RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/13/2024

SAFETY SYSTEM DIGITAL PLATFORM
- MELTAC (MITSUBISHI ELECTRIC TOTAL ADVANCED CONTROLLER) -
TOPICAL REPORT

Mitsubishi Electric Corporation

EPID:	**L-2023-TOP-0036**
RAI NO.:	**RAI 1**
DATE OF RAI ISSUE:	**1/19/2024**

RAI 1

Regulatory Basis: Title 10 of the *Code of Federal Regulations* (10 CFR) Paragraph 50.55a(h), "Protection and Safety Systems," requires that protection systems must be consistent with their licensing basis or may meet the requirements of the Institute of Electrical and Electronics Engineers (IEEE) Standard (Std) 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," and the correction sheet dated January 30, 1995. Clause 5.4, "Equipment Qualification" of IEEE Std 603-1991 states, in part, that safety system equipment shall be qualified by type test, previous operating experience, or analysis, or any combination of these three methods, to substantiate that it will be capable of meeting, on a continuing basis, the performance requirements as specified in the design basis. MELTAC is a safety system digital platform which shall meet the requirements in the above Clause 5.4.

Background and Issue: Section 5.0 of the MELTAC Topical Report (TR) states, in part, that "If any module is updated, and it is determined that qualification re-testing is required by the evaluations conducted in accordance with Section 6.1.7, the module will be tested with the same method and acceptance criteria. The same method and acceptance criteria will also be used for any new MELTAC modules." However, some testing standards and their criteria, especially for electromagnetic compatibility have been changed in the revised MELTAC TR.

Request: Please clarify if and how the same method and acceptance criteria will be used to qualify the updated and new MELTAC modules. Also provide a list of updated and new MELTAC modules with qualification methods and acceptance criteria to be used for their qualification.

ANSWER:

Since Regulatory Guides and corresponding Standards are revised, the method and acceptance criteria of MELTAC Platform Equipment Qualification are updated. Therefore, the updated and new MELTAC modules use the updated method and acceptance criteria used for previously qualified modules.

The list of updated and new MELTAC modules is provided in Attachment 1-1.
Attachment 1-2 shows a list of previously qualified MELTAC modules.

EQ Regulatory Guidance and Test methods for revised and new MELTAC modules are shown in Attachment 2-1.
EQ Regulatory Guidance and Test methods for previously qualified MELTAC modules are shown in Attachment 2-2.

No re-test will be performed for previously qualified modules as they will be inherited by the revised modules and new modules due to obsolescence.

Since the method and acceptance criteria of MELTAC Platform Equipment Qualification are updated for updated and new modules, we will revise type-name suffixes to identify new or updated modules from previously qualified modules.

Unless the Regulatory Guides for EQ Tests undergo further revisions, and the condition for qualification remains, the plan is to apply the updated test standard criteria for new/updated modules.

Impact on Topical Report and/or Support Documents.
The answer above will be added to Section 3, 4, 5, and Appendix F of MELTAC Topical Report (JEXU-1041-1008) (see Attachment-3).
There are no impacts on support documents.

Attachment 1-1 List of updated and new MELTAC modules

Category			Module Type	Unique model identification number
CPU Module			PCPJ	PCPJ-D1
System Management Module			PSMJ	PSMJ-D1
Bus Master Module			PFBJ	PFBJ-D1
Control Network I/F Module			PWNJ	PWNJ-D1
Analog Input Module	Current input		MLPJ	MLPJ-B1
	RTD 4 line type	4-line Pt200 Ω, 32 to 752 °F (0 to 400 °C)	MRTJ	MRTJ-E4
		4-line Pt100 Ω, 32 to 212 °F (0 to 100 °C)	MRTJ	MRTJ-K1
	Thermocouple K type	32 to 2372 °F (0 to 1300 °C)	MTCJ	MTCJ-F3
Analog Output Module	Current output		MAOJ	MAOJ-B1
Isolation Module	Current input, Current/Voltage output		KILJ	KILJ-B1
	RTD 4 line type input Current/Voltage output"	4-line Pt100 Ω, 32 to 302 °F (0 to 150 °C)	KIRJ	KIRJ-B1
		4-line Pt100 Ω, 32 to 392 °F (0 to 200 °C)	KIRJ	KIRJ-B2
		4-line Pt200 Ω, 32 to 752 °F (0 to 400 °C)	KIRJ	KIRJ-B3
	Thermocouple K type/RTD 4 line type input Voltage output		KITJ	KITJ-A1
E/O Converter Module	Electrical/Optical conversion	Electrical interface: RS-485	MEOJ	MEOJ-A2
		Electrical interface: RS-232C	MEOJ	MEOJ-B1
	CPU Power Supply (Large capacity type)		PPSJ	PPSJ-B3
Safety VDU Panel			T10DH	T10DH-N001
FMU Module			PFDJ	PFDJ-D1
Status Display and Switch Module	Single Redundant Parallel		PPNJ	PPNJ-D2
	Redundant Standby		614JND	614JND
Fan Modules	CPU Fan		KFNJ	KFNJ-A01
	PS Fan		KFNJ	KFNJ-A02
	Door Fan		KFNJ	KFNJ-A03
	I/O Fan		KFNJ	KFNJ-A04
Terminal Unit	Analog (AI/AO)		PSND	PSND-A01
	Digital (DI/DO)		PSND	PSND-A02
Optical Switch			RJMA	RJMA-A2

Category			Module Type	Unique model identification number
Contact input (built-in contact power supply) Current increase function	Contact impressed voltage: DC 48 V Contact current: 10 to 12 mA		RDIJ	RDIJ-A1
Contact input (built-in contact power supply)	Contact impressed voltage: DC 24 V Contact current: 9 to 12 mA		RDIJ	RDIJ-A2
Digital Output Module	Semiconductor output (open drain)		RDOJ	RDOJ-A1
Distribution Module	For Analog input		RDDJ	RDDJ-A1
Power Interface Module	Semiconductor output (open drain) Contact input (built-in contact power supply)		RPDJ	RPDJ-A1
Power Supply Module	I/O Power Supply		RPAJ	RPAJ-A1
Repeater Module	Repeater Alarm signal input (built-in contact power supply) Mutual anomaly monitoring function		RCMJ	RCMJ-A1
CPU Module Chassis	Non-split	Redundant Standby Redundant Parallel Single	ZCDJS	ZCDJS-A21
I/O Module Chassis	RDIJ Digital Input Module RDOJ Digital Output Module RPDJ PIF Module (This requires two slots)		ZRDJ	ZRDJ-AK1
	Analog Input Module		ZRXJ	ZRXJ-AA1
	Isolation Module		ZRSJ	ZRSJ-AA1
	Optical Conversion Module		ZREJ	ZREJ-AA1
Alarm Signal Input Modules	Alarm signal input Power supply		REIJ	REIJ-A1
EI Unit	EI Signal Processing Unit		EI-20W-027C	EI-20W-027C
	EI Unit Power Supply		EI-32C-027C	EI-32C-027C
	EI Detector Power Supply		EI-30C-027C	EI-30C-027C
	EI Operation Panel		EI-40C-027C	EI-40C-027C

Attachment 1-2 List of previously qualified modules

Category			Module Type	Unique model identification number
CPU Module			PCPJ	PCPJ-31
System Management Module			PSMJ	PSMJ-31
Bus Master Module			PFBJ	PFBJ-31
Control Network I/F Module			PWNJ	PWNJ-31
Analog Input Module	Current input		MLPJ	MLPJ-A1
	Voltage input		MAIJ	MAIJ-G1
	RTD 4 line type	4-line Pt200 Ω, 32 to 752 °F (0 to 400 °C)	MRTJ	MRTJ-D4
		4-line Pt200 Ω, 500 to 662 °F (260 to 350 °C)	MRTJ	MRTJ-G2
		4-line Pt100 Ω, 32 to 212 °F (0 to 100 °C)	MRTJ	MRTJ-J1
		4-line Pt100 Ω, 32 to 392 °F (0 to 200 °C)	MRTJ	MRTJ-J3
	Thermocouple K type	32 to 2372 °F (0 to 1300 °C)	MTCJ	MTCJ-E3
		32 to 752 °F (0 to 400 °C)	MTCJ	MTCJ-E8
Analog Output Module	Current output		MAOJ	MAOJ-A1
	Voltage output		MVOJ	MVOJ-A1
Digital Input Module	Contact input (built-in contact power supply)		MDIJ	MDIJ-A4
				MDIJ-G2
Digital Output Module	Relay contact output		MDOJ	MDOJ-A3
				MDOJ-G1
	Semiconductor output (open collector)		MDOJ	MDOJ-22
Pulse Input Module	Pulse input (for RCP rotation speed input)		MPIJ	MPIJ-11
Isolation Module	Current input, Current/Voltage output		KILJ	KILJ-A1
	RTD 4 line type input Current/Voltage output"	4-line Pt100 Ω, 32 to 302 °F (0 to 150 °C)	KIRJ	KIRJ-A1
		4-line Pt100 Ω, 32 to 392 °F (0 to 200 °C)	KIRJ	KIRJ-A2
		4-line Pt200 Ω, 32 to 752 °F (0 to 400 °C)	KIRJ	KIRJ-A3
	Pulse signal input (for RCP)		KIPJ	KIPJ-11
Distribution Module	For Digital I/O		KIOJ	KIOJ-04
				KIOJ-A2
	For Current input (Active)		KLPJ	KLPJ-A2
	For Current input (Passive)		KLPJ	KLPJ-B3
	For RTD input (4 wire)		KRTJ	KRTJ-A3
	For Thermocouple input		KTCJ	KTCJ-A2
	For Voltage input		KAIJ	KAIJ-A4

Category			Module Type	Unique model identification number
	For Current output		KAOJ	KAOJ-A2
	For Voltage output		KVOJ	KVOJ-A2
	For Pulse signal input (for RCP)		KAIJ	KAIJ-06
E/O Converter Module	Electrical/Optical conversion	Electrical interface: RS-485	MEOJ	MEOJ-A1
		Electrical interface: RS-232C	MEOJ	MEOJ-11
Power Interface Module	Semiconductor output(open collector) Contact input(built-in contact power supply)		DPOJ	DPOJ-C1
Power Supply Module	CPU Power Supply		PS	PS-12
	I/O Power Supply		PS	PS-22
	CPU Power Supply (Small capacity type)		PPSJ	PPSJ-03
	CPU Power Supply (Large capacity type)		PPSJ	PPSJ-13
Safety VDU Panel			T10DH	T10DH-M001
FMU Module			PFDJ	PFDJ-31
Status Display and Switch Module	Single Redundant Parallel		PPNJ	PPNJ-32
	Redundant Standby		PPNJ	PPNJ-31
Repeater Module	Repeater	For Subsystem-A	MRPJ	MRPJ-01
	Repeater	For Subsystem-B	MRPJ	MRPJ-02
	Repeater	For Subsystem-A/B Double Size	MRPJ	MRPJ-21
CPU Module Chassis	Mirror-split	Redundant Standby	ZCAJS	ZCAJS-M01
	Non-split	Redundant Parallel Single	ZCAJS	ZCAJS-A21
I/O Module Chassis	Digital Input Module Digital Output Module Analog Output Module Analog Input Module		ZIOJS	ZIOJS-A13
	PIF Module		ZEHJS	ZEHJS-A01
	Isolation Module		ZISJS	ZISJS-A01
	Optical Conversion Module		ZMEJS	ZMEJS-A01
Fan Modules	CPU Fan		KFNJ	KFNJ-A01
	PS Fan		KFNJ	KFNJ-A02
	Door Fan		KFNJ	KFNJ-A03
Terminal Unit	Analog (AI/AO)		PSND	PSND-A01
	Digital (DI/DO)		PSND	PSND-A02
Optical Switch			RJMA	RJMA-02

Attachment 2-1 EQ Regulatory Guidance and Test methods for updated and new MELTAC modules

Test Item	Regulatory Guidance	Reference to Topical Report (Section)
Environmental Test	RG 1.89 Rev.2 (IEC/IEEE Std. 60780-323-2016) RG1.209 Rev.0 (IEEE Std. 323-2003/EPRI TR-107330)	Module Level Test: 5.6.2.1
Seismic Test	RG 1.100 Rev.4 (IEEE Std. 344-2013)	Cabinet Test: 5.7.2.1 Module Level Test: 5.7.2.2
Electromagnetic Test	RG 1.180 Rev.2	[IEC Emission] Conducted Emissions, Low Frequency Test: None Conducted Emissions, High Frequency Test: 5.8.2.,1 - CISPR 16 in IEC 61000-6-4 Radiated Emissions, Magnetic Field Test: None Radiated Emissions, Electric Field Test: 5.8.2.2 - CISPR 16 in IEC 61000-6-4 [IEC Susceptibility] EMI/RFI Conducted Susceptibility Test for Power Leads: 5.8.2.3 - IEC 61000-4-6, -13, and -16 EMI/RFI Conducted Susceptibility Test for Signal Leads: 5.8.2.4 - IEC 61000-4-4, -5, -6, -12 and -16 Radiated Susceptibility, Magnetic Field Test: None Radiated Susceptibility, Electric Field Test: 5.8.2.5
Surge Withstand Capability Test	RG 1.180 Rev.2 (IEC 61000-4-12, IEC 61000-4-5, IEC 61000-4-4)	5.8.2.7 Surge Withstand Capability, Ring Wave Test 5.8.2.8 Surge Withstand Capability, Combination Wave Test 5.8.2.9 Surge Withstand Capability, Electrically Fast Transients/Bursts Test
Electrostatic Discharge Test	RG 1.180 Rev.2 (IEC 61000-4-2)	5.9
Isolation Test	RG 1.75 Rev.3 (IEEE Std. 384-1992)	5.10

Attachment 2-2 EQ Regulatory Guidance and Test methods for previously qualified MELTAC modules

Test Item	Regulatory Guidance	Reference to Topical Report (Section)
Environmental Test	RG 1.89 Rev.1 (IEEE Std. 323-1974) RG1.209 Rev.0 (IEEE Std. 323-2003/EPRI TR-107330)	System Level Test: 5.1.2.1 Module Level Test: 5.1.2.2
Seismic Test	RG 1.100 Rev.3 (IEEE Std. 344-2004)	Cabinet Test: 5.2.2.1 Module Level Test: 5.2.2.2
Electromagnetic Test	RG 1.180 Rev.1	Conducted Emissions, Low Frequency (CE101) Test: 5.3.2.1 Conducted Emissions, High Frequency (CE102) Test: 5.3.2.2 Radiated Emissions, Magnetic Field (RE101) Test: 5.3.2.3 Radiated Emissions, Electric Field (RE102) Test: 5.3.2.4 Conducted Susceptibility, Low Frequency (CS101) Test for Power Leads: 5.3.2.5 Conducted Susceptibility, High Frequency (CS114) Test for Power Leads: 5.3.2.6 Conducted Susceptibility, High Frequency (CS114) Test for Signal Leads: 5.3.2.7 Conducted Susceptibility, Bulk Cable Injection, Impulse Excitation (CS115) Test: 5.3.2.8 Conducted Susceptibility, Damped Sinusoidal Transients (CS116) Test: 5.3.2.9 Radiated Susceptibility, Electric Field (RS103) Test: 5.3.2.10
Surge Withstand Capability Test	RG 1.180 Rev.1 (IEC 61000-4-12, IEC 61000-4-5, IEC 61000-4-4)	5.3.2.11 Surge Withstand Capability, Ring Wave Test 5.3.2.12 Surge Withstand Capability, Combination Wave Test 5.3.2.13 Surge Withstand Capability, Electrically Fast Transients/Bursts Test
Electrostatic Discharge Test	IEC 61000-4-2	5.4
Isolation Test	RG 1.75 Rev.3 (IEEE Std. 384-1992)	5.5

GDC 24: Separation of Protection and Control Systems

The separation of protection and control systems is an application specific design characteristic. Redundant divisions of the protection systems are physically and electrically isolated from the non-safety control systems. Where safety sensors are shared between control and protection systems, signal selection logic is typically used in the control system to prevent erroneous control actions due to single sensor failures. Eliminating these erroneous control actions prevents challenges to the protection system while it is degraded due to the same sensor failure. Where non-safety signals control safety systems or components, logic in the safety systems is typically used to ensure prioritization of safety functions. The details regarding the separation of protection and control systems are described in Application Licensing Documentation.

GDC 25: Protection system requirements for reactivity control malfunctions

The MELTAC platform is capable and suitable for providing monitoring and control functions to assure that fuel design limits are not exceeded for any single malfunction of the reactivity control systems. The monitoring and control functions implemented within the MELTAC platform to perform this safety related function are described in application licensing documentation.

2. 10 CFR Part 50.55a

(a)(1) Quality Standards for Systems Important to Safety
Section 6 describes MELCO's 10 CFR 50 Appendix B QAP, which is fully compliant to 10 CFR 50 Appendix B.

MELCO has undergone an inspection by NRC to verify the implementation of an adequate QAP.

(h) Invokes IEEE Std. 603-1991

See conformance to IEEE Std. 603-1991

NRC Regulatory Guides

3. RG 1.22 Periodic Testing of Protection System Actuation Functions (Rev. 0, February 1972)

See GDC 21 conformance. The functions controlled by this Equipment can be configured at the application level to be completely testable through a combination of overlapping automatic and manual tests.

4. RG 1.29 Seismic Design Classification ~~for Nuclear Power Plants~~ (Rev. 4~~6~~4, March~~July~~~~March~~ 2007~~21~~~~07~~)

RAI 1, 4

The Equipment is designated Seismic Category I.

4-1 RG 1.29 Seismic Design Classification for Nuclear Power Plants (Rev. 6, July 2021)

RAI 1, 4

The Equipment is designated Seismic Category I. RAI 1, 4

5. RG 1.53 Application of the Single-Failure Criterion to Safety Systems (Rev. 2, November 2003)

endorses IEEE Std. 379-2000

See conformance to GDC 21 and 24. This Equipment can be configured at the application level so that safety functions are designed with N or N+1 divisions. Each safety division can be independent from the other safety divisions and from non-safety divisions. Independence ensures that credible single failures cannot propagate between divisions within the system and therefore cannot prevent proper protective action at the system level. Single failures considered in the divisions are described in the Failure Mode and Effect Analysis (FMEA) for each system. The FMEA method for the components of this Equipment is provided in this Topical Report. The MELTAC module level FMEA report is incorporated by reference. The module level FMEA provides input to the system level FMEA for each application. The system level FMEA is described in Application Licensing Documentation.

6. RG 1.75 Criteria for Independence of Electrical Safety Systems (Rev. 3, February 2005)

endorses IEEE Std. 384-1992

The MELTAC platform contains features to ensure that redundant safety divisions are physically and electrically independent of each other and physically and electrically independent of any non-safety divisions. Physical independence is maintained either by the required distance or by barriers which prevent propagation of fire or electrical faults. Electrical independence is maintained by fiber optic cable communication interfaces or conventional isolators, such as opto-couplers, relays or transformers. Conventional isolators include fault interrupting devices such as fuses or circuit breakers. Fiber optic cable communication interfaces are described in Section 4.3.2 (Control Network), 4.3.3 (Data Link) and 4.3.4 (Maintenance Network). Specifications and qualification of conventional isolators are discussed in Section 4.1.2 and 5.5 of this Topical Report, respectively.

7. RG 1.89 Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants (Rev. 12~~1~~, June~~April~~~~June~~ 1984~~2023~~1984) RAI 1, 4

endorses IEEE Std. 323-1974~~IEC/IEEE Std. 60780-323-2016~~~~IEEE Std. 323-1974~~

The environmental qualification of ~~this~~ Equipment listed in Table F-1 is by an appropriate combination of type testing and analysis. ~~This~~ Equipment listed in Table F-1 is qualified for use in a mild environment that is not adversely affected by plant accidents. Qualification for temperature and humidity is by type test. The generic MELTAC temperature and humidity qualification is demonstrated to envelope actual plant conditions by analysis of room ambient conditions and heat rise calculations for the installed configuration. Seismic qualification is by type testing. The generic MELTAC seismic qualification is demonstrated to envelope actual plant conditions by analysis of floor response spectrum at the installed location. Electromagnetic Interference (EMI) RAI 1, 4

qualification is by type testing. MELTAC is generically qualified to the EMI envelope and acceptance criteria that are identified by regulatory guidance as enveloping US nuclear plant installations.~~; therefore there is no additional site specific EMI qualification.~~ RAI 2

~~This~~ Equipment listed in Table F-1 has no known aging mechanisms, except as noted in Section 7.4 and accommodated by periodic replacement; random failures will be detected through self-diagnoses and periodic surveillance testing. RAI 1, 4

Type testing for conformance to RG 1.89 Rev.1 is described through the aggregate of all qualification reports – Environmental, Seismic and Electromagnetic Compatibility (EMC), see Section 5.0 and 5.1 through Section 5.5. RAI 1, 4 RAI 1, 4

7-0 RG 1.89 Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants (Rev. 2, April 2023)

endorses IEC/IEEE Std. 60780-323-2016

Equipment listed in Table F-2 is designed for use in a mild environment. It is planned to be qualified by an appropriate combination of type testing and analysis.

Type testing for conformance to RG 1.89 Rev.2 is described through the aggregate of all qualification reports – Environmental, Seismic and Electromagnetic Compatibility (EMC), see Section 5.0 and 5.6 through Section 5.10. RAI 1, 4

7-1 RG1.97 Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants (Rev.5, May 2019)

endorses IEEE Std. 497-2016

As described in conformance to GDC 13, the MELTAC platform contains features to monitor Type A, Type B and Type C variables for accident conditions in nuclear power plants.

8. RG 1.100 Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants (Rev. 3~~3~~4, September~~May~~~~September~~ 2009~~20~~09) RAI 1, 4

~~endorses IEEE 344-2013, IEEE Std C37.98-2013 , ASME QME-1-2017~~

This Equipment is designated Seismic Category I. It is designed and qualified to withstand the cumulative effects of a minimum of 5 Operating Basis Earthquakes (OBEs) and one Safe Shutdown Earthquake (SSE) without loss of safety function or physical integrity. The input spectrum is selected to envelope all anticipated applications. Conformance to this envelope for specific applications is discussed in Application Licensing Documentation.

8-1 RG 1.100 Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants (Rev. 4, May 2020)

endorses IEEE 344-2013, IEEE Std C37.98-2013, ASME QME-1-2017

This Equipment is designated Seismic Category I. It is designed to withstand the cumulative effects of a minimum of 5 Operating Basis Earthquakes (OBEs) and one Safe Shutdown Earthquake (SSE) without loss of safety function or physical integrity. The input spectrum is selected to envelope all anticipated RAI 1, 4

applications. Conformance to this envelope for specific applications is discussed in Application Licensing Documentation.

RAI 1, 4

9. RG 1.105 Setpoints for Safety-Related Instrumentation (Rev. 4~~3~~, February~~December~~ 2021~~1999~~)

endorses ANSI/ISA-~~S~~67.04.01-2018~~1994~~ ~~and ANS-10.4-1987~~

The uncertainties associated with the Equipment are described in this Topical Report. Appendix A.5 defines I/O module accuracies. Appendix A.6 defines Isolation Module accuracies. Appendix A.9 and A.21 defines accuracy of I/O power supplies. This includes uncertainties for signal conditioning modules, signal splitters, instrument loop power suppliers and analog to digital converters. The uncertainties associated with specific process instrumentation and the resulting safety-related setpoints are described in Application Licensing Documentation. The plant specific uncertainty/setpoint analysis is described in Application Licensing Documentation.

10. RG 1.118 Periodic Testing of Electric Power and Protection Systems (Rev. 3, April 1995)

endorses IEEE Std. 338-1987

See conformance to GDC 21, 10 CFR 50.36 and RG 1.22. The Equipment can be configured so that all safety functions are tested either automatically or manually, and so that manual tests do not require any system reconfiguration, such as jumpers or fuse removal.

11. RG 1.152 Criteria for Use of Computers in Safety Systems of Nuclear Power Plants (Rev. 3, July 2011)

endorses IEEE Std. 7-4.3.2-2003

The methods used for specifying, designing, verifying, validating and maintaining software for this Equipment conforms to these requirements, including requirements for a secure development environment and MELTAC features that facilitate a secure operational environment.

Section 6 describes the life cycle process for MELTAC software . MELTAC software consists of the basic software and application software as described in Section 4.1.3. The lifecycle of basic software is described in Section 6 of this Topical Report and~~The life cycle process for the MELTAC platform is described in~~ “MELTAC Platform Software Program Manual” (JEXU-1041-1016).

~~MELCO has undergone an inspection by NRC to verify the implementation of an adequate QAP.~~

The life cycle process for ~~the system~~ application software shall also comply with this RG. Application software should be developed as plant specific items and should be reviewed as Application Licensing Documentation. MELCO provides the general description of its life cycle process in Section 6 and “MELTAC Platform application software program manual” (JEXU-1041-1032). Licensees shall reference this general description as its own application software program manual. If there are any deviations from the said document (JEXU-1041-1032),

18. RG 1.173 Developing Software Life Cycle Processes for Digital Computer Software Used in Safety Systems of Nuclear Power Plants (Rev. 1, July 2013)

endorses IEEE Std. 1074-2006

The Software Life Cycle Process for this Equipment conforms to this Regulatory Guide. Section 6 describes the life cycle process including defining requirement specification for MELTAC software. See also the description for RG 1.152 requirement (No.11)

~~The Software Life Cycle Processes for the MELTAC platform are described in "MELTAC Platform Software Program Manual" (JEXU-1041-1016). MELCO has undergone an inspection by NRC to verify the implementation of an adequate QAP.~~

~~The Software Life Cycle Processes for the system application software are described in the Application Licensing Documentation.~~

19. RG 1.180 Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in s~~S~~safety-r~~R~~related Instrumentation and Control Systems (Rev. 12~~1~~, ~~C62.41.1-2002~~ October~~December~~~~October~~ 20031~~9~~03)

endorses MIL-STD-461E~~G~~~~E~~, IEC 61000 Parts 3, 4, and 6, IEEE Std. C62.41.~~1~~-1991~~2002~~1991, ~~C62.41.1-2002,~~ IEEE Std. C62.45-1992~~2002~~1992, IEEE Std. 1050-1996~~2002~~1996, EPRI TR-102323 ~~EPRI TR-102323~~ RAI 1, 4

~~This~~ Equipment listed in Table F-1 conforms to the EMI/RFI (Radio Frequency Interference) requirements of this standard. Qualification testing for the digital platform is described in Section 5.0, 5.3 and 5.4 of this Topical Report. RAI 1, 4 RAI 1, 4

19-1 RG 1.180 Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems (Rev. 2, December 2019)

endorses MIL-STD-461G, IEC 61000 Parts 3, 4, and 6, IEEE Std. C62.41.1-2002, C62.41.2-2002, IEEE Std. C62.45-2002, IEEE Std. 1050-2004 RAI 1, 4

Equipment listed in Table F-2 conforms to the EMI/RFI (Radio Frequency Interference) requirements of this standard. Qualification testing plan for the digital platform is described in Section 5.0, 5.8 and 5.9 of this Topical Report.

20. RG 1.204 Guidelines for Lightning Protection of Nuclear Power Plants (Rev. 0, November 2005)

The platform has been designed with surge resistance. Surge qualification testing has been performed using ANSI Std. 62.41, ANSI Std. 62.45, and IEEE Std. 472, see Section 5.3.

21. RG 1.209 Guidelines for Environmental Qualification of Safety-Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants (Rev. 0, March 2007)

endorses IEEE Std. 323-2003

~~This~~ Equipment listed in Table F-1 is tested and analyzed to satisfy the mild environment qualification requirements. RAI 1, 4

Equipment listed in Table F-2 is designed to satisfy the mild environment qualification requirements. RAI 1, 4

NRC Branch Technical Positions

22. BTP 7-8 Guidance for Application of Regulatory Guide 1.22

The Equipment includes extensive self-diagnosis tests which run continuously. The LCO related to bypassed or out of service conditions for a single division are dependent upon the extent of redundancy and the extent of automated self-testing for the equipment that remains in service to perform the safety function. The Equipment can be configured at the application level with additional manual test features to test the portions of the system that are not tested automatically. These manual test features can be configured so that all functions of the protection system are testable at power. Self-diagnosis tests are described in Section 4.1.5 of this Topical Report. Manual test features are described in Section 4.1.7 and 4.2.4 of this Topical Report, and also in Application Licensing Documentation.

23. BTP 7-11 Guidance on Application and Qualifications of Isolation Devices

endorses IEEE Std. 472, ANSI Std. C62.36, ANSI Std. C62.41, ANSI Std. C62.45

See conformance to RG 1.75. Isolation devices are qualified in conformance to these standards.

24. BTP 7-14 Guidance on Software Reviews for Digital Computer-Based I&C Systems

See conformance to RG 1.168 through 1.173.

25. BTP 7-17 Guidance on Self-Test and Surveillance Test Provisions

See conformance to GDC 21, 10 CFR 50.36, RG 1.22 and RG 1.118. Surveillance testing taken together with automatic self-testing provides a mechanism for detecting all failures. The methods used for testing are described in Application Licensing Documentation.

26. BTP 7-21 Guidance on Digital Computer Real-Time Performance

The real-time performance for this Equipment conforms to this BTP. The response time performance for digital platform components is described in Section 4.4 of this Topical Report. Requirements for system response time for conformance with the plant design basis and the response time of actual plant systems is described in Application Licensing Documentation.

(LARs) and lists the documents expected for a plant-specific review of a digital safety system. Some interpretation is required to identify the subset of documentation that applies to a generic review of a safety system digital platform. This interpretation and summary of DI&C-ISG-06 compliance is given in "Mapping of MELTAC Platform Licensing Documents to the DI&C-ISG-06 Guidance" (JEXU-1041-1012 Rev0).

IEEE Standards

33. IEEE Std. 7-4.3.2-2003 Criteria for Programmable Digital Computer Systems in Safety Systems of Nuclear Power Generating Stations

This Equipment conforms to all requirements of this standard, as augmented by RG 1.152.

34. ~~IEC/~~IEEE Std. ~~60780-~~323-~~2003~~2016~~-2003~~ Qualifying Class 1E Equipment for Nuclear Power Generating Systems ~~Nuclear Facilities —Electrical Equipment Important to Safety—Qualification Qualifying Class 1E Equipment for Nuclear Power Generating Systems~~ RAI 1, 4

~~This~~ Equipment listed in Table F-1 is qualified in conformance to this standard, as augmented by RG 1.89 Rev.1. See conformance to RG1.89 Rev.1. RAI 1, 4

34-1 IEC/IEEE Std. 60780-323-2016 Nuclear Facilities —Electrical Equipment Important to Safety—Qualification

Equipment listed in Table F-2 is designed to conform this standard, as augmented by RG 1.89 Rev.2. See conformance to RG1.89 Rev.2. RAI 1, 4

35. IEEE Std. 338-1987 Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems

The self-diagnosis that is usable for Periodic Surveillance Testing are described throughout this document. RG1.22 and Std. IEEE 338 test features that are configured at the system level or within the application software are described by the Application Licensing and design documentation.

36. IEEE Std. 344-2004~~13~~04 Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations RAI 1, 4

~~This~~ Equipment listed in Table F-1 conforms to this standard as augmented by RG 1.100 Rev.3. Conformance is described in the Section 5.0 and 5.2 of this Topical Report. RAI 1, 4

36-1 IEEE Std. 344-2013 Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

Equipment listed in Table F-2 is designed to conform to this standard as augmented by RG 1.100 Rev.4. Qualification Test Plan is described in the Section 5.7 of this Topical Report. RAI 1, 4

The software design description is documented in the Software Specifications as outputs of Design Phase which is described in Section 6.1.

51. IEEE Std. 1028-2008 IEEE Standard for Software Reviews and Audits

Software reviews and audits are described in “MELTAC Platform Software Program Manual” (JEXU-1041-1016).

52. IEEE Std. 1042-1987 IEEE Guide To Software Configuration Management

Configuration management is described in “MELTAC Platform Software Program Manual” (JEXU-1041-1016).

53. IEEE Std. 1074-2006 IEEE Standard for Developing Software Life Cycle Processes

The software life cycle process is described in Section 6 and in “MELTAC Platform Software Program Manual” (JEXU-1041-1016).

54. IEEE Std. 896-1991 Standard For Futurebus+® - Logical and Physical Layers

The communication between modules in the same subsystem of the MELTAC platform conforms to this standard.

Other Industry Standards

55. ANSI C62.41 IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

This Equipment conforms to the sections of this standard endorsed by RG 1.180.

56. ANSI C62.45 IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

This Equipment conforms to the sections of this standard endorsed by RG 1.180.

57. IEC 61000 Electromagnetic compatibility (Basic EMC publication)

This Equipment conforms to the following sections of this standard:

- IEC 61000-4-2: Testing and measurement techniques - Electrostatic discharge immunity tests. Basic EMC publication
- IEC 61000-4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test. Basic EMC publication
- IEC 61000-4-5: Testing and measurement techniques - Surge immunity test
- IEC 61000-4-12: Testing and measurement techniques - Oscillatory waves immunity test.

57-1 IEC 61000 Electromagnetic compatibility (Basic EMC publication)

IEC CISPR16 Specification for radio disturbance and immunity measuring apparatus and methods

RAI 1, 4

Equipment listed in Table F-2 is designed to conform to the following sections of this standard:

- IEC 61000-3-2: Limits – Limits for harmonic current emissions (equipment input current ≤16 A per phase)
- IEC 61000-4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test
- IEC 61000-4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields
- IEC 61000-4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests
- IEC 61000-4-16: Testing and measurement techniques – Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz
- IEC 61000-6-4: Generic standards – Emission standard for industrial environments
- IEC CISPR 16-2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements
- IEC CISPR 16-2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements

RAI 1, 4

58. ANSI/ISA-~~S~~67.04.01-2018~~1994~~ Setpoints For Nuclear Safety Related Instrumentation ~~Used in Nuclear Power Plants~~

See conformance to RG 1.105. The methodology used to develop setpoints is described in Application Licensing and Design Documentation.

59. MIL-STD-461E~~G~~~~E~~ Requirements for the Control of Electromagnetic Interference Characteristics of subsystems and equipment

RAI 1, 4

~~This~~ Equipment listed in Table F-1 conforms to this standard as referenced in RG 1.180 Rev.1. This standard replaces MIL-STD-461D and MIL-STD-462D referenced in EPRI TR-102323.~~This standard replaces MIL-STD-461D and MIL-STD-462D referenced in EPRI TR-102323.~~

RAI 1, 4

59-1 MIL-STD-461G Requirements for the Control of Electromagnetic Interference Characteristics of subsystems and equipment

Exemption conditions, described in RG 1.180 Rev.2, for tests described in this standard are applied to Equipment listed in Table F-2. See Section 5.8.

RAI 1, 4

4.1.1.4 Environmental Specifications

The MELTAC controller is designed to operate within the environmental conditions described in Table 4.1.1-2 and Table 4.1.1-2-1. Table 4.1.1-2 shows the environmental specifications for the modules qualified under Topical Report Rev.2. Table 4.1.1-2-1 shows the environmental specifications for the new and updated modules qualified under Topical Report Rev.3. Also see Section 5. RAI 1

Table 4.1.1-2 Environmental Specifications for the modules qualified under Topical Report Rev. 2

Item	Specifications	
Room Ambient temperature	Recommended	68 to 78.8 °F (20 to 26 °C) This temperature range is expected within a heated/ air-conditioned instrumentation and control room of the nuclear power plant. The controller should be mounted in a cabinet with no more than 18 °F (10 °C) heat rise. Operating within this range will maximize the life of the equipment.
	Operation guarantee	32 to 122 °F (0 to 50 °C) The controller should be mounted in a cabinet with no more than 18 °F (10 °C) heat rise.
Relative humidity	10 to 95%Rh (No condensation)	
Withstand voltage	AC power input line	AC power input line: 5 MΩ or more (500 VDC megger) (input - ground, input - DC output) Analog I/O line: 5 MΩ or more (500 VDC megger) (I/O - ground, input - output) Digital I/O line: 5 MΩ or more (500 VDC megger) (I/O - ground, input - output) Applicable standard: JIS-C0704-1995 (IEC664/947)
	I/O line	Analog I/O line: 1 KV AC (1 minute) (I/O - ground, input - output) Digital I/O line: 2 KV AC (1 minute) (I/O - ground, input - output) Applicable standard: JIS-C0704-1995 (IEC664/947)
Electro-magnetic Compatibility (EMC)	~~Regulatory Guide 1.180 Revision 2(2019) is applied.~~	RAI 1
	Electromagnetic Interference (EMI)	~~Complies with MIL-STD-461E for emissions:~~ Complies with MIL-STD-461E for emissions: RAI 1 1.Conducted emissions Conducted emissions from the power line (field discharge) ~~CE101: Low-frequency, 30 Hz to 10 kHz~~ ~~CE102: High-frequency, 10 kHz to 2 MHz~~ ~~Apply: CISPR 16 in IEC 61000-6-4 (2016) (Note 1)~~ ~~150 kHz to 30MHz~~ ~~150 kHz to 500 kHz: 79 quasi-peak maximum~~ RAI 1

Item	Specifications		
		~~500 kHz to 30MHz: 73 quasi-peak maximum~~ CE101: Low-frequency, 30 Hz to 10 kHz CE102: High-frequency, 10 kHz to 2 MHz 2.Radiated emission ~~RE101: Magnetic field, 30 Hz to 100 kHz~~ ~~RE102: Electric field, 2 MHz to 10 GHz~~ ~~Apply: CISPR 16 in IEC 61000-6-4(2016) (Note 2)~~ ~~30MHz to 6GHz~~ ~~30MHz to 230MHz: 40 quasi-peak maximum @ 10m~~ ~~230MHz to 1GHz: 47 quasi-peak maximum @ 10m~~ ~~1GHz to 3GHz: 76 peak maximum @ 3m~~ ~~3GHz to 6GHz: 80 peak maximum @ 3m~~ RE101: Magnetic field, 30 Hz to 100 kHz RE102: Electric field, 2 MHz to 10 GHz	RAI 1 RAI 1
	Electromagnetic Susceptibility (EMS)	~~Complies with MIL-STD-461E for susceptibility:~~ Complies with MIL-STD-461E for susceptibility: 1. Conducted susceptibility ~~CS101: Low-frequency, 30 Hz to 150 kHz~~ ~~CS114: High-frequency, 10 kHz to 30 MHz~~ ~~CS115: bulk cable injection, impulse excitation~~ ~~CS116: damped sinusoidal transients, 10 kHz to 100 MHz~~ ~~Power Leads~~ ~~Apply:~~ ~~IEC 61000-4-13 (16 to 2.4kHz) Class 2~~ ~~IEC 61000-4-16 (0 to 150kHz) Level 3~~ ~~IEC 61000-4-6 (150kHz to 80MHz) Level 3~~ ~~Signal Leads~~ ~~Apply: Low Withstand (Note 3)~~ ~~IEC 61000-4-4: 1kV (Level 3)~~ ~~IEC 61000-4-5: 2 kV open circuit test voltage and 1 kA short circuit current (Level 3)~~ ~~IEC 61000-4-6: 140 dBμV test voltage (Level 3)~~ ~~IEC 61000-4-12: 1kV (Level 2)~~ ~~IEC 61000-4-16: Level 3~~ CS101: Low-frequency, 30 Hz to 150 kHz CS114: High-frequency, 10 kHz to 30 MHz CS115: bulk cable injection, impulse excitation CS116: damped sinusoidal transients, 10 kHz to 100 MHz 2. Radiated susceptibility ~~RS103: Electric field, 30 MHz to 10 GHz~~ ~~Apply: (Note4)~~ ~~IEC 61000-4-3 (26 MHz to 6 GHz) 10V/m (Level 3)~~ RS103: Electric field, 30 MHz to 10 GHz 3. Surge to the power line ~~Apply: Elevated Withstand Level~~ • ~~IEEE Std. 472~~ • IEEE Std. 472	RAI 1 RAI 1 RAI 1 RAI 1 RAI 1

Item	Specifications	
		• IEC61000-4: - IEC61000-4-12: Ring wave - IEC61000-4-5: Surge (Switching, lightning) - IEC61000-4-4: Electrically Fast Transients/bursts
	~~Electric Static Discharge (ESD)~~	4. Electrostatic noise resistance ~~Floor mounted cabinets are installed over antistatic materials or concrete, and the relative humidity is in the range of 30% to 60%.~~ ~~For cabinet mounted MELTAC Nplus S modules:~~ ~~Discharge pulse voltage 8kV (contact) / 15kV (Air)~~ ~~Compliance standard: IEC 61000-4-2 Level 4~~ ~~For Chassis mounted modules:~~ ~~Discharge pulse voltage 4kV~~ ~~Compliance standard:~~ IEC 61000-4-2-~~1999~~1999 Level 2 ~~[Accessible parts]~~ ~~During normal operation,~~ ~~✓ The touch panel of the safety VDU panel and the surrounding area~~ ~~✓ The front/rear door handles of the cabinet and the surrounding area~~ ~~✓ The switches of the Status Display Module, and the surrounding area~~ ~~✓ The switches and fuses of the fans, and the surrounding area~~ ~~✓ The front panel of the Power Supply Modules and Analog Output Modules~~ ~~✓ EI Operation Panel~~ ~~During maintenance,~~ ~~Other than above.~~ ~~[Acceptance Criteria]~~ ~~During normal operation,~~ ~~A) There is no equipment damage~~ ~~B) Processors continue to function~~ ~~C) Data communications are not disrupted~~ ~~D) Discrete I/O does not change state~~ ~~E) Analog I/O levels do not vary by more than 3%~~ ~~F) There is no VDU image disturbance~~ ~~During maintenance,~~ ~~Only above A)~~ ~~5. Lightning impulse resistance~~ ~~AC power source line: Applied voltage 4 kV,~~

RAI 1

Item	Specifications	
		~~waveform 1.2/50 μs~~ ~~Digital I/O signal line: 4 kV, waveform 1.2/50 μs~~ ~~Applicable standard: JEC-210-1981 (Japanese Standard) Circuit category: 6~~ 5. Lightning impulse resistance AC power source line: Applied voltage 4 kV, waveform 1.2/50 μs Digital I/O signal line: 4 kV, waveform 1.2/50 μs Applicable standard: JEC-210-1981 (Japanese Standard) Circuit category: 6
	~~Harmonic Current Emissions (Note1)~~	~~For Power Supply modules or Units, the limits for harmonic current emissions (IEC 61000-3-2 or 12)~~ ~~THD: Less than 5% at 60Hz 115VAC, 50% load~~
Seismic resistance	MELTAC Cabinet (at floor mounting)	Horizontal: 2.5 G (X- and Y-directions) Vertical: 1 G
	MELTAC modules (at chassis mounting)	Horizontal: 10 G (X- and Y-directions) Vertical: 2 G
Radiation resistance	Environment in which radiation is negligible.	
Dust	1.87 x 10^{-8} lb/ft^3 (0.3 mg/m^3) Reference standard: JEIDA-63-2000 Class B (Japanese Standard).	
Corrosive gas	Environment where no corrosive gas is detected.	

RAI 1

~~Note 1: THD(; total harmonic distortion) of Input voltage for AC/DC power supply modules and units in MELTAC Nplus S platform shall not exceed 5%. See Appendix A, Section A.9 and A.2. When updating components in existing power plants using this platform, a consistency check with power quality shall be performed in the application design phase.~~

~~Note 2: Systems comprised with MELTAC Nplus S platform are not intended to be installed in areas with other equipment sensitive to magnetic fields.~~

~~Note 3: Systems comprised with MELTAC Nplus S platform are not intended to be implemented in plant areas characterized by surge environments with significant switching transients and lightning activity (e.g., in very close proximity to the service entrance from the switchyard).~~

~~Note 4: Systems comprised with MELTAC Nplus S platform are not intended to be installed in areas with strong sources of magnetic fields (e.g., CRTs, motors, cable bundles carrying high currents).~~

RAI 1

Table 4.1.1-2-1 Environmental Specifications for the modules qualified under Topical Report Rev. 3

Item	Specifications	
Room Ambient temperature	Recommended	68 to 78.8 °F (20 to 26 °C) This temperature range is expected within a heated/ air-conditioned instrumentation and control room of the nuclear power plant. The controller should be mounted in a cabinet with no more than 18 °F (10 °C) heat rise. Operating within this range will maximize the life of the equipment.
	Operation guarantee	32 to 122 °F (0 to 50 °C) The controller should be mounted in a cabinet with no more than 18 °F (10 °C) heat rise.
Relative humidity	10 to 95%Rh (No condensation)	
Withstand voltage	AC power input line	AC power input line: 5 MΩ or more (500 VDC megger) (input - ground, input - DC output) Analog I/O line: 5 MΩ or more (500 VDC megger) (I/O - ground, input - output) Digital I/O line: 5 MΩ or more (500 VDC megger) (I/O - ground, input - output) Applicable standard: JIS-C0704-1995 (IEC664/947)
	I/O line	Analog I/O line: 1 KV AC (1 minute) (I/O - ground, input - output) Digital I/O line: 2 KV AC (1 minute) (I/O - ground, input - output) Applicable standard: JIS-C0704-1995 (IEC664/947)
Electro-magnetic Compatibility (EMC)	Regulatory Guide 1.180 Revision 2(2019) is applied.	
	Electromagnetic Interference (EMI)	1.Conducted emissions Conducted emissions from the power line (field discharge) Apply: CISPR 16 in IEC 61000-6-4 (2016) (Note 1) 150 kHz to 30MHz 150 kHz to 500 kHz: 79 quasi-peak maximum 500 kHz to 30MHz: 73 quasi-peak maximum 2.Radiated emission Apply: CISPR 16 in IEC 61000-6-4(2016) (Note 2) 30MHz to 6GHz 30MHz to 230MHz: 40 quasi-peak maximum @ 10m 230MHz to 1GHz: 47 quasi-peak maximum @ 10m 1GHz to 3GHz: 76 peak maximum @ 3m 3GHz to 6GHz: 80 peak maximum @ 3m

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Item	Specifications	
	Electromagnetic Susceptibility (EMS)	1. Conducted susceptibility Power Leads Apply: IEC 61000-4-13 (16 to 2.4kHz) Class 2 IEC 61000-4-16 (0 to 150kHz) Level 3 IEC 61000-4-6 (150kHz to 80MHz) Level 3 Signal Leads Apply: Low Withstand (Note 3) IEC 61000-4-4: 1kV (Level 3) IEC 61000-4-5: 2 kV open circuit test voltage and 1 kA short circuit current (Level 3) IEC 61000-4-6: 140 dBμV test voltage (Level 3) IEC 61000-4-12: 1kV (Level 2) IEC 61000-4-16: Level 3 2. Radiated susceptibility Apply: (Note4) IEC 61000-4-3 (26 MHz to 6 GHz) 10V/m (Level 3) 3. Surge to the power line Apply: Elevated Withstand Level • IEC61000-4: - IEC61000-4-12: Ring wave - IEC61000-4-5: Surge (Switching, lightning) - IEC61000-4-4: Electrically Fast Transients/bursts
	Electric Static Discharge (ESD)	4. Electrostatic noise resistance Floor mounted cabinets are installed over antistatic materials or concrete, and the relative humidity is in the range of 30% to 60%. For cabinet mounted MELTAC Nplus S modules: Discharge pulse voltage 8kV (contact) / 15kV (Air) Compliance standard: IEC 61000-4-2 Level 4 For Chassis mounted modules: Discharge pulse voltage 4kV Compliance standard: IEC 61000-4-2 Level 2 [Accessible parts] During normal operation, ✓ The touch panel of the safety VDU panel and the surrounding area ✓ The front/rear door handles of the cabinet and the surrounding area ✓ The switches of the Status Display Module, and the surrounding area ✓ The switches and fuses of the fans, and the surrounding area ✓ The front panel of the Power Supply Modules

RAI 1

Item	Specifications	
		and Analog Output Modules ✓ EI Operation Panel During maintenance, Other than above. [Acceptance Criteria] During normal operation, A) There is no equipment damage B) Processors continue to function C) Data communications are not disrupted D) Discrete I/O does not change state E) Analog I/O levels do not vary by more than 3% F) There is no VDU image disturbance During maintenance, Only above A)
	Harmonic Current Emissions (Note1)	For Power Supply modules or Units, the limits for harmonic current emissions (IEC 61000-3-2 or 12) THD: Less than 5% at 60Hz 115VAC, 50% load
Seismic resistance	MELTAC Cabinet (at floor mounting)	Horizontal: 2.5 G (X- and Y-directions) Vertical: 1 G
	MELTAC modules (at chassis mounting)	Horizontal: 10 G (X- and Y-directions) Vertical: 2 G
Radiation resistance	Environment in which radiation is negligible.	
Dust	1.87 x 10^{-8} lb/ft^3 (0.3 mg/m^3) Reference standard: JEIDA-63-2000 Class B (Japanese Standard).	
Corrosive gas	Environment where no corrosive gas is detected.	

RAI 1

Note 1: THD(; total harmonic distortion) of Input voltage for AC/DC power supply modules and units in MELTAC Nplus S platform shall not exceed 5%. See Appendix A, Section A.9 and A.2. When updating components in existing power plants using this platform, a consistency check with power quality shall be performed in the application design phase.

Note 2: Systems comprised with MELTAC Nplus S platform are not intended to be installed in areas with other equipment sensitive to magnetic fields.

Note 3: Systems comprised with MELTAC Nplus S platform are not intended to be implemented in plant areas characterized by surge environments with significant switching transients and lightning activity (e.g., in very close proximity to the service entrance from the switchyard).

Note 4: Systems comprised with MELTAC Nplus S platform are not intended to be installed in areas with strong sources of magnetic fields (e.g., CRTs, motors, cable bundles carrying high currents).

5.0 ENVIRONMENTAL, SEISMIC, ELECTROMAGNETIC AND ISOLATION QUALIFICATION

This section describes the environmental, seismic, electromagnetic, surge withstand capability, electrostatic discharge and isolation qualifications of the MELTAC platform. The method and the result of the qualification testing are described. If any module is updated, and it is determined that qualification re-testing is required by the evaluations conducted in accordance with Section 6.1.7, the module will be tested with the same method and acceptance criteria. The same method and acceptance criteria will also be used for any new MELTAC modules.

For the qualification of updated and new MELTAC modules in the EQ Test, some changes will be made in accordance with the latest Regulatory Guides, Codes, and Standards.
Some Regulatory Guides on EQ has been revised between Rev.2 and Rev.3, resulting in changes to the recommended criteria and procedures for EQ testing.

Table 5.0-1 lists the type tests, regulatory guidance, and acceptance criteria that were applied for each qualification test under Topical Report Rev.2. Table 5.0-1-1 lists the module type tests, regulatory guidance, and acceptance criteria that are applied in Topical Report Rev.3.

RAI 1, 4

Table 5.0-1 Regulatory Guidance ~~Requirements~~ and ~~Reference to~~ Acceptance Criteria for Each Qualification Test Under Topical Report Rev.2

Test Item	Regulatory Guidance ~~Requirement~~	Reference to Acceptance Criteria
Environmental Test	RG 1.89 Rev.1 (IEEE Std. 323-1974~~IEC/IEEE Std. 60780-323-2016 IEEE Std. 323-1974~~) RG1.209 Rev.0 (IEEE Std. 323-2003/EPRI TR-107330)	System Level Test: 5.1.2.1 Module Level Test: 5.1.2.2
Seismic Test	RG 1.100 Rev.3 (IEEE Std. 344-2004~~13~~04)	Cabinet Test: 5.2.2.1 Module Level Test: 5.2.2.2
Electromagnetic Test	RG 1.180 Rev.1	Conducted Emissions, Low Frequency (CE101) Test: 5.3.2.1 Conducted Emissions, High Frequency (CE102) Test: 5.3.2.2~~1~~ Radiated Emissions, Magnetic Field (RE101) Test: 5.3.2.3~~2~~ Radiated Emissions, Electric Field (RE102) Test: 5.3.2.4~~3~~ Conducted Susceptibility, Low Frequency (CS101) Test for Power Leads: 5.3.2.5~~4~~ Conducted Susceptibility, High Frequency (CS114) Test for Power Leads: 5.3.2.6~~5~~ Conducted Susceptibility, High Frequency (CS114) Test for Signal Leads: 5.3.2.7~~6~~ Conducted Susceptibility, Bulk Cable Injection, Impulse Excitation (CS115) Test: 5.3.2.8~~7~~ Conducted Susceptibility, Damped Sinusoidal Transients (CS116) Test: 5.3.2.9~~8~~ Radiated Susceptibility, Electric Field (RS103) Test: 5.3.2.10~~9~~

RAI 1,4

Test Item	Regulatory Guidance ~~Requirement~~	Reference to Acceptance Criteria
		~~[IEC Emission]~~ ~~Conducted Emissions, Low Frequency Test: None~~ ~~Conducted Emissions, High Frequency Test: 5.3.3.,1~~ ~~- CISPR 16 in IEC 61000-6-4~~ ~~Radiated Emissions, Magnetic Field Test: None~~ ~~Radiated Emissions, Electric Field Test: 5.3.3.2~~ ~~- CISPR 16 in IEC 61000-6-4~~ ~~[IEC Susceptibility]~~ ~~EMI/RFI Conducted Susceptibility Test for Power Leads: 5.3.3.3~~ ~~- IEC 61000-4-6, -13, and -16~~ ~~EMI/RFI Conducted Susceptibility Test for Signal Leads: 5.3.3.4~~ ~~- IEC 61000-4-4, -5, -6, -12 and -16~~ ~~Radiated Susceptibility, Magnetic Field Test: None~~ ~~Radiated Susceptibility, Electric Field Test: 5.3.3.5~~
Surge Withstand Capability Test	RG 1.180 Rev.1 (IEC 61000-4-12, IEC 61000-4-5, IEC 61000-4-4)	5.3.2.11~~10~~ Surge Withstand Capability, Ring Wave Test 5.3.2.12~~11~~ Surge Withstand Capability, Combination Wave Test 5.3.2.13~~12~~ Surge Withstand Capability, Electrically Fast Transients/Bursts Test
Electrostatic Discharge Test	IEC 61000-4-2	5.4
Isolation Test	RG 1.75 Rev.3 (IEEE Std. 384-1992)	5.5

RAI 1, 4

RAI 1, 4

Table 5.0-1-1 Regulatory Guidance and Acceptance Criteria for Each Qualification Test Under Topical Report Rev.3

Test Item	Regulatory Guidance	Reference to Acceptance Criteria
Environmental Test	RG 1.89 Rev.2 (IEC/IEEE Std. 60780-323-2016) RG1.209 Rev.0 (IEEE Std. 323-2003/EPRI TR-107330)	Module Level Test: 5.6.2.1
Seismic Test	RG 1.100 Rev.4 (IEEE Std. 344-2013)	Cabinet Test: 5.7.2.1 Module Level Test: 5.7.2.2
Electromagnetic Test	RG 1.180 Rev.2	[IEC Emission] Conducted Emissions, Low Frequency Test: None Conducted Emissions, High Frequency Test: 5.8.2.,1 - CISPR 16 in IEC 61000-6-4 Radiated Emissions, Magnetic Field Test: None Radiated Emissions, Electric Field Test: 5.8.2.2 - CISPR 16 in IEC 61000-6-4 [IEC Susceptibility] EMI/RFI Conducted Susceptibility Test for Power Leads: 5.8.2.3 - IEC 61000-4-6, -13, and -16 EMI/RFI Conducted Susceptibility Test for Signal Leads: 5.8.2.4 - IEC 61000-4-4, -5, -6, -12 and -16 Radiated Susceptibility, Magnetic Field Test: None Radiated Susceptibility, Electric Field Test: 5.8.2.5
Surge Withstand Capability Test	RG 1.180 Rev.2 (IEC 61000-4-12, IEC 61000-4-5, IEC 61000-4-4)	5.8.2.7 Surge Withstand Capability, Ring Wave Test 5.8.2.8 Surge Withstand Capability, Combination Wave Test 5.8.2.9 Surge Withstand Capability, Electrically Fast Transients/Bursts Test
Electrostatic Discharge Test	RG 1.180 Rev.2 (IEC 61000-4-2)	5.9
Isolation Test	RG 1.75 Rev.3 (IEEE Std. 384-1992)	5.10

RAI 1, 4

The overview of the qualification tests, test methods, acceptance criteria and any deviations from the acceptance criteria for the MELTAC modules are provided in Sections 5.1 through 5.~~5~~10. Sections 5.1 through 5.5 provide an overview of the qualification tests for the modules described in Topical Report Rev.2, while sections 5.6 through 5.10 provide an overview of the qualification tests for the new and updated modules described in Topical Report Rev.3. These qualification tests demonstrate that the MELTAC platform is in accordance with the regulatory requirements in Table 5.0-1 and Table 5.0-1-1.
The test items and results are presented in the following test reports. The test reports reference the test procedures.

RAI 1

Table 5.0-2 Test Reports

Test Item	Test Report
Environmental Test	MELTAC-Nplus S Environmental Test Report (JEXU-1041-1044)
Seismic Test	MELTAC-Nplus S Seismic Test Report (JEXU-1041-1045)
Electromagnetic Test, Surge Withstand Test, Electrostatic Discharge Test	MELTAC-Nplus S EMC/ESD Test Report (JEXU-1041-1046)
Isolation Test	MELTAC-Nplus S Isolation Test Report (JEXU-1041-1047)

5.1 Environmental Qualification Testing

5.1.1 Environmental Specification and Outline of Test

The environmental specifications of the MELTAC platform are shown in Section 4.1.1.4.
The tests are performed to demonstrate that the MELTAC platform will continue to operate without loss of functions under the identified abnormal environmental conditions (temperature, humidity).

The MELTAC platform System Environmental Testing is performed in a cabinet equipped with representative components of the platform.

The MELTAC platform System Environmental Testing is in accordance with RG 1.89 Rev.1 which endorses ~~IEEE Std. 323-1974~~ ~~IEC/IEEE Std. 60780-323-2016~~ IEEE Std. 323-1974.

RAI 1

5.2 Seismic Qualification Testing

5.2.1 Overview

The seismic qualification testing confirms that the MELTAC platform maintains structural integrity and correct functional operation during and after a design basis earthquake. Seismic testing is part of the overall system seismic qualification which ensures there is no negative effect on the safety protection function of the equipment in case an earthquake occurs during plant operation.

The Cabinet Seismic Resistance Test is performed with a MELTAC cabinet fully loaded with most, but not all, MELTAC components. For the Cabinet Seismic Resistance Test, a test specimen is prepared for a typical safety protection system application. The tests are conducted using a 3-Direction large shaker table. The test specimen is vibration-excited on the tri-axial shaker table. During the test, the physical integrity and vibration characteristics of the cabinet are confirmed. All system functions are also confirmed before, during and after the excitation. The input acceleration used for the Cabinet Seismic Resistance Test is set high enough to cover the floor response spectrum range of power plants in the U.S.

In addition, the Module Seismic Resistance Tests are performed for mechanically different MELTAC-Nplus S components. For modules that have similar structures and positions of parts, one typical module type is tested because the module differences, such as input ranges, will have no impact on their seismic capability. Other mechanically comparable modules are qualified by similarity to the tested module. The similarity analysis for any untested modules is documented in the Seismic Qualification Report. The modules are mounted in a chassis for the Module Seismic Resistance Test.

In the seismic test, the acceleration ratio applied to the modules mounted in the cabinet with respect to the input acceleration of the cabinet increases with the position of the height within the cabinet. Hereafter, this acceleration ratio is called “response ratio”. For the Module Seismic Resistance Tests, the cabinet maximum response ratio is analyzed from the Cabinet Seismic Resistance Test. The input acceleration for the Cabinet Seismic Resistance Test is multiplied by the maximum response ratio, and additional margin is added to the worst case input acceleration for the chassis.

A chassis loaded with the MELTAC modules is vibration-excited with this worst case input acceleration. During and after this testing, the physical integrity and correct functional operation of the modules are confirmed.

The seismic testing methods for the MELTAC platform comply with RG 1.100 Rev.3, which endorses IEEE 344-2004. RAI 1

5.2.2 Seismic Resistance Test

5.2.2.1 Cabinet Seismic Resistance Test

For the Cabinet Seismic Resistance Test, a specimen that simulates a fully loaded safety protection system cabinet is prepared. The loading configuration represents the worst case

expected stress on internal mounting hardware. The MELTAC modules for the Cabinet Seismic Resistance Test are shown in Appendix A.
For module types with similar circuit electronics whose differences will have no impact on environmental test results, such as NO vs. NC contacts or differences in input ranges, one typical module type is selected.

[

RAI 1

RAI 1

5.3 Electromagnetic Compatibility and Radio Frequency Interference Qualification Testing

The EMI/RFI emission and susceptibility tests are performed for the MELTAC platform based on the methods and acceptance criteria of RG 1.180 Rev.1. The EMC qualification to RG 1.180 Rev.1 is confirmed for the MELTAC platform. The tests are performed with a MELTAC cabinet fully equipped with a typical configuration of the MELTAC components required for the safety protection system. RAI 1

[

RAI 1

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The specific test methods used for the EMI/RFI emission and susceptibility tests are described below as specified by ~~MIL-STD-461E Table 2 and Table 3 for the emission, Table 6 and Table 7 for the susceptibility of RG 1.180~~ MIL-STD-461E. RAI 1

- Conducted emissions, low frequency, 120 Hz to 10 kHz (CE101)
- Conducted emissions, high frequency, 10 kHz to 2 MHz (CE102)
- Radiated emissions, magnetic field, 30 Hz to 100 kHz (RE101)
- Radiate emissions, electric field, 2 MHz to 1 GHz, 1 GHz to 10 GHz (RE102)
- Conducted susceptibility, low frequency, 120 Hz to 150 kHz (CS101)
- Conducted susceptibility, high frequency, 10 kHz to 30 MHz (CS114)
- Conducted susceptibility, bulk cable injection, impulse excitation (CS115)
- Conducted susceptibility, damped sinusoidal transients, 10 kHz to 100 MHz (CS116)
- Radiated susceptibility, electric field, 30 MHz to 1 GHz, 1 GHz to 10 GHz (RS103)

- ~~Conducted emissions, high frequency, 150 kHz to 30 MHz (CISPR 16 in IEC61000-6-4)~~
- ~~Radiated emissions, electric field, 30 MHz to 6 GHz (CISPR 16 in IEC61000-6-4)~~
- ~~Conducted susceptibility, electrically fast transients/bursts (IEC61000-4-4)~~
- ~~Conducted susceptibility, surges (IEC61000-4-5)~~
- ~~Conducted susceptibility, disturbances induced by RF fields, 150 kHz to 80 MHz (IEC61000-4-6)~~
- ~~Conducted susceptibility, 100 kHz ring wave (IEC61000-4-12)~~
- ~~Conducted susceptibility, low frequency, 16 Hz to 2.4 kHz (IEC61000-4-13)~~
- ~~Conducted susceptibility, low frequency, 0 Hz to 150 kHz (IEC61000-4-16)~~
- ~~Radiated susceptibility, magnetic field, 60 Hz (IEC61000-4-8)~~
- ~~Radiated susceptibility, magnetic field, 60 Hz to 50 kHz (IEC61000-4-9)~~
- ~~Radiated susceptibility, magnetic field, 100 kHz and 1 MHz (IEC61000-4-10)~~
- ~~Radiated susceptibility, electric field, 26 MHz to 6 GHz (IEC61000-4-3)~~

RAI 1

For the Power Line Surge Withstand Capability Test, the following tests are performed with the same configuration as that for the EMI/RFI Test. The specific test methods used for these tests are described below as specified by IEC 61000-4.

- Surge Withstand Capability, Ring Wave (IEC 61000-4-12)
- Surge Withstand Capability, Combination Wave (IEC 61000-4-5)

- Surge Withstand Capability, Electrically Fast Transients/Bursts (IEC 61000-4-4)

~~An Oscillatory Wave Test related to surge withstand capability is performed based on IEEE Std. 472 for the MELTAC modules. The following test parameters are applied: a frequency range of 1 MHz, first peak voltage range of more than 2.5 kV and repetitive rate of more than 50 tests per second for a period of more than 2 seconds.~~

An Oscillatory Wave Test related to surge withstand capability is performed based on IEEE Std. 472 for the MELTAC modules. The following test parameters are applied: a frequency range of 1 MHz, first peak voltage range of more than 2.5 kV and repetitive rate of more than 50 tests per second for a period of more than 2 seconds.

RAI 1

For all Susceptibility and Surge Withstand Capability Tests the following acceptance criteria are applied:

- There is no equipment damage
- Processors continue to function
- Data communications are not disrupted
- Discrete I/O does not change state
- Analog I/O levels do not vary by more than 3%
- There is no VDU image disturbance

The satisfactory performance of the equipment is confirmed by means of a recorder connected to the Digital and Analog Output Modules. Digital input and the analog input levels are automatically monitored by the application software which displays an alarm in case of an error.

The occurrences of any system function abnormality, data communication abnormality, and equipment failure are confirmed by referring to the results of the self-diagnosis function of the MELTAC platform. It is verified that the self-diagnosis function is still operating at the end of the test.

Sections 5.3.1and 5.3.2 describe the test configuration, the test method, and acceptance criteria.

5.3.1 Test Configuration

~~The EUT is comprised of 2 cabinets: the CPU cabinet fitted with the CPU Chassis, E/O Converter Chassis, Optical Switch and Power Supply Modules, and the I/O cabinet fitted with the I/O Chassis, Power Interface Chassis, Isolation Chassis and Power Supply Modules. In order to attain the cabinet layout similar to the actual cabinet layout, the 2 cabinets are placed side by side with no space in between, thus acquiring the integral configuration. The cabinets are tested with the doors open to duplicate worst case conditions expected during testing and maintenance. The EUT also includes the safety VDU panel that is placed separately from the 2 cabinets.~~
~~The power to the safety VDU panel is supplied from the CPU cabinet and connected with the power cable and the signal cable. The EUT includes the module types required for safety protection system applications, as shown in Appendix A.~~

~~For module types whose differences will have no impact on EMC test results, such as NO vs. NC contacts or differences in input ranges, one typical module type is selected.~~

~~The EUT is comprised of either or in combination with the following configuration.~~
~~Cabinet configuration: EUT is comprised of cabinets fitted the multiple components such as the chassis, the modules and each Unit of Power Supply, FAN etc. The EUT includes the module types required for safety protection system applications, as shown in Appendix A. EUT is arranged of floor standing equipment. The cabinets are tested with the doors open to duplicate worst case conditions expected during testing and maintenance.~~

~~Chassis configuration: EUT is comprised of Chassis inserted the multiple MELTAC modules. EUT is arranged of table-top equipment~~

~~For module types whose differences will have no impact on EMC test results, such as NO vs. NC contacts or differences in input ranges, one typical module type is selected.~~

~~Configuration for combining safety VDU panels, The power to the safety VDU panel is supplied from the CPU cabinet and connected with the power cable and the signal cable.~~

RAI 1

The EUT is comprised of 2 cabinets: the CPU cabinet fitted with the CPU Chassis, E/O Converter Chassis, Optical Switch and Power Supply Modules, and the I/O cabinet fitted with the I/O Chassis, Power Interface Chassis, Isolation Chassis and Power Supply Modules. In order to attain the cabinet layout similar to the actual cabinet layout, the 2 cabinets are placed side by side with no space in between, thus acquiring the integral configuration. The cabinets are tested with the doors open to duplicate worst case conditions expected during testing and maintenance. The EUT also includes the safety VDU panel that is placed separately from the 2 cabinets.
The power to the safety VDU panel is supplied from the CPU cabinet and connected with the power cable and the signal cable. The EUT includes the module types required for safety protection system applications, as shown in Appendix A.

For module types whose differences will have no impact on EMC test results, such as NO vs. NC contacts or differences in input ranges, one typical module type is selected.

The AC power to the EUT is supplied from 2 systems: main and standby. Since both power sources with the EUT have the same configuration, the tests for AC input power line of CE102, CS101, CS114 and IEC 61000-4 are performed for one AC power cable.

5.3.2 Description of Tests ~~for the MIL-STD-461G and Surge Withstand Capability~~

RAI 1

5.3.2.1 Conducted Emissions, Low Frequency (CE101) Test

~~The test is not performed but IEC tests are performed instead. See 5.3.3 Description of IEC Tests.~~
~~The test is performed according to the method set forth in MIL-STD-461E, as follows:~~

RAI 1

~~a) Method~~
~~The conducted emissions from the input power lead cable of the EUT are measured to confirm that the electromagnetic conducted emissions from the EUT do not exceed the specified value.~~

~~b) Test Subject~~
~~The test subject is the AC input power lead cable including the return and ground cable of the EUT.~~
~~[~~

~~]~~

The test is performed according to the method set forth in MIL-STD-461E, as follows:

a) Method
The conducted emissions from the input power lead cable of the EUT are measured to confirm that the electromagnetic conducted emissions from the EUT do not exceed the specified value.

b) Test Subject
The test subject is the AC input power lead cable including the return and ground cable of the EUT.
[

]

RAI 1

5.3.2.2 Conducted Emissions, High Frequency (CE102) Test

~~The test is not performed but IEC tests are performed instead. See 5.3.3 Description of IEC Tests.~~
~~The test is performed according to the method set forth in MIL-STD-461E, as follows:~~

RAI 1

~~a) Method~~
~~The conducted emissions from the input power lead cable of the EUT are measured to confirm that the electromagnetic conducted emissions from the EUT do not exceed the specified value.~~

~~b) Test Subject~~
~~The test subject is the AC input power lead cable including the return and ground cable of the EUT.~~
~~[~~

~~]~~

The test is performed according to the method set forth in MIL-STD-461E, as follows:

a) Method
The conducted emissions from the input power lead cable of the EUT are measured to confirm that the electromagnetic conducted emissions from the EUT do not exceed the specified value.

b) Test Subject
The test subject is the AC input power lead cable including the return and ground cable of the EUT.
[

]

RAI 1

5.3.2.3 Radiated Emissions, Magnetic Field (RE101) Test

~~The test is not performed but IEC tests are performed instead. See 5.3.3 Description of IEC Tests.~~
~~The test is performed according to the method set forth in MIL-STD-461E, as follows:~~

~~a) Method~~
~~A loop sensor is placed on the surface of the object EUT to measure and confirm that the magnetic field radiated emissions from the EUT do not exceed the specified value.~~

~~b) Test Subject~~
~~The test subjects are the EUT enclosure, the electrical cable interface and the safety VDU panel. The 4 surfaces are scanned for 360 degrees with the loop sensor positioned at the center of the location (height) where the module is mounted.~~
~~[~~

~~]~~

RAI 1

The test is performed according to the method set forth in MIL-STD-461E, as follows:

a) Method
A loop sensor is placed on the surface of the object EUT to measure and confirm that the magnetic field radiated emissions from the EUT do not exceed the specified value.

b) Test Subject
The test subjects are the EUT enclosure, the electrical cable interface and the safety VDU panel. The 4 surfaces are scanned for 360 degrees with the loop sensor positioned at the center of the location (height) where the module is mounted.
[

]

RAI 1

5.3.2.4 Radiated Emissions, Electric Field (RE102) Test

~~The test is not performed but IEC tests are performed instead. See 5.3.3 Description of IEC Tests.~~
~~The test is performed according to the method set forth in MIL-STD-461E, as follows:~~

~~a) Method~~
~~Antennas are placed at the position specified for each frequency range from the border of the setup environment including the interface cable in order to confirm that the electric field radiated emissions from the EUT do not exceed the specified value.~~

RAI 1

~~b) Test Subject~~
~~The test subjects are the EUT enclosure, all interface cables and the safety VDU panel.~~
~~[~~

~~]~~

The test is performed according to the method set forth in MIL-STD-461E, as follows:

a) Method
Antennas are placed at the position specified for each frequency range from the border of the setup environment including the interface cable in order to confirm that the electric field radiated emissions from the EUT do not exceed the specified value.

b) Test Subject
The test subjects are the EUT enclosure, all interface cables and the safety VDU panel.
[

]

RAI 1

5.3.2.5 Conducted Susceptibility, Low Frequency (CS101) Test for Power Leads

~~The test is not performed but IEC tests are performed instead. See 5.3.3 Description of IEC Tests.~~
~~According to Section 4 of RG 1.180, the CS101 test is mentioned as the MIL-STD-461E test method that can be applied for testing the conducted EMI/RFI susceptibility of power leads. This test method is not applied to the signal lead.~~

~~The test is performed according to the method set forth in MIL-STD-461E, as follows:~~

~~a) Method~~
~~Confirm that the EUT can withstand the signal connected to the AC input power lead.~~

~~b) Test Subject~~
~~The test subject is the AC input power lead to the EUT.~~
~~[~~

~~]~~

RAI 1

According to Section 4 of RG 1.180 Rev.1, the CS101 test is mentioned as the MIL-STD-461E test method that can be applied for testing the conducted EMI/RFI susceptibility of power leads. This test method is not applied to the signal lead.

The test is performed according to the method set forth in MIL-STD-461E, as follows:

a) Method
Confirm that the EUT can withstand the signal connected to the AC input power lead.

b) Test Subject
The test subject is the AC input power lead to the EUT.
[

]

RAI 1

5.3.2.6 Conducted Susceptibility, High Frequency (CS114) Test for Power Leads

~~The test is not performed but IEC tests are performed instead. See 5.3.3 Description of IEC Tests.~~
~~The CS114 test is applicable to all interconnecting leads including the power leads of the EUT. This section describes the CS114 test that is applied to the power and control lines described~~

RAI 1

~~in Section 4.1.2 of RG 1.180.~~
~~The test is performed according to the method set forth in MIL-STD-461E, as follows:~~

~~a) Method~~
~~Confirm that the EUT can withstand the RF signals coupled onto the EUT associated cabling.~~

~~b) Test Subject~~
~~One each of the AC input power cables and the control cables (input and output cables of the Digital I/O Modules and Power Interface Module) to the EUT.~~
~~[~~

~~]~~

The CS114 test is applicable to all interconnecting leads including the power leads of the EUT. This section describes the CS114 test that is applied to the power and control lines described in Section 4.1.2 of RG 1.180 Rev.1.
The test is performed according to the method set forth in MIL-STD-461E, as follows:

a) Method
Confirm that the EUT can withstand the RF signals coupled onto the EUT associated cabling.

b) Test Subject
One each of the AC input power cables and the control cables (input and output cables of the Digital I/O Modules and Power Interface Module) to the EUT.
[

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RAI 1

5.3.2.7 Conducted Susceptibility, High Frequency (CS114) Test for Signal Leads

~~The test is not performed but IEC tests are performed instead. See 5.3.3 Description of IEC Tests.~~
~~The CS114 test is applicable to all interconnecting leads including the power leads of the EUT. This section describes the CS114 test that is applied to the signal line described in Section 4.2 of RG 1.180.~~

~~The test is performed according to the method set forth in MIL-STD-461E, as follows:~~

~~a) Method~~
~~Confirm that the EUT can withstand the RF signals coupled onto the EUT associated cabling.~~

~~b) Test Subject~~
~~One of each of the signal cables (input and output cables of the Analog I/O Modules, the Isolation Modules and the RGB cables) to the EUT.~~
~~[~~

~~]~~

RAI 1

The CS114 test is applicable to all interconnecting leads including the power leads of the EUT. This section describes the CS114 test that is applied to the signal line described in Section 4.2 of RG 1.180 Rev.1.

The test is performed according to the method set forth in MIL-STD-461E, as follows:

a) Method
Confirm that the EUT can withstand the RF signals coupled onto the EUT associated cabling.

b) Test Subject
One of each of the signal cables (input and output cables of the Analog I/O Modules, the Isolation Modules and the RGB cables) to the EUT.
[

RAI 1

RAI 1

]

5.3.2.8 Conducted Susceptibility, Bulk Cable Injection, Impulse Excitation (CS115) Test

~~The test is not performed but IEC tests are performed instead. See 5.3.3 Description of IEC Tests.~~ RAI 1

~~According to Section 4.2 of RG 1.180, the CS115 test is mentioned as the MIL-STD-461E test method that can be applied as the conducted EMI/RFI susceptibility test along the signal leads. This test method is not applied to the power lead.~~

~~The test is performed according to the method set forth in MIL-STD-461E as follows:~~

~~a) Method~~
~~Confirm that the EUT can withstand the impulse signals coupled onto the EUT associated cabling.~~

~~b) Test Subject~~
~~One of each of the signal cables (input and output cables of the Analog I/O Modules, the Digital I/O Modules, the PIF Module, the Isolation Modules and the RGB cables) to the EUT.~~
[

]

According to Section 4.2 of RG 1.180 Rev.1, the CS115 test is mentioned as the MIL-STD-461E test method that can be applied as the conducted EMI/RFI susceptibility test along the signal leads. This test method is not applied to the power lead.

The test is performed according to the method set forth in MIL-STD-461E as follows:

a) Method
Confirm that the EUT can withstand the impulse signals coupled onto the EUT associated cabling.

b) Test Subject
One of each of the signal cables (input and output cables of the Analog I/O Modules, the Digital I/O Modules, the PIF Module, the Isolation Modules and the RGB cables) to the EUT.
[

RAI 1

RAI 1

]

5.3.2.9 Conducted Susceptibility, Damped Sinusoidal Transients (CS116) Test

~~The test is not performed but IEC tests are performed instead. See 5.3.3 Description of IEC Tests.~~ RAI 1
~~According to Section 4.2 of RG 1.180, the CS116 test is stated as the MIL-STD-461E test method that can be applied as the conducted EMI/RFI susceptibility test along the signal cables. This test method is not applied to the power lead.~~

~~The test is performed according to the method set forth in MIL-STD-461E as follows:~~

~~a) Method~~
~~Confirm that the EUT can withstand the damped sinusoidal transients coupled onto the EUT associated cabling.~~

~~b) Test Subject~~
~~One each of the signal cables (input and output cables of the Analog I/O Modules, the Digital I/O Modules, the PIF Module, the Isolation Modules and the RGB cables) to the EUT.~~
[

]

According to Section 4.2 of RG 1.180 Rev.1, the CS116 test is stated as the MIL-STD-461E test method that can be applied as the conducted EMI/RFI susceptibility test along the signal cables. This test method is not applied to the power lead.

The test is performed according to the method set forth in MIL-STD-461E as follows:

a) Method
Confirm that the EUT can withstand the damped sinusoidal transients coupled onto the EUT associated cabling.

b) Test Subject
One each of the signal cables (input and output cables of the Analog I/O Modules, the Digital I/O Modules, the PIF Module, the Isolation Modules and the RGB cables) to the EUT.
[RAI 1

RAI 1

]

5.3.2.10 Radiated Susceptibility, Electric Field (RS103) Test

~~The test is not performed but IEC tests are performed instead. See 5.3.3 Description of IEC Tests.~~ RAI 1
~~The test is performed according to the method set forth in MIL-STD-461E as follows:~~

~~a) Method~~
~~Confirm that the EUT can withstand the electric field emitted from the antenna.~~

~~b) Test Subject~~
~~The test subjects are the EUT enclosure, all interface cables and the safety VDU panel.~~

~~The EUT enclosure is placed above the floor as in actual plant conditions to make its height 7.55 ft (2300 mm). Then the emission of the radiated electric field to the EUT enclosure comes from 4 horizontal directions because the top and the bottom parts are not likely to be affected by the electric field.~~
[

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The test is performed according to the method set forth in MIL-STD-461E as follows:

a) Method
Confirm that the EUT can withstand the electric field emitted from the antenna.

b) Test Subject
The test subjects are the EUT enclosure, all interface cables and the safety VDU panel.

The EUT enclosure is placed above the floor as in actual plant conditions to make its height 7.55 ft (2300 mm). Then the emission of the radiated electric field to the EUT enclosure comes from 4 horizontal directions because the top and the bottom parts are not likely to be affected by the electric field.
[RAI 1

RAI 1

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5.3.2.11 Surge Withstand Capability, Ring Wave Test

The test is performed according to the method set forth in IEC 61000-4-12 as follows. For the withstand voltage of the test, the B Medium Exposure is selected out of the location categories described in IEEE Std. C62.41-1991 (RG 1.180 Rev.1 Table 22), and the corresponding surge voltage level is applied. RAI 1

a) Method
Confirm that the EUT withstands the transient damped phenomenon (Ring Wave) generated by the low-voltage power network applied to the input power lead cable.

b) Test Subject
The test subject is the AC input power lead to the EUT.
[

]

5.3.2.12 Surge Withstand Capability, Combination Wave Test

The test is performed according to the method set forth in IEC 61000-4-5 as follows. For the withstand voltage of the test, the B Medium Exposure is selected out of the location categories described in IEEE Std. C62.41-1991 (RG 1.180 Rev.1 Table 22), and the according surge level is applied. RAI 1

a) Method
Confirm that the EUT withstands the unidirectional surge generated by the over-voltage due to the transient phenomenon of switching and lightning applied to the input power lead cable.

b) Test Subject
The test subject is the AC input power lead to the EUT.
[

]

5.3.2.13 Surge Withstand Capability, Electrically Fast Transients/bursts Test

The test is performed according to the method set forth in IEC 61000-4-4 as follows. For the withstand voltage of the test, the B Medium Exposure is selected out of the location categories described in IEEE Std. C62.41-1991 (RG 1.180 Rev.1 Table 22), and the corresponding surge voltage level is applied. RAI 1

a) Method
Confirm that the EUT withstands the electrical fast transient/burst: EFT/B applied to the input power lead cable.

b) Test Subject
The test subject is the AC input power lead to the EUT.

[

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~~**5.3.3 Description of IEC Tests**~~

5.3.3.1 ~~Conducted Emissions, High Frequency Test~~

~~The test is performed according to the method set forth in IEC 61000-6-4, as follows:~~

~~a) Method~~
~~The conducted emissions from the input power lead cable of the EUT are measured to confirm that the electromagnetic conducted emissions from the EUT do not exceed the specified value.~~

~~b) Test Subject~~
~~The test subject is the AC input power lead cable including the return and ground cable of the EUT.~~

~~[~~

~~]~~

5.3.3.2 ~~Radiated Emissions, Electric Field Test~~

RAI 1

~~The test is performed according to the method set forth in IEC 61000-6-4, as follows:~~

~~a) Method~~
~~Antennas are placed at the position specified for each frequency range from the border of the setup environment including the interface cable in order to confirm that the electric field radiated emissions from the EUT do not exceed the specified value.~~

~~b) Test Subject~~
~~The test subjects are the EUT enclosure, all interface cables and the safety VDU panel.~~

~~[~~

~~]~~

5.3.3.3 ~~EMI/RFI Conducted Susceptibility Test for Power Leads~~

~~The test is performed according to the method set forth in IEC 61000-4-6, -13 and -16 for the power leads, as follows:~~

~~a) Method~~
~~Confirm that the EUT can withstand the EMI/RFI signal connected to the AC input power lead.~~

~~b) Test Subject~~
~~The test subject is the AC input power lead to the EUT.~~

[

]

5.3.3.4 ~~EMI/RFI Conducted Susceptibility Test for Signal Leads~~

~~The test is performed according to the method set forth in IEC 61000-4-4, -5, -6, -12 and -16, as follows:~~
~~For the withstand voltage of the test, the B-Medium Exposure is selected out of the location categories described in IEEE Std. C62.41-2002, and the corresponding surge voltage level "Low Withstand" (in Table 16 of RG 1.180) is applied.~~

~~a) Method~~
~~Confirm that the EUT can withstand the EMI/RFI signals coupled onto the EUT associated cabling.~~

~~b) Test Subject~~
~~One of each of the signal cables (input and output cables of the Analog I/O Modules, the Isolation Modules and the RGB cables) to the EUT.~~

RAI 1

[

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5.3.3.5 ~~Radiated Susceptibility, Electric Field Test~~

~~The test is performed according to the method set forth in IEC 61000-4-3 as follows:~~

~~a) Method~~
~~Confirm that the EUT can withstand the electric field emitted from the antenna.~~

~~b) Test Subject~~
~~The test subjects are the EUT enclosure, all interface cables and the safety VDU panel.~~

~~The EUT enclosure is placed above the floor as in actual plant conditions to make its height 7.55 ft (2300 mm) maximum. Then the emission of the radiated electric field to the EUT enclosure comes from 4 horizontal directions because the top and the bottom parts are not likely to be affected by the electric field.~~

[

]

5.3.3.6 ~~Harmonic Current Emissions Test~~

~~The test is performed according to the method set forth in IEC 61000-3-2 as follows:~~

~~a) Method~~
~~The harmonic emissions from the AC power port of EUT are measured to confirm that total harmonic distortion, THD, from the EUT do not exceed the specified value.~~

~~b) Test Subject~~
~~The test subject is the AC input power ports of the EUTs which are Power Supply modules or Units~~

~~[~~

~~]~~

RAI 1

5.6 Environmental Qualification Testing

5.6.1 Environmental Specification and Outline of Test

The environmental specifications of the MELTAC platform are shown in Section 4.1.1.4.
The tests are performed to demonstrate that the MELTAC platform will continue to operate without loss of functions under the identified abnormal environmental conditions (temperature, humidity).

RAI 1

The MELTAC platform System Environmental Testing is performed in a cabinet equipped with representative components of the platform.

The MELTAC platform System Environmental Testing is in accordance with RG 1.89 Rev.2 which endorses IEC/IEEE Std. 60780-323-2016.

5.6.2 Contents of Environmental Test

5.6.2.1 Module Environmental Test

The MELTAC modules for the Module Environmental Test are shown in Appendix A.
For module types with similar circuit electronics whose differences will have no impact on environmental test results, such as NO vs. NC contacts or differences in their input ranges, one typical module type is selected.

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RAI 1

RAI 1

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5.7 Seismic Qualification Testing

5.7.1 Overview

The seismic qualification testing confirms that the MELTAC platform maintains structural integrity and correct functional operation during and after a design basis earthquake. Seismic testing is part of the overall system seismic qualification which ensures there is no negative effect on the safety protection function of the equipment in case an earthquake occurs during plant operation.

The Cabinet Seismic Resistance Test is performed with a MELTAC cabinet fully loaded with most, but not all, MELTAC components. For the Cabinet Seismic Resistance Test, a test specimen is prepared for a typical safety protection system application. The tests are conducted using a 3-Direction large shaker table. The test specimen is vibration-excited on the tri-axial shaker table. During the test, the physical integrity and vibration characteristics of the cabinet are confirmed. All system functions are also confirmed before, during and after the excitation. The input acceleration used for the Cabinet Seismic Resistance Test is set high enough to cover the floor response spectrum range of power plants in the U.S.

In addition, the Module Seismic Resistance Tests are performed for mechanically different MELTAC-Nplus S components. For modules that have similar structures and positions of parts, one typical module type is tested because the module differences, such as input ranges, will have no impact on their seismic capability. Other mechanically comparable modules are qualified by similarity to the tested module. The similarity analysis for any untested modules is documented in the Seismic Qualification Report. The modules are mounted in a chassis for the Module Seismic Resistance Test. RAI 1

In the seismic test, the acceleration ratio applied to the modules mounted in the cabinet with respect to the input acceleration of the cabinet increases with the position of the height within the cabinet. Hereafter, this acceleration ratio is called “response ratio”. For the Module Seismic Resistance Tests, the cabinet maximum response ratio is analyzed from the Cabinet Seismic Resistance Test. The input acceleration for the Cabinet Seismic Resistance Test is multiplied by the maximum response ratio, and additional margin is added to the worst case input acceleration for the chassis.

A chassis loaded with the MELTAC modules is vibration-excited with this worst case input acceleration. During and after this testing, the physical integrity and correct functional operation of the modules are confirmed.

The seismic testing methods for the MELTAC platform comply with RG 1.100 Rev.4, which endorses IEEE 344-2013.

5.7.2 Seismic Resistance Test

5.7.2.1 Cabinet Seismic Resistance Test

For the Cabinet Seismic Resistance Test, a specimen that simulates a fully loaded safety protection system cabinet is prepared. The loading configuration represents the worst case

expected stress on internal mounting hardware. The MELTAC modules for the Cabinet Seismic Resistance Test are shown in Appendix A.
For module types with similar circuit electronics whose differences will have no impact on environmental test results, such as NO vs. NC contacts or differences in input ranges, one typical module type is selected.

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5.7.2.2 Module Seismic Resistance Test

For the Module Seismic Resistance Test, physical and functional integrity are confirmed by testing individual modules or chassis loaded with multiple modules. The MELTAC modules for the Module Seismic Resistance Test are shown in Appendix A.
For module types whose differences will have no impact on environmental test results, such as NO vs. NC contacts or differences in input ranges, one typical module type is selected.

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5.8 Electromagnetic Compatibility and Radio Frequency Interference Qualification Testing

The EMI/RFI emission and susceptibility tests are performed for the MELTAC platform based on the methods and acceptance criteria of RG 1.180 Rev.2. The EMC qualification to RG 1.180 Rev.2 is confirmed for the MELTAC platform. The tests are performed with a MELTAC cabinet fully equipped with a typical configuration of the MELTAC components required for the safety protection system.
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The specific test methods used for the EMI/RFI emission and susceptibility tests are described below as specified by Table 3 for the emission, Table 7 for the susceptibility of RG 1.180 Rev.2.

- Conducted emissions, high-frequency, 150 kHz to 30 MHz (CISPR 16 in IEC61000-6-4)
- Radiated emissions, electric field, 30 MHz to 6 GHz (CISPR 16 in IEC61000-6-4)
- Conducted susceptibility, electrically fast transients/bursts (IEC61000-4-4)
- Conducted susceptibility, surges (IEC61000-4-5)
- Conducted susceptibility, disturbances induced by RF fields, 150 kHz to 80 MHz (IEC61000-4-6)
- Conducted susceptibility, 100 kHz ring wave (IEC61000-4-12)
- Conducted susceptibility, low frequency, 16 Hz to 2.4 kHz (IEC61000-4-13)
- Conducted susceptibility, low frequency, 0 Hz to 150 kHz (IEC61000-4-16)
- Radiated susceptibility, magnetic field, 60 Hz (IEC61000-4-8)
- Radiated susceptibility, magnetic field, 60 Hz to 50 kHz (IEC61000-4-9)
- Radiated susceptibility, magnetic field, 100 kHz and 1 MHz (IEC61000-4-10)
- Radiated susceptibility, electric field, 26 MHz to 6 GHz (IEC61000-4-3)

RAI 1

For the Power Line Surge Withstand Capability Test, the following tests are performed with the same configuration as that for the EMI/RFI Test. The specific test methods used for these tests are described below as specified by IEC 61000-4.

- Surge Withstand Capability, Ring Wave (IEC 61000-4-12)
- Surge Withstand Capability, Combination Wave (IEC 61000-4-5)
- Surge Withstand Capability, Electrically Fast Transients/Bursts (IEC 61000-4-4)

For all Susceptibility and Surge Withstand Capability Tests the following acceptance criteria are applied:

- There is no equipment damage
- Processors continue to function
- Data communications are not disrupted

- Discrete I/O does not change state
- Analog I/O levels do not vary by more than 3%
- There is no VDU image disturbance

The satisfactory performance of the equipment is confirmed by means of a recorder connected to the Digital and Analog Output Modules. Digital input and the analog input levels are automatically monitored by the application software which displays an alarm in case of an error.

The occurrences of any system function abnormality, data communication abnormality, and equipment failure are confirmed by referring to the results of the self-diagnosis function of the MELTAC platform. It is verified that the self-diagnosis function is still operating at the end of the test.

Sections 5.8.1 and 5.8.2 describe the test configuration, the test method, and acceptance criteria.

RAI 1

5.8.1 Test Configuration

The EUT is comprised of either or in combination with the following configuration,
Cabinet configuration: EUT is comprised of cabinets fitted the multiple components such as the chassis, the modules and each Unit of Power Supply, FAN etc. The EUT includes the module types required for safety protection system applications, as shown in Appendix A. EUT is arranged of floor standing equipment. The cabinets are tested with the doors open to duplicate worst case conditions expected during testing and maintenance.

Chassis configuration: EUT is comprised of Chassis inserted the multiple MELTAC modules. EUT is arranged of table-top equipment

For module types whose differences will have no impact on EMC test results, such as NO vs. NC contacts or differences in input ranges, one typical module type is selected.

Configuration for combining safety VDU panels, The power to the safety VDU panel is supplied from the CPU cabinet and connected with the power cable and the signal cable.

The AC power to the EUT is supplied from 2 systems: main and standby. Since both power sources with the EUT have the same configuration, the tests for AC input power line of IEC 61000-4 are performed for one AC power cable.

5.8.2 Description of Tests

5.8.2.1 Conducted Emissions, High Frequency Test

The test is performed according to the method set forth in IEC 61000-6-4, as follows:

a) Method
The conducted emissions from the input power lead cable of the EUT are measured to confirm that the electromagnetic conducted emissions from the EUT do not exceed the specified value.

b) Test Subject
The test subject is the AC input power lead cable including the return and ground cable of the EUT.

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5.8.2.2 Radiated Emissions, Electric Field Test

The test is performed according to the method set forth in IEC 61000-6-4, as follows:

RAI 1

a) Method
Antennas are placed at the position specified for each frequency range from the border of the setup environment including the interface cable in order to confirm that the electric field radiated emissions from the EUT do not exceed the specified value.

b) Test Subject
The test subjects are the EUT enclosure, all interface cables and the safety VDU panel.

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5.8.2.3 EMI/RFI Conducted Susceptibility Test for Power Leads

The test is performed according to the method set forth in IEC 61000-4-6, -13 and -16 for the power leads, as follows:
The operating envelops described in Table 10, 11, 12 of RG 1.180 Rev.2 are applied.

a) Method
Confirm that the EUT can withstand the EMI/RFI signal connected to the AC input power lead.

b) Test Subject
The test subject is the AC input power lead to the EUT.
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5.8.2.4 EMI/RFI Conducted Susceptibility Test for Signal Leads

The test is performed according to the method set forth in IEC 61000-4-4, -5, -6, -12 and -16, as follows:
The operating envelop for “Low Withstand” (described in Table 16 of RG 1.180 Rev.2) is applied.

a) Method
Confirm that the EUT can withstand the EMI/RFI signals coupled onto the EUT associated cabling.

b) Test Subject
One of each of the signal cables (input and output cables of the Analog I/O Modules, the Isolation Modules and the RGB cables) to the EUT.
[RAI 1

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5.8.2.5 Radiated Susceptibility, Electric Field Test

The test is performed according to the method set forth in IEC 61000-4-3, for operating envelop corresponding to Level 3, as follows:

a) Method
Confirm that the EUT can withstand the electric field emitted from the antenna.

b) Test Subject
The test subjects are the EUT enclosure, all interface cables and the safety VDU panel.

The EUT enclosure is placed above the floor as in actual plant conditions to make its height 7.55 ft (2300 mm) maximum. Then the emission of the radiated electric field to the EUT enclosure comes from 4 horizontal directions because the top and the bottom parts are not likely to be affected by the electric field.
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5.8.2.6 Harmonic Current Emissions Test

The test is performed according to the method set forth in IEC 61000-3-2 as follows:

a) Method
The harmonic emissions from the AC power port of EUT are measured to confirm that total harmonic distortion, THD, from the EUT do not exceed the specified value.

b) Test Subject
The test subject is the AC input power ports of the EUTs which are Power Supply modules or Units

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5.8.2.7 Surge Withstand Capability, Ring Wave Test

The test is performed according to the method set forth in IEC 61000-4-12 as follows. For the withstand voltage of the test, the Elevated Withstand Level, described in Table 23 of RG 1.180 Rev.2, is selected, and the corresponding test level 4 is applied.

RAI 1

a) Method
Confirm that the EUT withstands the transient damped phenomenon (Ring Wave) generated by the low-voltage power network applied to the input power lead cable.

b) Test Subject
The test subject is the AC input power lead to the EUT.

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5.8.2.8 Surge Withstand Capability, Combination Wave Test

The test is performed according to the method set forth in IEC 61000-4-5 as follows. For the withstand voltage of the test, the Elevated Withstand Level, described in Table 23 of RG 1.180 Rev.2, is selected, and the corresponding test level 4 is applied.

a) Method
Confirm that the EUT withstands the unidirectional surge generated by the over-voltage due to the transient phenomenon of switching and lightning applied to the input power lead cable.

b) Test Subject
The test subject is the AC input power lead to the EUT.
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5.8.2.9 Surge Withstand Capability, Electrically Fast Transients/bursts Test

The test is performed according to the method set forth in IEC 61000-4-4 as follows. For the withstand voltage of the test, the Elevated Withstand Level, described in Table 23 of RG 1.180 Rev.2, is selected, and the corresponding test level 4 is applied.

RAI 1

a) Method
Confirm that the EUT withstands the electrical fast transient/burst: EFT/B applied to the input power lead cable.

b) Test Subject
The test subject is the AC input power lead to the EUT.
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5.9 Electrostatic Discharge Qualification Testing

RAI 1

Same as 5.4. See Section 5.4.

5.10 Isolation Qualification Testing

RAI 1

Same as 5.5. See Section 5.5.

APPENDIX F MODULE IDENTIFIERS AND CORRESPONDING EQ TYPE TEST

Appendix F identifies each module listed in Appendix A and its corresponding EQ type test. Each type test is identified, as well as the applicable regulatory guides, codes and standards as listed in Table 5.0-1 and Table 5.0-1-1 (see Section 5).

Table F-1 lists the modules qualified under Topical Report Rev.2. Table F-2 lists the new and updated modules qualified under Topical Report Rev.3.

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Table F-1 The modules qualified in Topical Report Rev.2 and the EQ Type Test

Category			Module Type	Unique model identification number	Topical Report Rev.2 SER Qualified (Table 3.2-1:)	Type Test (Note 1)	Reference
CPU Module			PCPJ	PCPJ-31	Y	Table 5.0-1	Table A.1
System Management Module			PSMJ	PSMJ-31	Y	Table 5.0-1	Table A.2
Bus Master Module			PFBJ	PFBJ-31	Y	Table 5.0-1	Table A.3
Control Network I/F Module			PWNJ	PWNJ-31	Y	Table 5.0-1	Table A.4
Analog Input Module	Current input		MLPJ	MLPJ-A1	Y	Table 5.0-1	Table A.5
	Voltage input		MAIJ	MAIJ-G1	Y	Table 5.0-1	
	RTD 4 line type	4-line Pt200 Ω, 32 to 752 °F (0 to 400 °C)	MRTJ	MRTJ-D4	Y	Table 5.0-1	
		4-line Pt200 Ω, 500 to 662 °F (260 to 350 °C)	MRTJ	MRTJ-G2	Y	Table 5.0-1	
		4-line Pt100 Ω, 32 to 212 °F (0 to 100 °C)	MRTJ	MRTJ-J1	Y	Table 5.0-1	
		4-line Pt100 Ω, 32 to 392 °F (0 to 200 °C)	MRTJ	MRTJ-J3	Y	Table 5.0-1	
	Thermocouple K type	32 to 2372 °F (0 to 1300 °C)	MTCJ	MTCJ-E3	Y	Table 5.0-1	
		32 to 752 °F (0 to 400 °C)	MTCJ	MTCJ-E8	Y	Table 5.0-1	
Analog Output Module	Current output		MAOJ	MAOJ-A1	Y	Table 5.0-1	Table A.6
	Voltage output		MVOJ	MVOJ-A1	Y	Table 5.0-1	
Digital Input Module	Contact input (built-in contact power supply)		MDIJ	MDIJ-A4	Y	Table 5.0-1	Table A.7
				MDIJ-G2	Y	Table 5.0-1	
Digital Output Module	Relay contact output		MDOJ	MDOJ-A3	Y	Table 5.0-1	Table A.8
				MDOJ-G1	Y	Table 5.0-1	
	Semiconductor output (open collector)		MDOJ	MDOJ-22	Y	Table 5.0-1	
Pulse Input Module	Pulse input (for RCP rotation speed input)		MPIJ	MPIJ-11	Y	Table 5.0-1	Table A.9

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Category			Module Type	Unique model identification number	Topical Report Rev.2 SER Qualified (Table 3.2-1:)	Type Test (Note 1)	Reference
Isolation Module	Current input, Current/Voltage output		KILJ	KILJ-A1	Y	Table 5.0-1	Table A.10
	RTD 4 line type input Current/Voltage output"	4-line Pt100 Ω, 32 to 302 °F (0 to 150 °C)	KIRJ	KIRJ-A1	Y	Table 5.0-1	
		4-line Pt100 Ω, 32 to 392 °F (0 to 200 °C)	KIRJ	KIRJ-A2	Y	Table 5.0-1	
		4-line Pt200 Ω, 32 to 752 °F (0 to 400 °C)	KIRJ	KIRJ-A3	Y	Table 5.0-1	
	Pulse signal input (for RCP)		KIPJ	KIPJ-11	Y	Table 5.0-1	Table A.11
Distribution Module	For Digital I/O		KIOJ	KIOJ-04	Y	Table 5.0-1	
				KIOJ-A2	Y	Table 5.0-1	
	For Current input (Active)		KLPJ	KLPJ-A2	Y	Table 5.0-1	
	For Current input (Passive)		KLPJ	KLPJ-B3	Y	Table 5.0-1	
	For RTD input (4 wire)		KRTJ	KRTJ-A3	Y	Table 5.0-1	
	For Thermocouple input		KTCJ	KTCJ-A2	Y	Table 5.0-1	
	For Voltage input		KAIJ	KAIJ-A4	Y	Table 5.0-1	
	For Current output		KAOJ	KAOJ-A2	Y	Table 5.0-1	
	For Voltage output		KVOJ	KVOJ-A2	Y	Table 5.0-1	
	For Pulse signal input (for RCP)		KAIJ	KAIJ-06	Y	Table 5.0-1	
E/O Converter Module	Electrical /Optical conversion	Electrical interface: RS-485	MEOJ	MEOJ-A1	Y	Table 5.0-1	Table A.12
		Electrical interface: RS-232C	MEOJ	MEOJ-11	Y	Table 5.0-1	
Power Interface Module	Semiconductor output(open collector) Contact input(built-in contact power supply)		DPOJ	DPOJ-C1	Y	Table 5.0-1	Table A.13
Power Supply Module	CPU Power Supply		PS	PS-12	Y (Note 4)	Table 5.0-1 (Note 4)	Table A.14
	I/O Power Supply		PS	PS-22	Y	Table 5.0-1	
	CPU Power Supply (Small capacity type)		PPSJ	PPSJ-03	Y (Note 4)	Table 5.0-1 (Note 4)	
	CPU Power Supply (Large capacity type)		PPSJ	PPSJ-13	Y	Table 5.0-1	

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Category			Module Type	Unique model identification number	Topical Report Rev.2 SER Qualified (Table 3.2-1:)	Type Test (Note 1)	Reference
Safety VDU Panel			T10DH	T10DH-M001	Y	Table 5.0-1	Table A.15
FMU Module			PFDJ	PFDJ-31	Y	Table 5.0-1	Table A.16
Status Display and Switch Module	Single Redundant Parallel		PPNJ	PPNJ-32	Y	Table 5.0-1	Table A.19
	Redundant Standby		PPNJ	PPNJ-31	Y	Table 5.0-1	
Repeater Module	Repeater	For Subsystem-A	MRPJ	MRPJ-01	Y	Table 5.0-1	Table A.20
	Repeater	For Subsystem-B	MRPJ	MRPJ-02	Y	Table 5.0-1	
	Repeater	For Subsystem-A/B Double Size	MRPJ	MRPJ-21	Y	Table 5.0-1	
CPU Module Chassis	Mirror-split	Redundant Standby	ZCAJS	ZCAJS-M01	Y (Note 2)	Table 5.0-1 (Note 2)	Table A.21
	Non-split	Redundant Parallel Single	ZCAJS	ZCAJS-A21	Y (Note 2)	Table 5.0-1 (Note 2)	
I/O Module Chassis	Digital Input Module Digital Output Module Analog Output Module Analog Input Module		ZIOJS	ZIOJS-A13	Y	Table 5.0-1	Table A.22
	PIF Module		ZEHJS	ZEHJS-A01	Y (Note 4)	Table 5.0-1 (Note 4)	
	Isolation Module		ZISJS	ZISJS-A01	Y (Note 4)	Table 5.0-1 (Note 4)	
	Optical Conversion Module		ZMEJS	ZMEJS-A01	Y (Note 4)	Table 5.0-1 (Note 4)	
Fan Modules	CPU Fan		KFNJ	KFNJ-A01	N (Note 3)	NA (Note 3)	Table A.23
	PS Fan		KFNJ	KFNJ-A02	N (Note 3)	NA (Note 3)	
	Door Fan		KFNJ	KFNJ-A03	N (Note 3)	NA (Note 3)	
Terminal Unit	Analog (AI/AO)		PSND	PSND-A01	N (Note 3)	NA (Note 3)	Table A.24
	Digital (DI/DO)		PSND	PSND-A02	N (Note 3)	NA (Note 3)	
Optical Switch			RJMA	RJMA-02	Y	Table 5.0-1	Table A.25

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Note 1 : Applicable Regulatory Guides, Codes, and Standards for each EQ Type Test is described in Table 5.0-1 or Table 5.0-1-1 in Section 5.

Note 2 : The reprogramming version of the CPU chassis (ZCAJS-A23) is not accepted for use in operational safety systems. Only the ZCAJS without the –A23 suffix may be installed in the safety system. The re-programming chassis may be used to perform reprogramming activities only.

Note 3 : The KFNJ fan Assembly module and the PSND Termination Unit module were not included in the platform qualification equipment during testing and are therefore not qualified for use in safety-related applications. This is generic open item 1.

Note 4 : These modules were not included in the platform qualification equipment during equipment qualification（EQ）testing but were qualified by analysis. “Qualification by Analysis” of the summary of MELTAC platform EQ (JEXU-1041-1023) for additional information on qualification of these items.

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Table F-2 The modules qualified in Topical Report Rev.3 and onwards and the EQ Type Test

Category			Module Type	Modul Identifier Under Topical Report Rev.3	Module Identifier Under Topical Report Rev.2	Type Test (Note 1)	Reference
CPU Module			PCPJ	PCPJ-D1	PCPJ-31	Table 5.0-1-1	Table A.1
System Management Module			PSMJ	PSMJ-D1	PSMJ-31	Table 5.0-1-1	Table A.2
Bus Master Module			PFBJ	PFBJ-D1	PFBJ-31	Table 5.0-1-1	Table A.3
Control Network I/F Module			PWNJ	PWNJ-D1	PWNJ-31	Table 5.0-1-1	Table A.4
Analog Input Module	Current input		MLPJ	MLPJ-B1	MLPJ-A1	Table 5.0-1-1	Table A.5
	RTD 4 line type	4-line Pt200 Ω, 32 to 752 °F (0 to 400 °C)	MRTJ	MRTJ-E4	MRTJ-D4	Table 5.0-1-1	
		4-line Pt100 Ω, 32 to 212 °F (0 to 100 °C)	MRTJ	MRTJ-K1	MRTJ-J1	Table 5.0-1-1	
	Thermocouple K type	32 to 2372 °F (0 to 1300 °C)	MTCJ	MTCJ-F3	MTCJ-E3	Table 5.0-1-1	
Analog Output Module	Current output		MAOJ	MAOJ-B1	MAOJ-A1	Table 5.0-1-1	Table A.6
Isolation Module	Current input, Current/Voltage output		KILJ	KILJ-B1	KILJ-A1	Table 5.0-1-1	Table A.10
	RTD 4 line type input Current/Voltage output"	4-line Pt100 Ω, 32 to 302 °F (0 to 150 °C)	KIRJ	KIRJ-B1	KIRJ-A1	Table 5.0-1-1	
		4-line Pt100 Ω, 32 to 392 °F (0 to 200 °C)	KIRJ	KIRJ-B2	KIRJ-A2	Table 5.0-1-1	
		4-line Pt200 Ω, 32 to 752 °F (0 to 400 °C)	KIRJ	KIRJ-B3	KIRJ-A3	Table 5.0-1-1	
	Thermocouple K type/RTD 4 line type input Voltage output		KITJ	KITJ-A1	new module	Table 5.0-1-1	
E/O Converter Module	Electrical/Optical conversion	Electrical interface: RS-485	MEOJ	MEOJ-A2	MEOJ-A1	Table 5.0-1-1	Table A.12
		Electrical interface: RS-232C	MEOJ	MEOJ-B1	MEOJ-11	Table 5.0-1-1	
	CPU Power Supply (Large capacity type)		PPSJ	PPSJ-B3	PPSJ-13	Table 5.0-1-1	
Safety VDU Panel			T10DH	T10DH-N001	T10DH-M001	Table 5.0-1-1	Table A.15

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Category		Module Type	Modul Identifier Under Topical Report Rev.3	Module Identifier Under Topical Report Rev.2	Type Test (Note 1)	Reference
FMU Module		PFDJ	PFDJ-D1	PFDJ-31	Table 5.0-1-1	Table A.16
Status Display and Switch Module	Single Redundant Parallel	PPNJ	PPNJ-D2	PPNJ-32	Table 5.0-1-1	Table A.19
	Redundant Standby	614JND	614JND	new module	Table 5.0-1-1	
Fan Modules	CPU Fan	KFNJ	KFNJ-A01	KFNJ-A01	Table 5.0-1-1	Table A.23
	PS Fan	KFNJ	KFNJ-A02	KFNJ-A02	Table 5.0-1-1 (Note 2)	
	Door Fan	KFNJ	KFNJ-A03	KFNJ-A03	Table 5.0-1-1 (Note 2)	
	I/O Fan	KFNJ	KFNJ-A04	KFNJ-A04	Table 5.0-1-1 (Note 2)	
Terminal Unit	Analog (AI/AO)	PSND	PSND-A01	PSND-A01	Table 5.0-1-1	Table A.24
	Digital (DI/DO)	PSND	PSND-A02	PSND-A02	Table 5.0-1-1 (Note 2)	
Optical Switch		RJMA	RJMA-A2	RJMA-02	Table 5.0-1-1	Table A.25
Contact input (built-in contact power supply) Current increase function	Contact impressed voltage: DC 48 V Contact current: 10 to 12 mA	RDIJ	RDIJ-A1	new module	Table 5.0-1-1	Table A.26
Contact input (built-in contact power supply)	Contact impressed voltage: DC 24 V Contact current: 9 to 12 mA	RDIJ	RDIJ-A2	new module	Table 5.0-1-1	
Digital Output Module	Semiconductor output (open drain)	RDOJ	RDOJ-A1	new module	Table 5.0-1-1	Table A.27
Distribution Module	For Analog input	RDDJ	RDDJ-A1	new module	Table 5.0-1-1	Table A.28
Power Interface Module	Semiconductor output (open drain) Contact input (built-in contact power supply)	RPDJ	RPDJ-A1	new module	Table 5.0-1-1	Table A.29

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Category			Module Type	Modul Identifier Under Topical Report Rev.3	Module Identifier Under Topical Report Rev.2	Type Test (Note 1)	Reference
Power Supply Module	I/O Power Supply		RPAJ	RPAJ-A1	new module	Table 5.0-1-1	Table A.30
Repeater Module	Repeater Alarm signal input (built-in contact power supply) Mutual anomaly monitoring function		RCMJ	RCMJ-A1	new module	Table 5.0-1-1	Table A.31
CPU Module Chassis	Non-split	Redundant Standby Redundant Parallel Single	ZCDJS	ZCDJS-A21	new module	Table 5.0-1-1	Table A.32
I/O Module Chassis	RDIJ Digital Input Module RDOJ Digital Output Module RPDJ PIF Module (This requires two slots)		ZRDJ	ZRDJ-AK1	new module	Table 5.0-1-1	Table A.33
	Analog Input Module		ZRXJ	ZRXJ-AA1	new module	Table 5.0-1-1	
	Isolation Module		ZRSJ	ZRSJ-AA1	new module	Table 5.0-1-1	
	Optical Conversion Module		ZREJ	ZREJ-AA1	new module	Table 5.0-1-1	
Alarm Signal Input Modules	Alarm signal input Power supply		REIJ	REIJ-A1	new module	Table 5.0-1-1	Table A.34
EI Unit	EI Signal Processing Unit		EI-20W-027C	EI-20W-027C	new module	Table 5.0-1-1	Table A.35
	EI Unit Power Supply		EI-32C-027C	EI-32C-027C	new module	Table 5.0-1-1	
	EI Detector Power Supply		EI-30C-027C	EI-30C-027C	new module	Table 5.0-1-1	
	EI Operation Panel		EI-40C-027C	EI-40C-027C	new module	Table 5.0-1-1	

Note 1: Applicable Regulatory Guides, Codes, and Standards for each EQ Type Test is described in Table 5.0-1 or Table 5.0-1-1 in Section 5.

Note 2: These modules were not included in the platform qualification equipment during equipment qualification (EQ) testing but were qualified by analysis.

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