modeling features included in ACE Rev. 1.0 are the following:

[ ]^{c}

[ ]c

[

]a,c

2 ACOUSTIC CIRCUIT MODEL METHODOLOGY

This section describes the theoretical development of the acoustic circuit model methodology. The two steps involved in obtaining the acoustic load definition for the MNGP RSD consist in the following:

[ ]^{a,c}

2.1 NUMERICAL SOLUTION OF THE 3D [ ]^{a,c} EQUATION

[ ]^{a,c}

a,c

a,c

2.2 ACOUSTIC CIRCUIT ANALYSIS OF MEASURED MSL PRESSURE FLUCTUATIONS

In the acoustic circuit analysis, MSLs are modeled by following parameters:

[ ] a,c

Application of the methodology generates solutions in each MSL for:

[ ] a,c

Where:

[ ] a,c

Where:

[ ] a,c

[ ] a,c

Figure 2-1 Schematic of Pressure Measurement Locations on an MSL

[ ] a,c

a,c

3 END-TO-END BENCHMARK OF ACE REV. 1.0 USING MEASURED PLANT DATA

[

a,c

]

3.1 MONTICELLO RSD [ ]^{a,c} DEVELOPMENT

The geometric model of the steam dryer and surrounding fluid is developed using plant drawings and steam dryer design drawings as outlined in Reference 1. This is an improved model based on:

[

a,c

]

Table 3-1 lists the main dimensions used to develop the [ ]^{a,c}.

Table 3-1 Monticello [ ]^{b} Main Dimensions

[	
	]^{b}

[

]a,c

a,c

Figure 3-1 Steam Dryer Top View

a,c

Figure 3-2 Section A-A from Figure 3-1

Table 3-2 [ ]b	
[	
	]b

a,c

a,c

Figure 3-3 [ ][a,c]

a,c

Figure 3-4 Two-Dimensional Cross-Section View at Z=70.9"

a,c

Figure 3-5 Two-Dimensional Cross-Section View at Z=131.1"

a,c

Figure 3-6 Acoustic Model Structure Three-Dimensional Views

a,c

3.2 ANALYSIS OF PRESSURE TRANSUCER DATA MEASURED ON THE STEAM DRYER

a,c

a,c

Figure 3-7 Monticello RSD Instrumentation Locations – Top View

a,c

b

Figure 3-8 [ ][b]

b

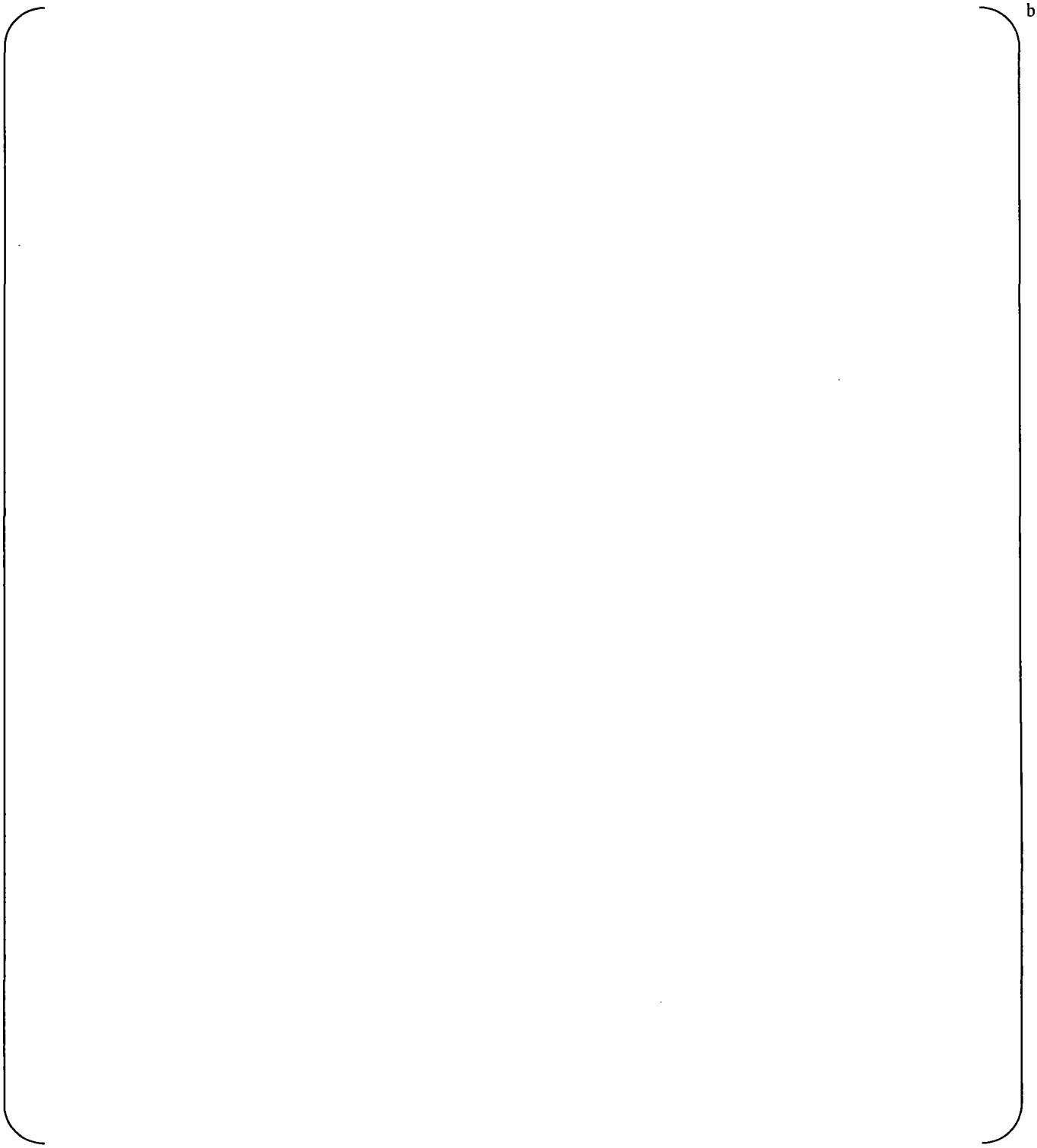

Figure 3-9 [ ][b]

[ ]b

Figure 3-10 [ ]b

b

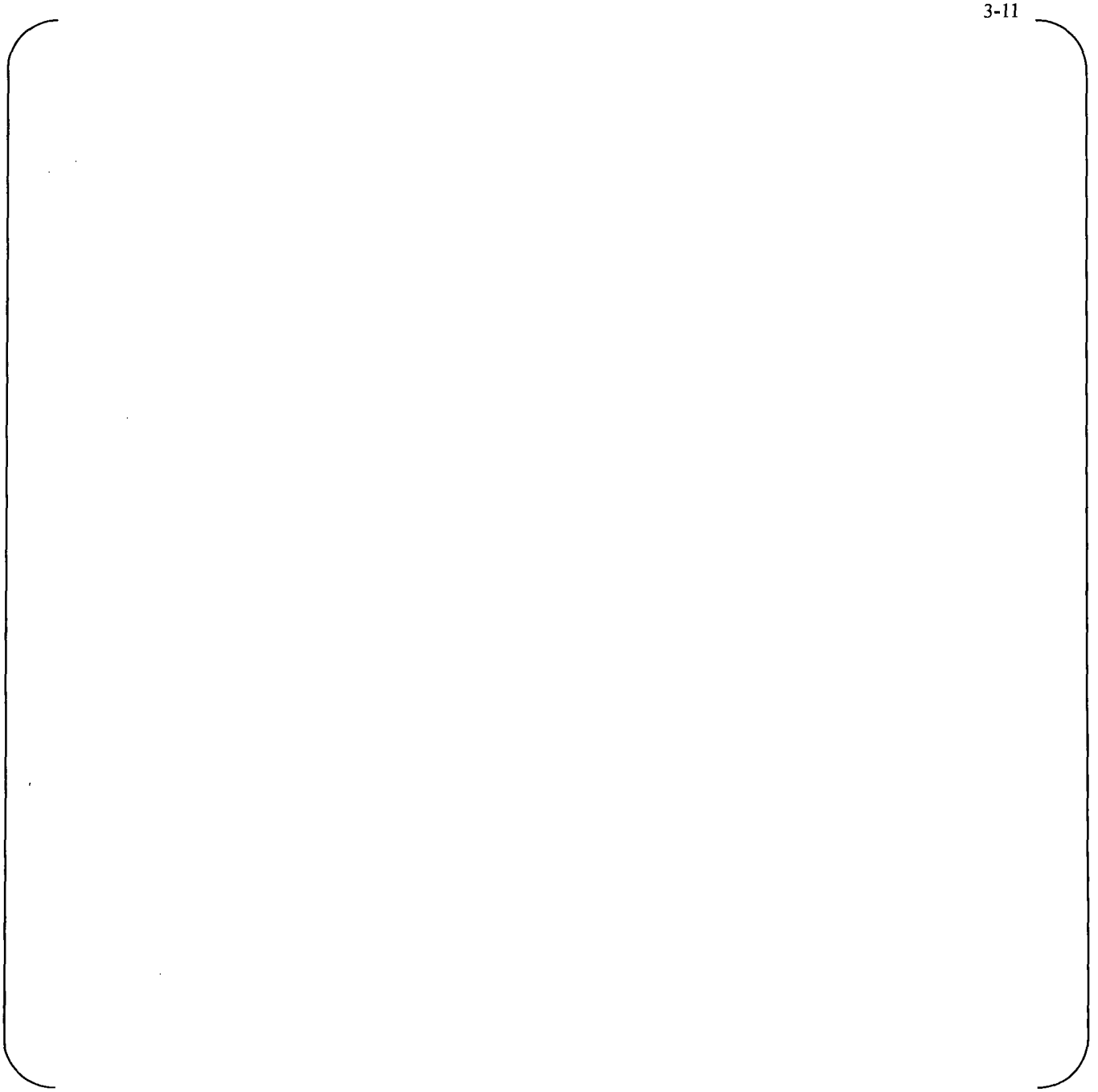

Figure 3-11 [ ][b]

a,c

[b

]

Figure 3-12 [

]^{b}

[b

]

Figure 3-13 [

]^{b}

[a,c]

Figure 3-14 [ ][b]

[a,c]

a,c

3.3 DEVELOPMENT OF THE ACOUSTIC CIRCUIT ENHANCED REV. 1.0 MODELING PARAMETERS

a,c

a,c

Table 3-3 [ ]b	
[	
	]b

a,c

Where:

[

a,c

Table 3-4 [ ]b	
[	
	]b

[ ]a,c

Table 3-5 [ ]b		
[		
		]b

[

]a,c

[

]a,c

Table 3-6 [ ]b		
[		
		]b

Table 3-7 [ ]b		
[		
		]b

[

a,c

]

Table 3-8 [	]b
[	
	]b

The application of the total uncertainties listed in Table 3-8 to the predicted pressure loads is compared with the measured data as shown in Figures 3-15 and 3-16.

[ ]b

Figure 3-15 [ ]b

b

Figure 3-16 [

]b

[

]a,c

3.4 END-TO-END COMPARISON OF PREDICTIVE MODELS WITH MEASURED PLANT DATA

[

]a,c

Table 3-9 [ ]b	
[	
	]b

[

]a,c

b

Figure 3-17 [ ]b

[

]a,c

Table 3-10 [ ]b				
[				
				]b

b

Figure 3-18 [**]**[a,c]**

b

Figure 3-19 [ ][b]

b

Figure 3-20 [ ][b]

[ ]b

Figure 3-21 [ ]b

b

Figure 3-22 [ ][b]

b

Figure 3-23 [ ][b]

[ ]b

Figure 3-24 [ ]b

[ ]b

Figure 3-25 [ ]b

b

Figure 3-26 [**]**[b]**

b

Figure 3-27 [ ][b]

b

Figure 3-28 [ ][b]

[ ]b

Figure 3-29 [ ]b

4 DEVELOPMENT OF THE ACOUSTIC LOAD DEFINITION FOR THE MONTICELLO RSD USING ACE REV. 1.0

[

]a,c

Table 4-1 [		]b
[		
		]b

b

Figure 4-1 [ ][b]

b

Figure 4-2 [ ][b]

[b

Figure 4-3 [ ]b

[b

Figure 4-4 [ ]b

5 CONCLUSIONS

[

]a,c

6 REFERENCES

1. [

]a,c

2. [

]a,c

3. [

]a,c