Summary of MELTAC Platform CGD Activity

Non-Proprietary Version

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1.0 INTRODUCTION

This document explains the recurring CGD activity of Mitsubishi Electric Corporation (MELCO) for Mitsubishi Electric Total Advanced Controller (MELTAC) platform described in “Safety System Digital Platform - MELTAC - Topical Report” (JEXU-1041-1008).

This activity is performed under MELCO’s 10 CFR 50 Appendix B QAP. MELCO’s 10 CFR 50 Appendix B QAP is explained in “Quality Manual based on U.S. Nuclear Regulations” (ESC Procedure N-G000-P) corresponding to Section D.2.2 of “Digital I&C-ISG-06 Licensing Process”.

The MELTAC Re-evaluation Program (MRP) activity corresponding to Section D.10.4.2.4.2 of ISG-06 was performed as a one-time activity under MELCO’s 10 CFR 50 Appendix B QAP, to establish the baseline of the MELTAC platform applied for the US (See Section 6.0 of “Safety System Digital Platform - MELTAC - Topical Report” (JEXU-1041-1008)).
Through this MRP activity, the MELTAC platform became a basic component.

After the baseline of the MELTAC platform was established, the recurring CGD activity has been performed on parts in parallel with the design activity of the MELTAC platform.
The design activity of the MELTAC platform under MELCO’s 10 CFR 50 Appendix B QAP is explained in “Summary of MELTAC Platform Design” (JEXU-1041-1026).
Basic software is not the scope of the recurring CGD activity for the MELTAC platform because all basic software supplied with the MELTAC platform are developed and maintained by MELCO as described in Section 6 of “Safety System Digital Platform - MELTAC - Topical Report” (JEXU-1041-1008).

Table 1-1 Reference Document

Document Title	Document Number
“Safety System Digital Platform - MELTAC - Topical Report”	JEXU-1041-1008
Quality Manual based on U.S. Nuclear Regulations	ESC Procedure N-G000-P
Summary of MELTAC Platform Design	JEXU-1041-1026

1.1 Description

In this document, the following words are used by the following description.

Part

“Part” means a purchased item. The parts for the MELTAC platform are categorized in the following two types:

- A part purchased from NQA-1 supplier
- A part purchased from non-NQA-1 supplier (i.e.: commercial grade part)

A part purchased from NQA-1 supplier is purchased and controlled under MELCO’s 10 CFR 50 Appendix B QAP.
A part purchased from non-NQA-1 supplier is purchased and controlled under MELCO’s ISO 9001 QAP.

Component

"Component" means a deliverable item, which is described in Appendix A of "Safety System Digital Platform - MELTAC - Topical Report" (JEXU-1041-1008).
The components of the MELTAC platform can be categorized into the following two types:

- An in-house manufactured unit/printed circuit board (PCB)
  MELCO manufactures units/PCBs in-house under MELCO's 10 CFR 50 Appendix B QAP. An in-house manufactured unit consists of multiple discrete parts and single or multiple in-house manufactured PCB(s). An in-house manufactured PCB consists of multiple discrete electric parts.

- A part without in-house assembly
  This is treated as a component without in-house assembly.
  The description of "part" is provided in the top of this section.

1.2 Scope and Action Policy of CGD Activity for MELTAC Platform

The scope and action policy of the recurring CGD activity for the MELTAC platform are described below:

- Parts without in-house assembly
  The CGD activity for this component type is performed under the CGD procedures of MELCO's 10 CFR 50 Appendix B QAP as an essential action. The CGD procedures of MELCO's 10 CFR 50 Appendix B QAP are in accordance with 10 CFR 21.
  See Section 3 regarding the CGD activity for this component type.

- Parts applied to in-house manufactured unit/PCB
  The CGD activity for this component type is not required because manufacturing, inspection and testing process for this component type is performed in accordance with MELCO's nuclear quality assurance program (MELCO's 10 CFR 50 Appendix B QAP), which is in accordance with 10 CFR 50 Appendix B.
  However, considering the basis of test coverage for this component type, MELCO references the EPRI-TR-102260, "Supplemental Guidance for the Application of EPRI Report NP-5652", Option D as a useful supplemental method to review the test coverage for each component in the development phase of the MELTAC platform.
  See Appendix A regarding how MELCO applies the EPRI-TR-102260 Option D to this component type.

1.3 Referencing Guidance

EPRI-TR-102260, “Supplemental Guidance for the Application of EPRI Report NP-5652”, Section 3.2.2 “Acceptance Process” states:

“In Option D, the original equipment manufacturer is buying several commercial grade parts and possibly raw materials (e.g., potting compounds) that are installed into an assembly. The assembly, inspection, and testing process is performed in accordance with the supplier's nuclear quality assurance program. **(Note:** There may be cases where the assembly is manufactured under the supplier's commercial quality program and tested as a unit under the supplier's nuclear quality assurance program.) If the combination of the assembly, inspection and testing of the complete assembly demonstrates the acceptability of the parts, the individual commercial grade parts may be accepted and dedicated by this process. An example of this could be the assembly of discrete electronic components into a circuit board which is inspected to the circuit board drawing, visually examined for acceptable manufacturing, and then verified to perform correctly using automated testing equipment.”

“The important point is the original equipment manufacturer's practices for accepting a commercial grade item do not have to follow the guidance in EPRI Report NP-5652 as long as they meet the intent of 10 CFR 50 Appendix B. Probably the most significant difference encountered is that the original equipment manufacturer may not specifically list critical characteristics for acceptance on a separate form. The original equipment manufacturer may rely on these characteristics being specified in subsupplier purchase orders, part drawings, codes and standards, product specifications, manufacturing drawings, travelers, or inspection/test forms. In the case of purchased commercial grade items, the original equipment manufacturer must provide reasonable assurances the procurement requirements imposed on subsuppliers are being met.”

EPRI-TR-102260, “Supplemental Guidance for the Application of EPRI Report NP-5652”, EXAMPLE 3-2 of Section 3.2.3 “Example” states:

“The supplier manufactures the printed circuit boards in-house. The boards are an assembly consisting of the insulator sheeting and the mounted discrete electronic parts. The electronic parts making up the board are procured from unapproved suppliers, mainly local electronic distributors. Specific technical requirements are imposed in the purchase orders for the various types of discrete electronic parts.
These parts include resistors, diodes, capacitors, transistors, and SCR's. The electronic parts are subject to a sample visual and identification inspection upon receipt.
Southern uses Option D to accept the commercial grade printed circuit boards made up of individual commercial grade electronic parts. The printed circuit board acceptance consists of a visual inspection against the circuit board drawing to assure the proper parts have been assembled, a visual inspection to assure sound connections, a bum-in of the boards to detect infant mortality, and then verifying the proper electronic performance of the printed circuit boards using automatic testing equipment controlled under the supplier's 10CFR50, Appendix B program. The successful completion of the burn-in and performance testing provides reasonable assurance the individual electronic parts are acceptable for the safety-related utility purchase order.”

2.0 OVERVIEW

The CGD activities for the MELTAC platform has the following two phases according to the lifecycle of the MELTAC platform.

- Development of the MELTAC platform for design change of itself
- Manufacturing and testing of the MELTAC platform applied to an application

2.1 Development Phase of the MELTAC Platform for Design Change of Itself

During this phase, design and V&V activities are performed as described in “Summary of MELTAC Platform Design” (JEXU-1041-1022), “Summary of MELTAC Platform Equipment Qualification” (JEXU-1041-1023), and “Summary of MELTAC Platform V&V” (JEXU-1041-1026).
In parallel with the design activity above, the CGD activities related to the target components of the deign activity are performed as shown in Table 2-1 below.

Table 2-1 CGD Activity Performed in the Development Phase of MELTAC Platform

No.	CGD Activity	Activity Description
1	Identify items	Identify commercial grade items (CGIs) of the MELTAC platform. This activity is performed during the hardware design activity of each component.
2	Determine safety functions	Determine safety functions of each CGI which is identified in the activity No.1.
3	Identify relevant technical information	Identify any relevant technical information that may affect each CGI.
4	Identify the items that could adversely affect safety functions	Identify whether each CGI could affect safety functions of the entire MELTAC platform.
5	Conduct FMEA	To complement the activity No.6, conduct FMEA for each component. This activity is described in “Summary of MELTAC Platform Reliability” (JEXU-1041-1027).
6	Identify Critical Characteristics (CCs)	Identify critical characteristics of each CGI that could affect safety functions of the entire MELTAC platform and document them.
7	Determine acceptance methods for each CC	Determine acceptance methods for each CC. For CGI(s) to be dedicated, one or combination of the following acceptance methods shall be used to verify each CC. Method 1) Special Test and Inspections Method 2) Commercial Grade Survey of Supplier Method 3) Source Verification Method 4) Acceptable Supplier/Item In the development phase of the MELTAC platform, the applicable method for each CC of all CGIs is Method 1.
8	Document the Commercial Grade Item Dedication Plan	Document the detailed action plan for dedicating each CGI. The document contains detailed acceptance methods to verify each CC.

9	Execute the plan	Evaluate CCs according to the Commercial Grade Item Dedication Plan.
10	Document the CGD report	Document the result of the verification of CCs.
11	Provide General Commercial Grade Item Dedication Plan for application	Provide the general plan for application that the MELTAC platform is applied based on the CGD report of the MELTAC platform (the output of the item No.11 of this list). This plan shall contain acceptance methods to verify the CCs of the MELTAC platform applied to an application.

2.2 Manufacturing and Testing of the MELTAC Platform Applied to an Application

The CGD activity for the MELTAC platform applied to an application is application specific. However, the expected flow of the CGD activities will be similar to the flow of the CGD activity for the development phase of the MELTAC platform.

The commercial grade item dedication plan for specific application shall be provided based on the “general commercial grade item dedication plan for application”, which is the final output of the CGD activity of the development phase of the MELTAC platform (see the item No.11 of Table 2-1).

3.0 CGD ACTIVITY PERFORMED IN DEVELOPMENT PHASE

3.1 Identify Item

According to the policy described in Section 1.2, the commercial grade items (CGIs) are shown in Table 3-1. This section describes the CGD activity for Power Supply Modules as a representative CGI.

Table 3-1 Commercial Grade Item of the MELTAC Platform (1/2)

Table 3-1 Commercial Grade Item of the MELTAC Platform (2/2)

3.2 Determine Safety Functions

To determine the safety functions of CGIs listed in Table 3-1, safety functions of the entire MELTAC platform are shown in Table 3-2 below. The safety functions of the entire MELTAC platform are succeeded to each component. It is considered that each component could affect the safety functions of the entire MELTAC platform. Table 3-3 shows which component could adversely affect the safety functions of the entire MELTAC platform.
The safety functions of each CGI are determined with considering the information shown in Table 3-3.
Table 3-4 shows the safety functions of the Power Supply Module (for I/O power supply) as representative CGI's safety functions.

Table 3-2 Safety Functions of Entire MELTAC Platform

No.	Safety Functions	
1	Input (from I/O)	Acquire analog or digital input signals from connected devices such as analog sensors or binary switches.
2	Input (from Network)	Acquire analog or digital input signals from other controllers connected via control network or data link.
3	Operation	Execute application logics (generated and downloaded via the engineering tool) using data retrieved by the step (1) above as inputs to perform an operation.
4	Output (to I/O)	Output analog or digital signals to connected devices such as valves and motors.
5	Output (to Network)	Output analog or digital signals to other controllers connected via control network or data link.
6	Input (from S-VDU) and operation	Respond to operator inputs via Class 1E human system interface displays.
7	Output (to S-VDU)	Display information to operators via Class 1E human system interface displays.
8	Self-diagnosis	Perform diagnostic monitoring of MELTAC modules and self-protection from erroneous commands from non-safety HSI workstations.
9	Independence	Secure independence not to prevent implementation of the safety functions No.1 through No.8. (1) Electric isolation from outside of the controller in process data I/O and communication. - I/O between the IO modules (AI/AO/DI/DO/PIF) and field devices. - Communication between safety channels - Communication between safety and non-safety systems (2) Communication independence - Between safety channels - Between safety and non-safety systems
10	Environmental	Required environmental tests for equipment which is a part of nuclear safety system.
11	Seismic	Required seismic tests for equipment which is a part of nuclear safety system.
12	EMC	Required EMC tests for equipment which is a part of nuclear safety system.
13	Isolation	Isolation test between IO modules (AI/AO/DI/DO/PIF) and field devices such as sensor.

Table 3-3 Safety Functions of the Entire MELTAC Platform which Could Be Affected by the Components (1/2)

Table 3-3 Safety Functions of the Entire MELTAC Platform which Could Be Affected by the Components (2/2)

Table 3-4 Safety Function of the Power Supply Module (for I/O Power Supply)

3.3 Identify Relevant Technical Information

The relevant technical information that may affect each CGI is as follows.

(1) Power Supply Module (PS) Hardware Specification (JEXU-1028-1040)

3.4 Identify the Items that Could Adversely Affect Safety Functions

See Table 3-3.

3.5 Conduct FMEA

FMEA of CGIs listed in Table 3-1 is performed. The results are used to identify critical characteristics of each component.

The results of FMEA of each component are listed in “Summary of MELTAC Platform Reliability” (JEXU-1041-1027).

3.6 Identify Critical Characteristics (CCs) Based on the Safety Functions

The CCs for each CGI shall be identified from the related hardware design documents (e.g. specifications, drawings, part lists), the result of FMEA, seismic and environmental conditions of the target component, and the manuals/catalogs of the purchased parts assembled in the target component.

The identified CCs are described per each component, and are documented under MELCO's 10 CFR 50 Appendix B QAP. Table 3-5 shows the CCs of the Power Supply Module (for the I/O module) as a representative CGI's CCs..

Table 3-5 Results of Identifying CCs for the Power Supply Module (for I/O Power Supply) (1/5)

Table 3-5 Results of Identifying CCs for the Power Supply Module (for I/O Power Supply) (2/5)

Table 3-5 Results of Identifying CCs for the Power Supply Module (for I/O Power Supply) (3/5)

Table 3-5 Results of Identifying CCs for the Power Supply Module (for I/O Power Supply) (4/5)

Table 3-5 Results of Identifying CCs for the Power Supply Module (for I/O Power Supply) (5/5)

3.7 Determine acceptance methods for each CC

The applicable acceptance method for each CGIs of the MELTAC platform is Special Test, which is one of Method 1.
Testing of each component is performed in combination with other related components under the design activity procedure of MELCO's 10 CFR 50 Appendix B QAP.
Specifications of Special Test for the CGIs must be included in the test specification for components. Therefore, the test specification for components shall be reviewed in view of whether necessary specifications for verification of the CCs are contained.

Table 3-6 shows the acceptance methods for the CCs of the Power Supply Module (for the I/O power supply) as the acceptance methods for the representative CGI.

3.8 Execute the plan and document the Commercial Grade Item Dedication Report

As the verification result for CCs of the representative CGI, Table 3-6 shows the result for the Power Supply Module (for I/O power supply).

Table 3-6 CC Verification Plan and Results for the Power Supply Module (for I/O Power Supply) (1/3)

Table 3-6 CC Verification Plan and Results for the Power Supply Module (for I/O Power Supply) (2/3)

Table 3-6 CC Verification Plan and Results for the Power Supply Module (for I/O Power Supply) (3/3)

3.9 Provide General Commercial Grade Item Dedication Plan for Application

This plan shall contain the acceptance methods to verify the CCs of the MELTAC platform applied to an application.
At the development phase of the MELTAC platform, the acceptance method for CCs for all CGIs is Method 1 (Special Test).
The acceptance methods for CCs for all CGIs for manufacturing and testing the MELTAC platform applied to an application will be provided upon the completion of the qualification test under MELCO's 10 CFR 50 Appendix B QAP, with considering survey of supplier (Method 2) and/or special test and inspections (Method 1).

The difference between the methods described in this general CGD plan for application and the methods described in the CGD plan for the development phase of the MELTAC platform is acceptable, provided that the assessment of these differences is demonstrated properly in this CGD plan for application.

APPENDIX A CONSIDERATION FOR THE PARTS APPLIED TO IN-HOUSE MANUFACTURED UNIT/PRINTED CIRCUIT BOARD

As described in Section 1.2, the CGD activity for an in-house manufactured unit/printed circuit board (PCB) is regarded as optional, however, considering the parts used for each in-house manufactured unit/PCB, MELCO references the EPRI-TR-102260, “Supplemental Guidance for the Application of EPRI Report NP-5652” Option D as a useful supplemental method in the development phase of the MELTAC platform. This Appendix describes the result of implementation of the above method regarding Current Input for Module, as a representative. To implement the method above, MELCO uses the procedure flow described in Table 2-1.

A.1 Identify Safety Function

The safety functions of the Analog Input Module (Current Input) are listed in Table A.1. Hardware specifications of the module that could affect safety functions are identified in the list.

Table A.1 Safety Function of Analog Input Module (Current Input)

A.2 Identify Relevant Technical Information

The relevant technical information that may affect each CGI is as follows.
(1) Analog I/O Modules Common Hardware Specification (JEXU-1028-1176)
(2) Current Input Module (MLPJ) Hardware Specification (JEXU-1028-1177)

A.3 Identify the Items that Could Adversely Affect Safety Functions

See Table 3-3.

A.4 Conduct FMEA

The results of FMEA of each component are listed in “Summary of MELTAC Platform Reliability” (JEXU-1041-1027).

A.5 Identify Critical Characteristics (CCs) based on the safety functions

Table A.2 Results of Identify CCs for Analog Input Module (Current Input)(1/4)

Table A.2 Results of Identify CCs for Analog Input Module (Current Input)(2/4)

Table A.2 Results of Identify CCs for Analog Input Module (Current Input)(3/4)

Table A.2 Results of Identify CCs for Analog Input Module (Current Input)(4/4)

A.6 Determine Acceptance Methods for Each CC

Table A.3 shows the acceptance methods for the CCs of the Analog Input Module (Current Input).

A.7 Execute the Plan and Document the Commercial Grade Item Dedication Report

Table A.3 shows the verification result for the Analog Input Module (Current Input).

Table A.3 CC Verification Plan and Results for Analog Input Module (Current Input)(1/6)

Table A.3 CC Verification Plan and Results for Analog Input Module (Current Input)(2/6)

Table A.3 CC Verification Plan and Results for Analog Input Module (Current Input)(3/6)

Table A.3 CC Verification Plan and Results for Analog Input Module (Current Input)(4/6)

Table A.3 CC Verification Plan and Results for Analog Input Module (Current Input)(5/6)

Table A.3 CC Verification Plan and Results for Analog Input Module (Current Input)(6/6)
