ENCLOSURE 4

Westinghouse Non-Proprietary

WCAP-16767-NP, Rev. 0

"Response to Request for Additional Information on Westinghouse AP1000 Combined License (COL) Pre-Application Technical Reports Number 42 and Number 88"

April 2007

Westinghouse Non-Proprietary Class 3

WCAP-16767-NP
APP-PMS-GL-042
Revision 0

April 2007

Response to Request for Additional Information on Westinghouse AP1000 Combined License (COL) Pre-Application Technical Reports Number 42 and Number 88

WCAP-16767-NP
APP-PMS-GL-042
Revision 0

Response to NRC Request for Additional Information on Westinghouse AP1000 Combined License (COL) Pre-Application Technical Reports Number 42 and Number 88

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April 2007

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*Electronically approved records are authenticated in the electronic document management system.

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1 INTRODUCTION

By letter dated May 22, 2006 (DCP/NRC1736), Westinghouse Electric Company, LLC submitted AP1000 Technical Report 42, "Resolution of Common Q NRC Items for AP1000," and by letter dated December 13, 2006, (DCP/NRC1808), Westinghouse submitted AP1000 Technical Report 88, "AP1000 I&C Data Communication and Manual Control of Safety Systems and Components," both of which discuss the instrumentation and controls platform for the AP1000.

The NRC staff has reviewed these reports and determined that additional information is required. By letter dated March 26, 2007 (ML070800740), the NRC has transmitted 22 questions to Westinghouse. Section 2 of this document contains the responses which contain only Westinghouse proprietary information. These responses include RAI-TR88-001 through RAI-TR88-007, RAI-TR88-010 through RAI-TR88-016, and RAI-TR88-018 through RAI-TR88-022. Section 3 of this document contains the responses which contain both Westinghouse proprietary information and information proprietary to our supplier, Emerson Process Management Power & Water Solutions, Inc. These responses include RAI-TR88-007, RAI-TR88-008, and RAI-TR88-017.

The following product and/or corporate names are registered trademarks and are included within these responses:

The Actel name is a registered trademark of Actel Corporation.

Advant is a registered trademark of ABB Process Automation Corporation.

Ovation is a mark of Emerson Process Management.

Ethernet is a registered trademark of Xerox Corp.

All other products and corporate names used in this document may be trademarks or registered trademarks of other companies, and are used only for explanation and to the owners' benefit, without intent to infringe.

2 RESPONSES CONTAINING INFORMATION PROPRIETARY TO WESTINGHOUSE ELECTRIC COMPANY LLC

This section contains the responses which contain only Westinghouse proprietary information.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-001
Revision 0

Question:

Functionally describe the FPGA input and output interfaces including inputs and outputs supporting test functions (e.g., a simple electrical description of the input/output (I/O) lines and the states that the inputs and outputs may take).

Westinghouse Response:

Introduction

The Component Interface Module (CIM) is an existing product that is part of the Common Q Platform.
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Command Inputs from the I&C System Ports

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Component Feedback Signals from the Field Interface

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CIM and Component Status Outputs to the I&C System Ports

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Diagnostic Signals

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Configuration Jumpers

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Front Panel Interface

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-002
Revision 0

Question:

Provide a typical functional logic diagram for the FPGA as configured for each type of plant load.

Westinghouse Response:

The Component Interface Module (CIM) is an existing product that is part of the Common Q platform.
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Reference:

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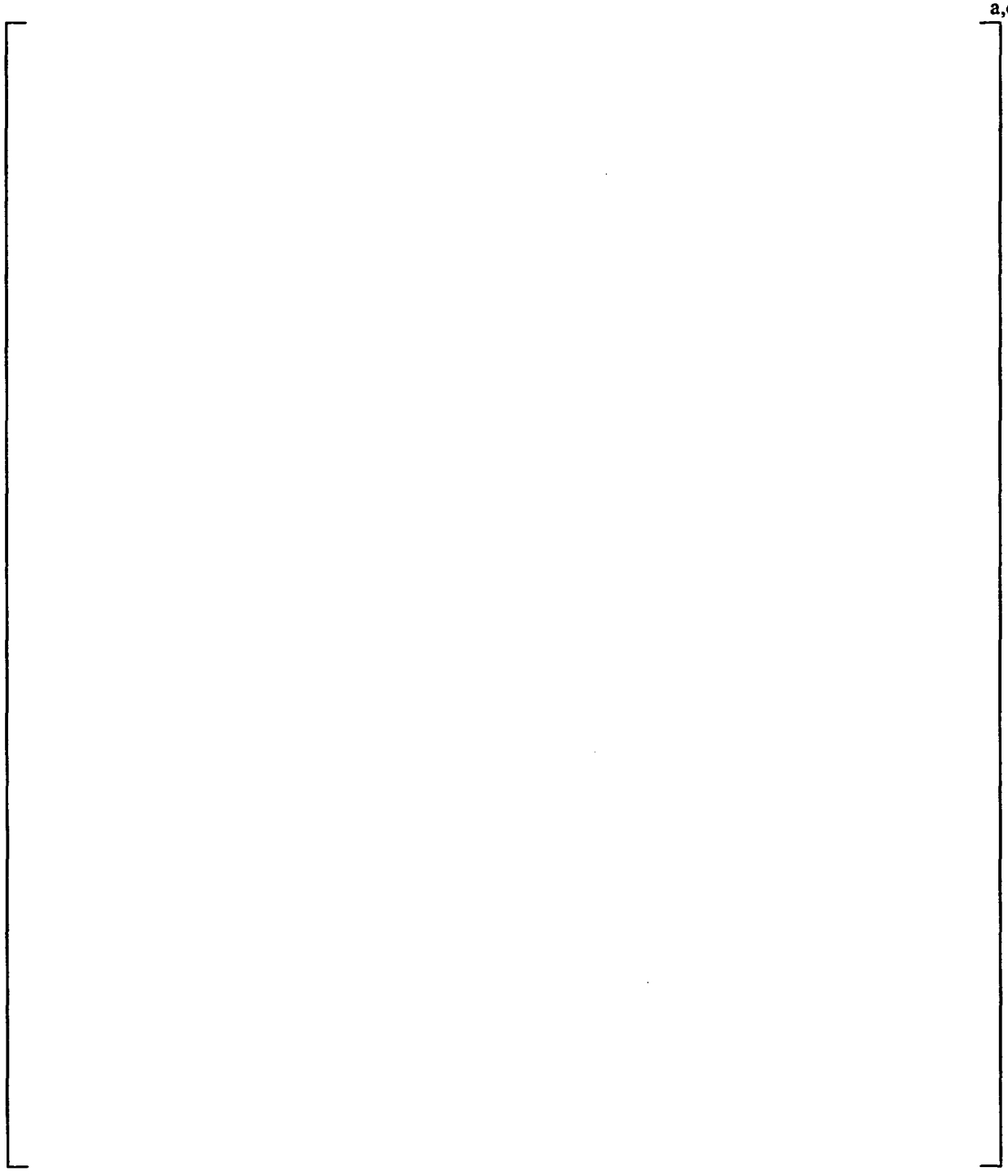

From Figure 2.1 of Reference 1: Priority Logic Block

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From Figure 2.2 of Reference 1: Priority On/Off Inputs

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From Figure 3.1 of Reference 1: CIM Universal Component Logic

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From Figure A-5 of Reference 1: Simplified Logic for Typical SOV

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-003
Revision 0

Question:

Describe the process for accepting the A54SX16 FPGA as a basic component.

Westinghouse Response:

The process for accepting the A54SX16 Field Programmable Gate Array (FPGA) as a basic component is consistent with the design control and commercial dedication requirements of the Westinghouse Appendix B Quality Assurance (QA) program (Reference 1 of this RAI).

The A54SX16 FPGA is purchased as a commercial part. The gate configuration is developed and maintained under the Westinghouse QMS. The Verification and Validation program is described in the response to RAI TR88-004. The configured FPGA is accepted as part of the commercial dedication process for the Component Interface Module (CIM) Priority Logic/Interface Module described in the response to RAI TR88-005.

Reference:

1. "Westinghouse Electric Company Quality Management System (QMS)"

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-004
Revision 0

Question:

Describe the process for verifying and validating the FPGA programming including the process for accepting any software tools used to assure the quality of the design and implementation.

Westinghouse Response:

The Component Interface Module (CIM) is an existing product that is part of the Common Q Platform.
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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-005
Revision 0

Question:

Describe the routine production acceptance process for configured FPGAs.

Westinghouse Response:

The A54SX16 Field Programmable Gate Array (FPGA) is purchased as a commercial part. It is accepted as a basic component as part of the commercial dedication of the Component Interface Module (CIM) [ ]^{a,c}. The commercial dedication of this module for safety-related use is in accordance with established procedures under the Westinghouse Electric Company Quality Assurance (QA) Program (Reference 1 of this RAI) and is specified in the Commercial Dedication Instruction (CDI).

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Reference:

1. "Westinghouse Electric Company Quality Management System (QMS)"

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-006
Revision 0

Question:

Describe the process for identifying and addressing known issues with the FPGA and programming tools. What significant issues were identified?

Westinghouse Response:

The vendor literature was reviewed for known problems for the candidate Field Programmable Gate Array (FPGA). The datasheets and application notes (e.g., see Reference 1 of this RAI) identified common issues including power supply sequencing, device input voltage limits, and hot swap behavior. These issues are considered in the design. [

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Reference:

1. Actel® Application Note: Power-Up and Power-Down Behavior of 54SX and RT54SX Devices.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-007
Revision 0

Question:

Describe how the CIM design deals with the power-up and power-down behavior of the A54SX16 FPGA as described in the Actel Corporation application note on this topic.

Westinghouse Response:

In order to avoid damage to the Field Programmable Gate Array (FPGA) during power-up and power-down sequences, the vendor requires (Reference 1 of this RAI) that the V_{CCR} (supply voltage for input tolerance) must always be greater or equal to V_{CCI} (supply voltage to the I/O pins). [

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Thirdly, Actel recommends that voltage should not be applied to inputs until the supplies have stabilized. [

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Reference:

1. Actel® Application Note: Power-Up and Power-Down Behavior of 54SX and RT54SX Devices.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-010
Revision 0

Question:

Describe the system response when field components do not respond to a PLS control signal. For example, does the PLS continue to send the command until it is accomplished? Does the FPGA store the command until either it is accomplished or withdrawn? Can memory of PLS commands sent, but not completed result in unexpected action of field components when a protection and monitoring system (safety related) (PMS) actuation signal is reset?

Westinghouse Response:

The Component Interface Module (CIM) is an existing product that is part of the Common Q Platform.
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The Plant Control System (PLS) interfaces to Component Interface Modules (CIMs) in the Protection and Safety Monitoring System (PMS) to allow control of selected safety components.

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In summary, unexpected component motion does not occur when a PMS actuation is reset. [

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-011
Revision 0

Question:

Functionally describe the CIM input and output interfaces including inputs and outputs supporting test functions (e.g., a simple electrical description the I/O lines, information source or destination, and the states that the inputs and outputs may take).

Westinghouse Response:

Introduction

The Component Interface Module (CIM) is an existing product that is part of the Common Q Platform.
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Command Inputs (CMX, CMY, and CMZ)

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Component Feedback Inputs (CIN1 through CIN8)

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CIM and Component Status Outputs (FBX, FBY, and FBZ)

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CIM Relay Outputs

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Ovation Local I/O Bus Connection to the RNC

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-012
Revision 0

Question:

Describe CIM random failure modes and the effect upon safety actuation.

Westinghouse Response:

The Component Interface Module (CIM) is a device based on conventional solid state electronics. As such, its random failure modes have the potential to defeat the safety actuation of the connected equipment as well as to cause spurious actuation of the connected equipment. [

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In the event that a random failure defeats a safety actuation, plant safety is maintained by the other divisions of the PMS and the redundancy in the plant's fluid systems. Also, since the CIM is not in the Diverse Actuation System (DAS) actuation path, DAS automatic and DAS manual functions are not affected by CIM random failures.

Although spurious equipment actuations are a potential consequence of random failures in CIM devices, design measures are taken to limit the impact on the plant. Where the consequences of spurious equipment actuations are deemed to be onerous, such as with the squib actuated depressurization valves, the coincidence of multiple CIM outputs (from separate modules in different cabinets) is required to cause the plant equipment to change state or to complete the fluid flow path.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-013
Revision 0

Question:

Describe any potential CIM common cause failures that could result in spurious actuation of multiple engineered safety feature functions.

Westinghouse Response:

The usual causes of potential common cause failure, including functional and/or hardware design error, electromagnetic interference (EMI), abnormal temperature, and seismic activity are addressed for the Component Interface Module (CIM) in the same manner as other electronic devices used in nuclear safety applications, which is through a rigorous design process and equipment qualification for adverse environments. [

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Thus, the potential for CIM common cause failure leading to multiple spurious actuations is not a likely occurrence.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-014
Revision 0

Question:

Describe operator notification port select switch position and local control switch position.

Westinghouse Response:

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

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AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-015
Revision 0

Question:

Describe any features provided to prevent improper configuration of a CIM in the field.

Westinghouse Response:

The Component Interface Module (CIM) is not configured in the field.

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-016
Revision 0

Question:

Describe any features provided to prevent assigning a CIM to a function different than the one for which is configured.

Westinghouse Response:

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-018
Revision 0

Question:

Do the fiber optic ports of the fiber optic modems physically contain only a transmitter or receiver or do they contain optical transceivers which have been configured to perform only one or the other function? If these ports contain transceivers, describe the provisions to prevent reconfiguration.

Westinghouse Response:

The Advant® Ovation® Interface (AOI) uses Fast Ethernet® media converters. The converters internally include both a receiver and a transmitter. The receiver and the transmitter connect to separate fiber-optic connectors. Therefore, there is no requirement or ability to configure the "direction" of the unit.

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-019
Revision 0

Question:

Describe the response of the non-safety systems to receipt of corrupt, invalid, unauthentic, late, out of sequence, or no messages from the PMS via the Advant/Ovation gateway.

Westinghouse Response:

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-020
Revision 0

Question:

Describe how priority of diverse actuation system commands over soft control commands is assured, for motor operated valves.

Westinghouse Response:

The Motor Control Centers (MCC) associated with the Motor-Operated Valves (MOVs) accept separate demands from the Diverse Actuation System (DAS) and the Component Interface Modules (CIM) in the Protection and Safety Monitoring System (PMS). (Soft control commands are sent to the MCC via the CIM.) [

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-021
Revision 0

Question:

Identify the hardware modules to be used in the AP1000 PMS and for each module identify the corresponding test article in the hardware qualification test report (00000-ICE-37764).

Westinghouse Response:

The Protection and Safety Monitoring System (PMS) uses the hardware modules identified by an asterisk (*) in the attached tables extracted from Table 3-1 and Table 3-2 in Reference 1 of this RAI.

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The Common Q safety equipment is located in the Auxiliary Building in a mild (non-harsh) environment. Therefore, age-related degradation is expected to be insignificant for temperature and humidity.

The AP1000 temperature and humidity conditions for qualification of PMS equipment are presented in "AP1000 Design Control Document," Appendix 3D (Reference 2 of this RAI). Temperature and humidity qualification of the PMS equipment is covered by DCD Tier 1 (ITAAC) 2.5.2, Item 4 (Reference 2).

The PMS seismic Category I equipment will be tested or analyzed to confirm that it can withstand seismic design basis loads without loss of safety function. The seismic qualification of the PMS seismic Category I equipment is covered by DCD Tier 1 (ITAAC) 2.5.2, Item 2 (Reference 2).

The PMS equipment will be tested or analyzed to confirm that it has electrical surge withstand capability (SWC), and can withstand the electromagnetic interference (EMI), radio frequency interference (RFI), and electrostatic discharge (ESD) conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function. This activity is covered by DCD Tier 1 (ITAAC) 2.5.2, Item 3) (Reference 2).

References:

1. 00000-ICE-37764, Rev. 03, "Summary Qualification of Hardware Testing for Common Q Applications," Westinghouse Electric Company LLC.

2. APP-GW-GL-700, Rev. 15, "AP1000 Design Control Document," Westinghouse Electric Company LLC.

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

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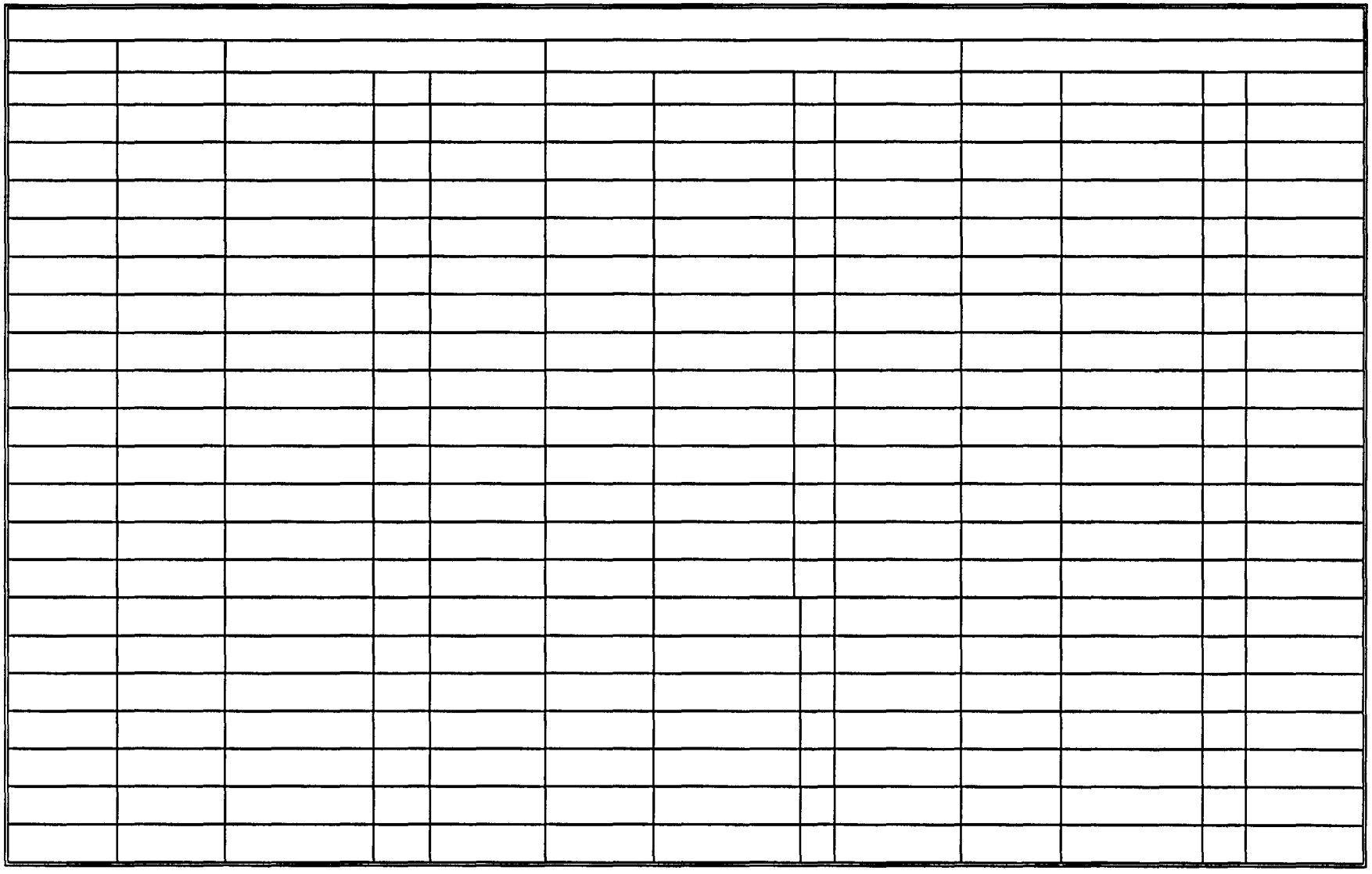

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AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-022
Revision 0

Question:

Provide the seismic response spectra for location of PMS equipment.

Westinghouse Response:

The seismic required response spectra for the following AP1000 Instrumentation and Control (I&C) Rooms are provided.

Room 12301 Division A I&C Room Elevation 107' 2"
Room 12304 Division B I&C Room Elevation 107' 2"
Room 12313 Division C I&C Room Elevation 107' 2"
Room 12305 Division D I&C Room Elevation 107' 2"

The spectra (at 2%, 3%, 4%, 5% and 7% critical damping) are provided for Elevation 99' (Table 1, Figure 1-1, and Figure 1-2 of this RAI) and Elevation 135' (Table 2, Figure 2-1, and Figure 2-2 of this RAI.) For purposes of qualification, spectra at Elevation 135' should be used. If needed, estimated spectra may be generated for Elevation 107'.

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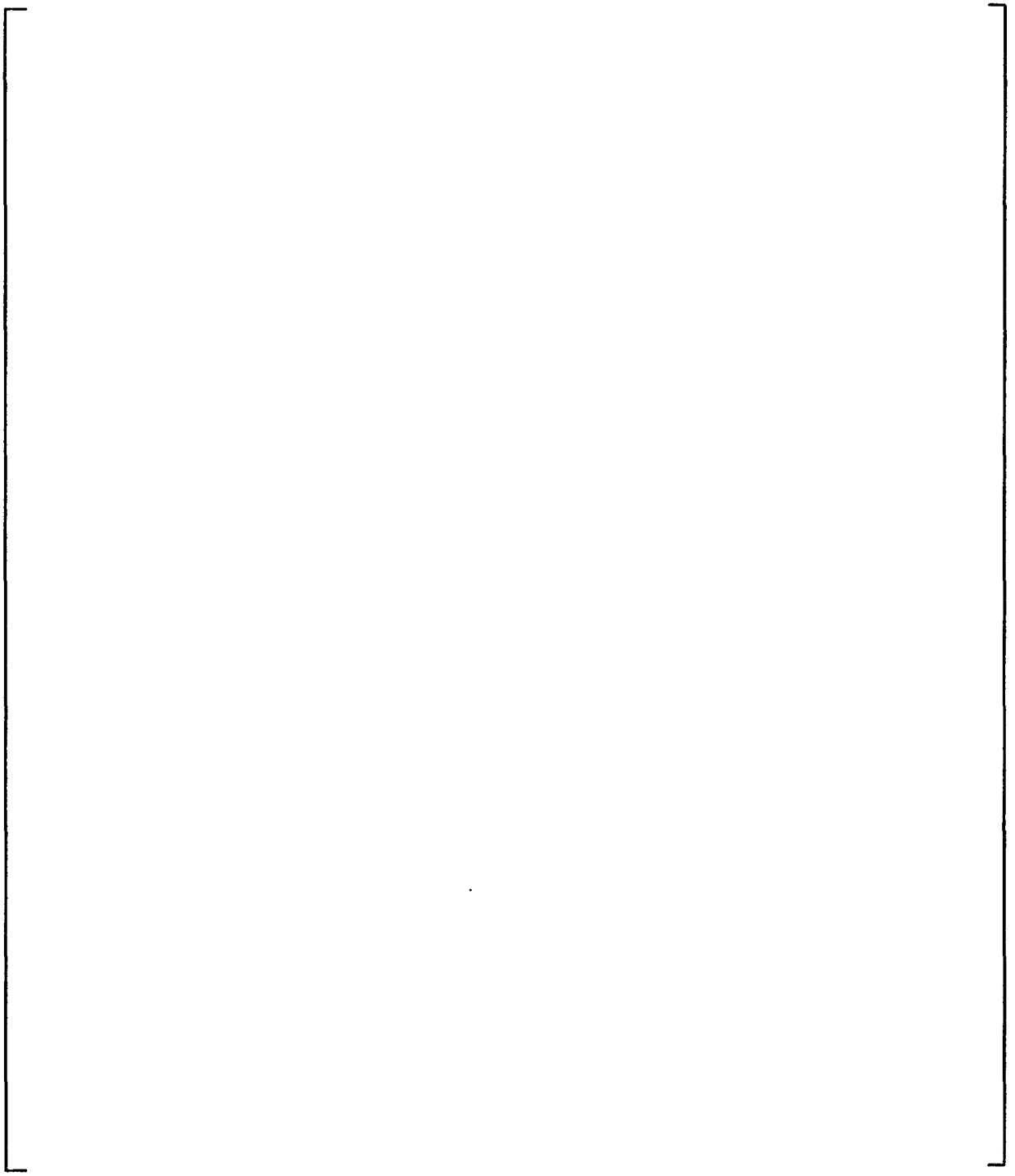

Figure 1-1: ASB FRS Horizontal Direction At or Below Elevation 99'

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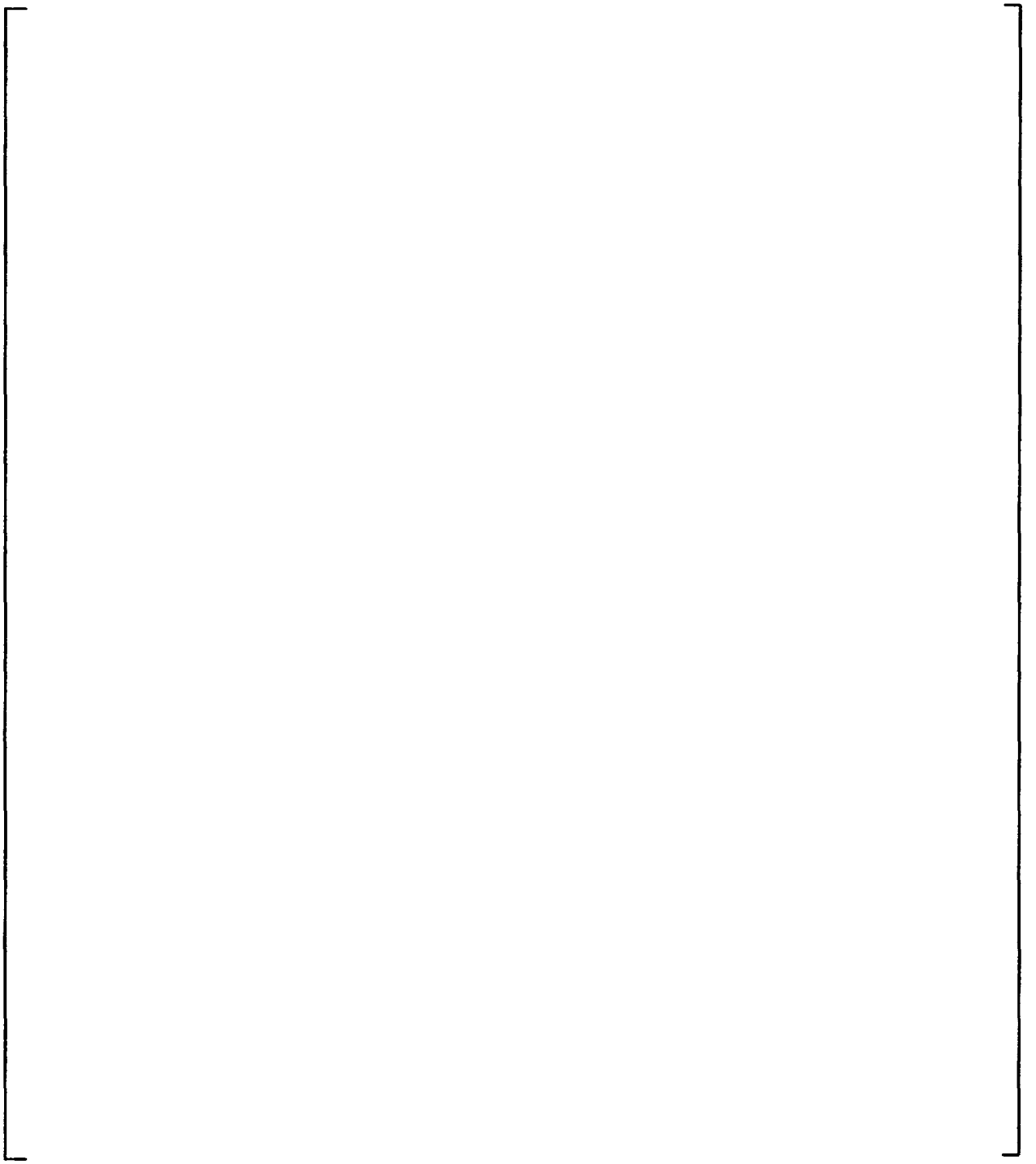

Figure 1-2: ASB FRS Vertical Direction At or Below 99'

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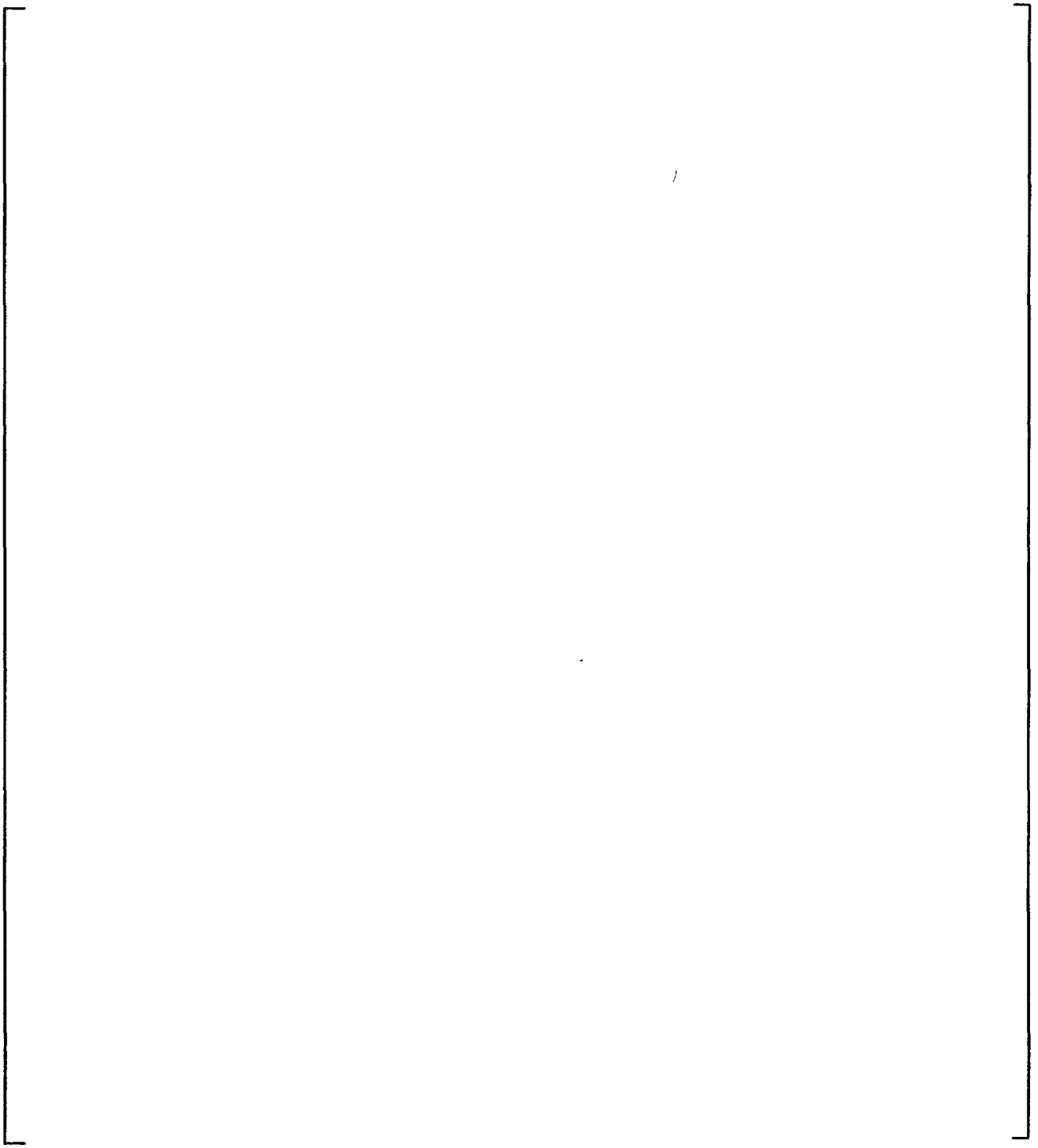

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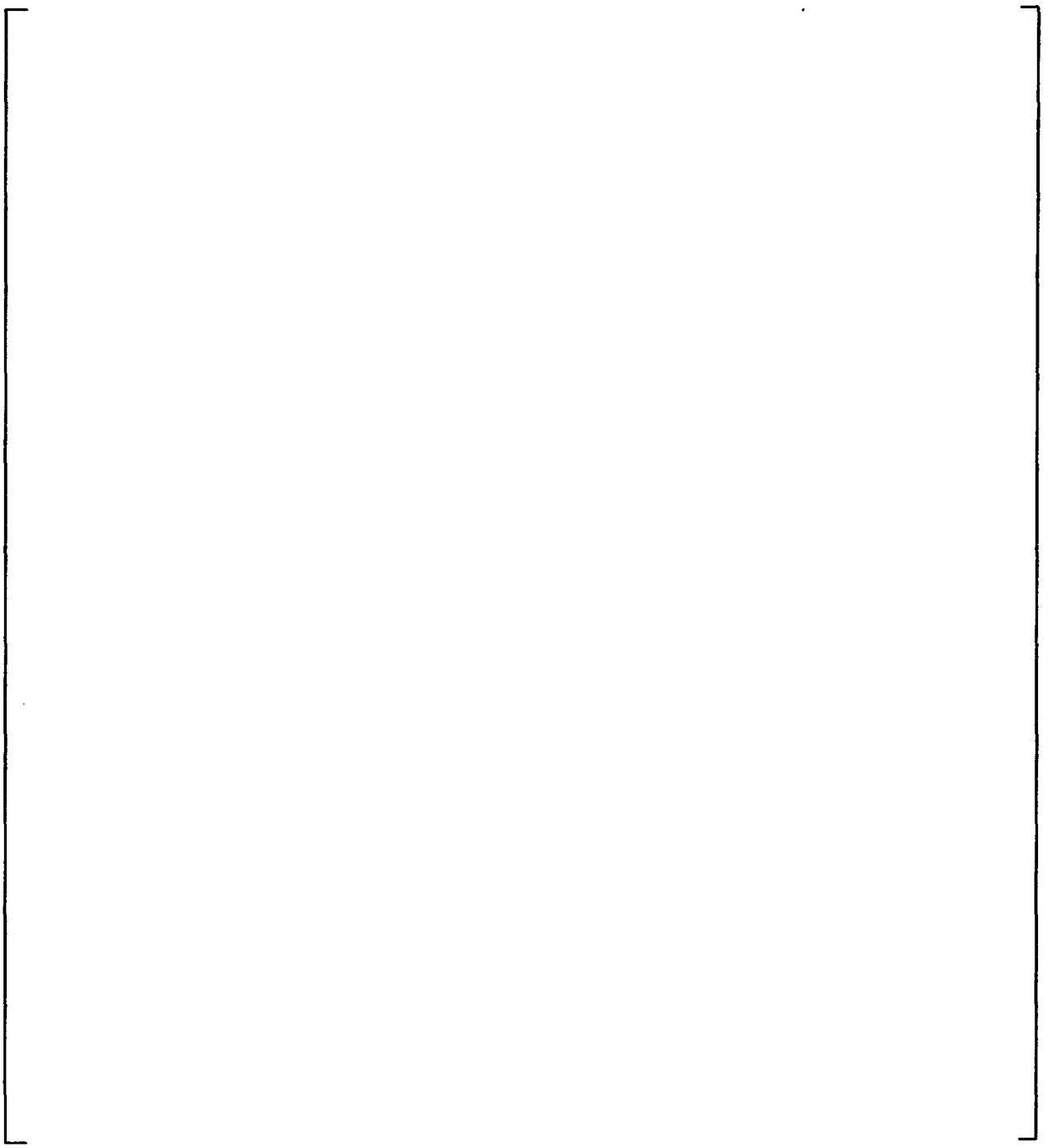

Figure 2-1: ASB FRS Horizontal Direction At or Below Elevation 135'

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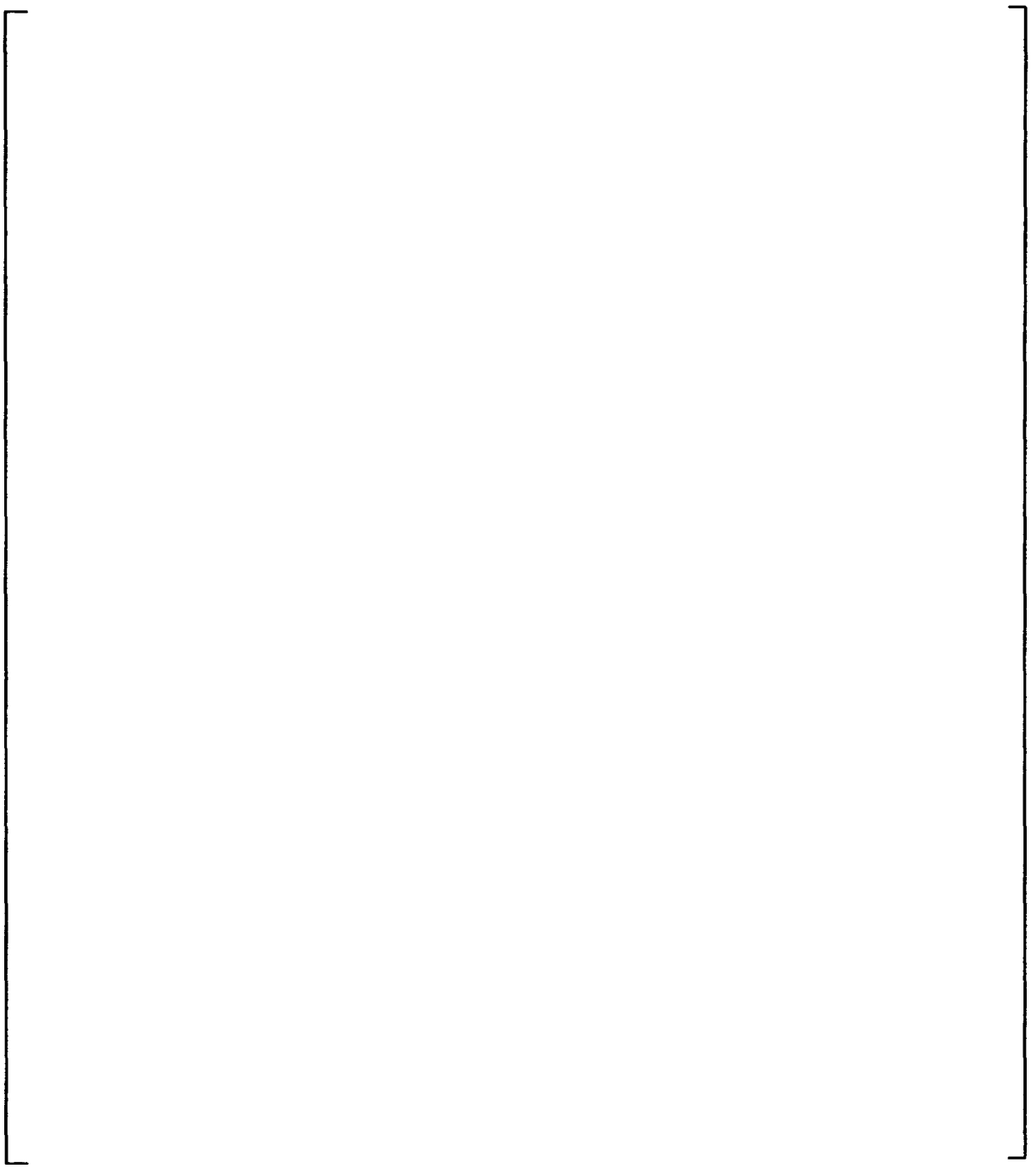

Figure 2-2: ASB FRS Vertical Direction At or Below Elevation 135'

Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

3 RESPONSES CONTAINING INFORMATION PROPRIETARY TO WESTINGHOUSE ELECTRIC COMPANY LLC AND INFORMATION PROPRIETARY TO EMERSON PROCESS MANAGEMENT POWER & WATER SOLUTIONS, INC.

This section contains the responses which contain both Westinghouse proprietary information and information proprietary to our supplier, Emerson Process Management Power & Water Solutions, Inc. These responses include RAI-TR88-007, RAI-TR88-008, and RAI-TR88-017.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-008
Revision 0

Question:

Describe any provisions for ensuring the integrity (i.e., messages were not corrupted in transmission) and validity (i.e., messages belong to the set of legitimate messages) of messages passed between the Remote Node Controller (RNC) and the Communication Card Module.

Westinghouse Response:

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.

AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-009
Revision 0

Question:

Describe any provisions for ensuring the integrity, validity, and authenticity (i.e., messages originated from an expected network location) of messages passed between the RNC and the plant control system (nonsafety related) (PLS).

Westinghouse Response:

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

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AP1000 Technical Report Review

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR88-017
Revision 0

Question:

Describe the features provided to prevent unauthorized or incorrect reconfiguration of the RNC via the Ovation network.

Westinghouse Response:

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Design Control Document (DCD) Revision:

None.

PRA Revision:

None.

Technical Report (TR) Revision:

None.