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Safety-Related

Project Document No.	Rev.	-	2

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TOSHIBA CORPORATION
NUCLEAR ENERGY SYSTEMS & SERVICES DIV.

Commercial Dedication Instruction

Customer Name	N/A (As per each Job Order)
Project Name	N/A (As per each Job Order)
Item Name	N/A (As per each Job Order)
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Product Name	LVPS Module
Model Number	HNS0500

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1. Product Identification

a. Part Number: See following table

b. Model Number: HNS0500

c. Drawing Number: 5Q8K0018 Rev.2

d. Manufacturer's Name: TOSHIBA Corporation, Power Systems Company, Power Platform Development Department (PPDD)

Sub supplier: { }[a,c]

e. Manufacturer's Model Number: See following table

f. Manufacturer's Catalog Number: N/A

g. Name plate data: N/A

h. Applicable Material/Part Specification Number: N/A

i. Identification of Parent Component: See Section 2.3

j. Software Version: N/A

k. Firmware Version: N/A

Table 1 Part Number List

Part Number: (Procurement/Purchase Specification Number/ Part Number)	Manufacturer's Model Number	Description
5Q8K0018/P001	HNS0500B00000	-

2. Product Description

2.1 Definitions

a. General Name of Product: LVPS module

b. Product Name of Manufacturer: LVPS module

c. Description of Terms

LVPS: Low Voltage Power Supply that is used in a unit to supply DC power to modules in the unit. Each unit has two LVPS modules that are redundant power supplies of the unit.

d. Abbreviation

AC	Alternate Current
AQ	Augmented Quality
APRM	Average Power Range Monitor
CC	Critical Characteristics
C of C	Certificate of Conformance
CCA	Critical Characteristics for Acceptance
CCD	Critical Characteristics for Design
CDI	Commercial Dedication Instruction
CFI	Counterfeit and Fraudulent Items
CG	Commercial Grade
DC	Direct Current
DTF	Digital Trip Function
EMC	Electromagnetic Compatibility
EQ	Equipment Qualification
FMEA	Failure Mode and Effect Analysis
Fuchu-PS	Toshiba Fuchu Complex Power Systems Segment

LVPS	Low Voltage Power Supply
LPRM	Local Power Range Monitor
MSIV	Main Steam Isolation Valve
NICSD	Toshiba Fuchu-PS Nuclear Instrumentation and Control Systems Department
NISD	Nuclear Instrumentation Systems Development & Designing Group
NSR	Non-Safety-Related
OPRM	Oscillation Power Range Monitor
PPDD	Power Platform Development Department
QA	Quality Assurance
QC	Quality Control
RPS	Reactor Protection System
SD	Software Development
SPTM	Suppression Pool Temperature Monitoring System
SR	Safety-Related
SRNM	Startup Range Neutron Monitor
TLF	Trip Logic Function
US	United States

2.2 Function of Product

An LVPS module is a plug-in type unit power supply that receives AC power or DC power and supplies DC power to middle plane of the parent components. The LVPS module has three power outputs (DC 5V, +15V, -15V).

The LVPS module monitors the output voltage inside the power supply, and generates an alarm in case of failure.

2.3 Function of Parent Component

Table 2 Function of Parent Component

Part No.	Model No.	Parent Component	Function of Parent Component (Safety Function)	Functional Classification of Parent Component
P001	HNS0500 B00000	LPRM unit, APRM unit, OPRM unit, SRNM unit, SPTM unit, SPTM-S unit, DTF-RPS unit, TLF-RPS unit, DTF-MSIV unit, DTF-MSIV-S unit, TLF-MSIV unit	Parent Components generate safety-related signals.	Safety Related

3. Safety Related Function

The LVPS module is required to perform before, during, and after abnormal environmental conditions (seismic, environmental and Electromagnetic Compatibility (EMC) conditions). The LVPS module shall perform the safety related functions described in the following table. The environmental and EMC qualification of the LVPS module are not performed as a standalone item. The verification of environmental and EMC qualification will take place at a higher level as part of system equipment qualification effort (Refer to Section 6.2.1).

Table 3 Safety Related Function

Part No.	Model No.	Safety Related Function	Functional Classification
P001	HNS0500B 00000	The LVPS module is mounted on and electrically connected to the parent components which have safety-related functions. The LVPS module supplies the power supply for operation to each module mounted in the parent component (safety function).	Safety Related (Having an effect on performance of the system safety function)

The LVPS module is required to operate during and after the defined design basis events.

■ Seismic Sensitive Part/Assembly

□ Not Seismic Sensitive

□ Application Does Not Require Seismic Adequacy

The LVPS module is attached to a parent system, and the seismic integrity of the LVPS module is verified by qualification testing (Refer to Section 6.2.1).

3.1 Functional Classification

The functional mode and functional classification were evaluated and identified as follows.

a. Functional Mode : □ Active Functional Mode

■ Passive Functional Mode

b. Functional Classification : ■ Safety-Related (SR)

□ Non-Safety-Related (NSR)

□ Augmented Quality (AQ)

4. Critical Characteristics for Design

Table 4-1 shows the Critical Characteristics for Design (CCD) and technical evaluations. Table 4-2 shows the result of Failure Mode and Effect Analysis (FMEA). This evaluation is performed base on technical requirements for the LVPS modules of OPRM application. Though technical requirements specified in Purchase Specification (Reference (1)) are based on the OPRM Unit Detailed Design Specification for Power Range Neutron Monitor (Reference (5)), technical requirements for the LVPS module to each application of Parent Components shown in Table 2 are common.

Nuclear Instrumentation Systems Development & Designing Group (NISD) evaluated following supplier's module design:

Manufacturer's Model Number : HNS0500A00000 (Commercial use)

Module Design Specification : 5G8HA757 Rev.1 (Reference (2))

This module was developed under the ISO-9001 Quality Assurance (QA) process but not verified under the Nuclear Instrumentation and Control Systems Department (NICSD) Appendix-B QA program. For dedication of this module, NICSD requires PPDD to apply additional QA and documentation requirements specified in Purchase Specification (Reference (1)). By applying additional requirements based on the Purchase Specification (Reference (1)), manufacturer's model number is changed to the following to distinguish the commercial use and US safety-related use.

Manufacturer's Model Number : HNS0500B00000 (US safety-related use)

NISD evaluated following supplier's module design and sub supplier's delivery specification for US safety-related use, and confirmed this module satisfies requirements specified in Purchase Specification (Reference (1))

Supplier's module design

LVPS Module HNS0500 Series Module Design Specification : 5G8HC111 Rev.1 (Reference (3))

Sub supplier's delivery specification

Product Specification for LVPS module : [a,c] Rev.H (Reference (4))
Outline Dimensional Drawing : [a,c] Rev.K (Reference (10))
Parts List (Main Body) : [a,c] Rev.E (Reference (11))
Parts List [a,c] : [a,c] Rev.M (Reference (12))
Parts List [a,c] : [a,c] Rev.G (Reference (13))
Parts List [a,c] : [a,c] Rev.E (Reference (14))
Parts List [a,c] : [a,c] Rev.J (Reference (15))
Parts List [a,c] : [a,c] Rev.F (Reference (16))
Parts List [a,c] : [a,c] Rev.G (Reference (17))
Circuit Diagram : [a,c] Rev.C (Reference (18))
Circuit Diagram [a,c] : [a,c] Rev.- (Reference (19))
Coating Instruction [a,c] : [a,c] Rev.B (Reference (20))
Coating Instruction [a,c] : [a,c] Rev.B (Reference (21))
Coating Instruction [a,c] : [a,c] Rev.B (Reference (22))
Coating Instruction [a,c] : [a,c] Rev.B (Reference (23))
Coating Instruction [a,c] : [a,c] Rev.B (Reference (24))
Coating Instruction [a,c] : [a,c] Rev.B (Reference (25))
Printed Circuit Board Diagram [a,c] : [a,c] Rev.- (Reference (28))
Printed Circuit Board Diagram [a,c] : [a,c] Rev.- (Reference (29))
Printed Circuit Board Diagram [a,c] : [a,c] Rev.- (Reference (30))
Printed Circuit Board Diagram [a,c] : [a,c] Rev.- (Reference (31))
Printed Circuit Board Diagram [a,c] : [a,c] Rev.- (Reference (32))

Table 4-1 CCD and Technical Evaluation

Part No.	No	CCD	Manufacturer's specification	Technical Evaluation
P001	1	Physical Characteristics -Dimension Section 6 of purchase specification*1 (80.9W × 128.4H × 176.0D mm) Permissible deviations for dimensions are specified in receiving inspection specification (Reference (7)). -Mass Section 6 of purchase specification*1 (2000g or less)	Dimension is specified in Section 4.1.1 of MDS*2 (80.9W × 128.4H × 176.0D mm) Mass is specified in Section 4.1.2 of MDS*2 (2000g or less)	Manufacturer's item meets the purchaser requirement. This characteristic does not directly contribute to safety function. However, this characteristic related to item compatibility, form or fit is important when considering replacement and Counterfeit and Fraudulent Items (CFI) issues. Mass is a factor which may affect seismic capability of parent component.
	2	Physical Characteristics -General configuration and shape Module configuration and shape is described in Section 6 of purchase specification*1	Module configuration is described in Sections 4.1.1 of MDS*2	Manufacturer's item meets the purchaser requirement. This characteristic does not directly contribute to safety function. However, this characteristic related to item compatibility, form or fit is important when considering replacement and CFI issues. These characteristics contribute to Equipment Qualification (EQ) and EMC capability.

Part No.	No	CCD	Manufacturer's specification	Technical Evaluation
	3	Performance Characteristics - Rated Power Input. Sections 5.2.8 -1 of Unit DDS*3 specifies Rated Power Input. DC power Input Voltage 135 to 230VDC (guaranteed range) Input Current 0.65A (at 220VAC) AC power Input Voltage 90 to 150VAC (guaranteed range) AC Input Frequency 45 to 70Hz Input Current 4A (at 100VAC) - Rated DC Output Sections 5.2.8 -2 of Unit DDS*3 specifies Rated DC Output. +5VDC 7.5A +15VDC 4A -15VDC 0.7A	Rated AC Power Input is specified in Section 5.1.1 of MDS*2 AC power Input Voltage 90 to 150VAC (guaranteed range) AC Input Frequency 45 to 70Hz Input Current 4A or less Rated DC Power Input is specified in Section 5.1.1 of MDS*2 Input Voltage 135 to 230VDC (guaranteed range) Rated DC Output is specified in Section 5.2.1 of MDS*2. +5VDC 7.5A +15VDC 4A -15VDC 0.7A	Manufacturer's item meets the purchaser requirement. This characteristic contributes to safety function of parent component.
	4	Performance Characteristics -Power Supply Voltage Monitor Function -Overvoltage Protection Function -Over Current Protection Function Sections 5.2.8 -3 of Unit DDS*3 specifies above Performance Characteristics	Power Supply Error Monitoring Function is specified in Section 5.2.2 of MDS*2. Over Voltage Protection Function is specified in Section 6.1.1 of MDS*2. Over Current Protection Function Function is specified in Section 6.1.2 of MDS*2.	Manufacturer's item meets the purchaser requirement. This characteristic contributes to safety function of parent component.

*1 Purchase Specification, 5Q8K0018 Rev.2 (Reference (1))

*2 MDS: Module Design Specification, 5G8HC111 Rev.1 (Reference (3))

*3 Unit DDS: Unit Detailed Design Specification, 5B8K0041 Rev.2 (Reference (5))

Table 4-2 Failure Mode and Effect Analysis

No.	Function	Failure Mode	Failure Mechanism	Effect on System	Method of Detection	Effect on Plant Operation	Remarks
1	Input connecto r	Output voltage drop or loss	Short circuit failure or contact failure of a connector	+5VDC, +/-15VDC outputs drop to 0V. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
2	Input fuse	Output voltage drop or loss	Fuse open, or contact failure of fuse holder contact	+5VDC, +/-15VDC outputs drop 0V. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
3	Input noise reduction circuit	Output voltage drop or loss	Open circuit failure of choke coil. Short circuit failure of capacitor or surge absorber.	+5VDC, +/-15VDC outputs drop to 0V due to fuse open. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
4		Degradation of noise reduction function	Open circuit failure of capacitor, or varistor. Short circuit failure of choke coil.	+5VDC, +/-15VDC outputs are normal. Noise level may be increased.	None	None	
5	Primary rectifier circuit	Output voltage drop or loss	Open circuit failure of diode. Short circuit failure of capacitor.	+5VDC, +/-15VDC outputs drop to 0V due to fuse open. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	

No.	Function	Failure Mode	Failure Mechanism	Effect on System	Method of Detection	Effect on Plant Operation	Remarks
6		Increase of Ripple	Failure of capacitor, diode	+5VDC, +/-15VDC outputs are normal. Ripple level may be increased.	None	None	
7	Inrush current reduction circuit	Output voltage drop or loss	Failure of diode, resistor, or capacitor	+5VDC, +/-15VDC outputs drop to 0V due to fuse open or thermal fuse open.LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None.Parent unit have redundant power supply line of LVPS module.	
8		Increase of Inrush current	Failure of capacitor, resistor, or TRIAC	+5VDC, +/-15VDC outputs are normal. Inrush current may be increased when power is turning on.	None	None	
9	Transformer and control circuit for +5VDC output	Output voltage drop or loss	Failure of control circuit or transformer	+5VDC outputs drop to 0V. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
10		Output voltage drop or loss	Failure of control circuit or transformer	+5VDC output voltage is limited and drops to 0V due to overvoltage protection circuit. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
11		Loss of overvoltage protection function	Failure of control circuit	+5VDC output is normal.	None	None	
12	Transformer and control circuit for +/-15VDC output	Output voltage drop or loss	Failure of control circuit or transformer	+/-15VDC outputs drop to 0V. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
13		Output voltage drop or loss	Failure of control circuit or transformer	+/-15VDC output voltage is limited and drops to 0V due to overvoltage protection circuit. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
14		Loss of overvoltage protection function	Failure of control circuit	+/-15VDC output is normal.	None	None	
15	Rectifier and smoothing circuit for +5VDC	Output voltage drop or loss	Failure of capacitor, diode, resistor, or choke coil	+5VDC output drops to 0V.LVPS module generates a Power Supply Error Monitoring Signal.	Power Supply Error Monitoring Signal	None.Parent unit have redundant power supply line of LVPS module.	
16		Output voltage drop	Failure of capacitor, diode, resistor, or choke coil	+5VDC output may drop within allowable range without Power Supply Error Monitoring signal generation.	None	None	
17		Increase of Ripple	Failure of capacitor, diode, resistor, or choke coil	+5VDC outputs is normal. Ripple level may be increased.	None	None	
18	Rectifier and smoothing circuit for +15VDC	Output voltage drop or loss	Failure of capacitor, diode, resistor, or choke coil	+15VDC output drops to 0V. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
19		Output voltage drop	Failure of capacitor, diode, resistor, or choke coil	+15VDC output may drop within allowable range without Power Supply Error Monitoring signal generation.	None	None	
20		Increase of Ripple	Failure of capacitor, diode, resistor, or choke coil	+15VDC outputs is normal. Ripple level may be increased.	None	None	
21	Rectifier and smoothing circuit for -15VDC	Output voltage drop or loss	Failure of capacitor, diode, resistor, or choke coil	-15VDC output drops to 0V. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
22		Output voltage drop	Failure of capacitor, diode, resistor, or choke coil	-15VDC output may drop within allowable range without Power Supply Error Monitoring signal generation.	None	None	

No.	Function	Failure Mode	Failure Mechanism	Effect on System	Method of Detection	Effect on Plant Operation	Remarks
23		Increase of Ripple	Failure of capacitor, diode, resistor, or choke coil	-15VDC output is normal. Ripple level may be increased.	None	None	
24	Output voltage detection and adjustment circuit for +5VDC	Output voltage drop or loss	Failure of capacitor, diode, resistor, photo-coupler, or trimmer	+5VDC output drops to 0V. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
25		Output voltage drop	Failure of capacitor, diode, resistor, photo-coupler, or trimmer	+5VDC output voltage is limited and drops to 0V due to overvoltage protection circuit. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
26		Output voltage drop	Failure of capacitor, diode, resistor, photo-coupler, or trimmer	+5VDC output may drop within allowable range without Power Supply Error Monitoring signal generation.	None	None	
27	Output voltage detection and adjustment circuit for +15VDC	Output voltage drop or loss	Failure of capacitor, diode, resistor, photo-coupler, or trimmer	+15VDC output drops to 0V. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
28		Output voltage drop or loss	Failure of capacitor, diode, resistor, photo-coupler, or trimmer	+15VDC output voltage is limited and drops to 0V due to overvoltage protection circuit. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
29		Output voltage drop	Failure of capacitor, diode, resistor, photo-coupler, or trimmer	+15VDC output may drop within allowable range without Power Supply Error Monitoring signal generation.	None	None	
30	Output voltage detection and adjustment circuit for -15VDC	Output voltage drop or loss	Failure of capacitor, diode, resistor, photo-coupler, or trimmer	-15VDC output drops to 0V.LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None.Parent unit have redundant power supply line of LVPS module.	
31		Output voltage drop or loss	Failure of capacitor, diode, resistor, photo-coupler, or trimmer	-15VDC output voltage is limited and drops to 0V due to overvoltage protection circuit. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
32		Output voltage drop	Failure of capacitor, diode, resistor, photo-coupler, or trimmer	-15VDC output may drop within allowable range without Power Supply Error Monitoring signal generation.	None	None	
33	Overvoltage detection circuit for +5VDC	Output voltage drop	Failure of capacitor, diode, resistor, or photo-coupler	Overvoltage detection setting becomes too low. LVPS module generates a spurious Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
34		Loss of overvoltage detection function	Failure of capacitor, diode, resistor, or photo-coupler	Overvoltage detection setting becomes too high. Loss of +5VDC overvoltage detection function.	None	None	
35	Overvoltage detection circuit for +15VDC	Output voltage drop	Failure of capacitor, diode, resistor, or photo-coupler	Overvoltage detection setting becomes too low. LVPS module generates a spurious Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
36		Loss of overvoltage detection function	Failure of capacitor, diode, resistor, or photo-coupler	Overvoltage detection setting becomes too high. Loss of +15VDC overvoltage detection function.	None	None	
37	Overvoltage detection circuit for -15VDC	Spurious Power Supply Error Monitoring Signal generation	Failure of capacitor, diode, resistor, or photo-coupler	Overvoltage detection setting becomes too high. LVPS module generates a spurious Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None.Parent unit have redundant power supply line of LVPS module.	

No.	Function	Failure Mode	Failure Mechanism	Effect on System	Method of Detection	Effect on Plant Operation	Remarks
38		Loss of overvoltage detection function	Failure of capacitor, diode, resistor, or photo-coupler	Overvoltage detection setting becomes too low. Loss of -15VDC overvoltage detection function.	None	None	
39	Under voltage detection circuit for +5VDC	Spurious Power Supply Error Monitoring Signal generation	Failure of capacitor, diode, resistor, operational amplifier, or transistor	Under voltage detection setting becomes too high. LVPS module generates a spurious Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
40		Loss of under voltage detection function	Failure of capacitor, diode, resistor, operational amplifier, or transistor	Under voltage detection setting becomes too low. Loss of +5VDC under voltage detection function.	None	None	
41	Under voltage detection circuit for +15VDC	Spurious Power Supply Error Monitoring Signal generation	Failure of capacitor, diode, resistor, operational amplifier, or transistor	Under voltage detection setting becomes too high. LVPS module generates a spurious Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
42		Loss of under voltage detection function	Failure of capacitor, diode, resistor, operational amplifier, or transistor	Under voltage detection setting becomes too low. Loss of +15VDC under voltage detection function.	None	None	
43	Under voltage detection circuit for -15VDC	Spurious Power Supply Error Monitoring Signal generation	Failure of capacitor, diode, resistor, operational amplifier, or transistor	Under voltage detection setting becomes too low. LVPS module generates a spurious Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
44		Loss of under voltage detection function	Failure of capacitor, diode, resistor, operational amplifier, or transistor	Under voltage detection setting becomes too high. Loss of -15VDC under voltage detection function.	None	None	
45	Protection diodes for +5VDC output	Output voltage drop or loss	Failure of diodes	+5VDC output drops to 0V.LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None.Parent unit have redundant power supply line of LVPS module.	
46		Output voltage drop	Failure of diodes	+5VDC output may drop within allowable range without Power Supply Error Monitoring signal generation.	None	None	
47	Protection diodes for +15VDC output	Output voltage drop or loss	Failure of diodes	+15VDC output drops to 0V. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
48		Output voltage drop	Failure of diodes	+15VDC output may drop within allowable range without Power Supply Error Monitoring signal generation.	None	None	
49		Loss of reverse voltage protection function	Failure of diodes	Loss of reverse voltage protection function	None	None	
50	Protection diodes for -15VDC output	Output voltage drop or loss	Failure of diodes	+15VDC output drops to 0V. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
51		Output voltage drop	Failure of diodes	+15VDC output may drop within allowable range without Power Supply Error Monitoring signal generation.	None	None	

No.	Function	Failure Mode	Failure Mechanism	Effect on System	Method of Detection	Effect on Plant Operation	Remarks
52		Loss of reverse voltage protection function	Failure of diodes	Loss of reverse voltage protection function	None	None	
53	Smoothing circuit for +5VDC	Output voltage drop or loss	Short circuit failure of capacitor	+5VDC output decreases to 0V due to fuse open. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None.Parent unit have redundant power supply line of LVPS module.	
54		Increase of ripple	Failure of capacitor	+5VDC output is normal. Ripple level may be increased.	None	None	
55	Smoothing circuit for +15VDC	Output voltage drop or loss	Short circuit failure of capacitor	+15VDC output decreases to 0V due to fuse open. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
56		Increase of ripple	Failure of capacitor	+15VDC output is normal. Ripple level may be increased.	None	None	
57	Smoothing circuit for -15VDC	Output voltage drop or loss	Short circuit failure of capacitor	-15VDC output drops to 0V due to fuse open. LVPS module generates a Power Supply Error Monitoring Signal.	Minor failure signal and LED indication of parent unit	None. Parent unit have redundant power supply line of LVPS module.	
58		Increase of ripple	Failure of capacitor	-15VDC output is normal. Ripple level may be increased.	None	None	

5. Critical Characteristics for Acceptance, Verification Methods and Responsibilities

The physical characteristics and performance characteristics are able to be measured as CCAs by the supplier testing and Nuclear Instrumentation and Control Systems Department (NICSD) intends to receive Certificate of Conformance (C of C) and the supplier's test record during the receiving inspection, the following supplier's process to control CC shall be verified as CCAs,, as a minimum, through Commercial Grade (CG) survey of PPDD, evaluation of[ ]^{a,c}, and receiving inspection.

- Design Control (Document Control)
- Inspection and Test Control
- Measuring and Test Equipment Control

The NICSD also performs a review of supplier document and special test to supplement the verification of the physical characteristics and performance characteristics. To supplement verification of the general configuration and shape, supplier's control capability regarding "Configuration Control and Traceability of Hardware" shall be verified through CG Survey of PPDD, evaluation of[ ]^{a,c}, and receiving inspection.

Table 5-1 CCA and Verification Method

Item No	Critical Characteristics for Acceptance	Verification Method for Qualification	Responsibility	Verification Method for Production	Responsibility
1	Physical Characteristics -Dimension -Mass -General Configuration and Shape	-	-	Receiving Inspection (Receiving C of C and supplier's test record, Section 6.1.1)	NICS-QC
				Review of Supplier Documents (Section 6.1.2)	NICSD Verifier

Item No	Critical Characteristics for Acceptance	Verification Method for Qualification	Responsibility	Verification Method for Production	Responsibility
2	Performance Characteristics - Rated Power Output -Power Supply Voltage Monitor Function -Overvoltage Protection Function -Over Current Protection Function	-	-	Receiving Inspection (Receiving C of C and supplier's test record, Section 6.1.1)	NICS-QC
				Review of Supplier Documents (Section 6.1.2)	NICSD Verifier
				Special Test (Section 6.1.3)	NICS-QC
3	Design Control (Document Control)	CG Survey of PPDD and evaluation of [ ]a,c (Section 6.2.2)	NICS-QA	Receiving Inspection (Receiving C of C, Section 6.1.1)	NICS-QC
4	Inspection and Test Control	CG Survey of PPDD and evaluation of [ ]a,c (Section 6.2.2)	NICS-QA	Receiving Inspection (Receiving C of C, Section 6.1.1)	NICS-QC
5	Measuring and Test Equipment Control	CG Survey of PPDD and evaluation of [ ]a,c (Section 6.2.2)	NICS-QA	Receiving Inspection (Receiving C of C, Section 6.1.1)	NICS-QC
6	Configuration Control and Traceability of Hardware	CG Survey of PPDD, Evaluation of [ ]a,c (Section 6.2.2)	NICS-QA	Receiving Inspection (Receiving C of C, Section 6.1.1)	NICS-QC

NICSD Nuclear Instrumentation and Control Systems Department

NICS-QA Quality Assurance Group for Nuclear Instrumentation & Control Systems

NICS-QC Quality Control Group for Nuclear Instrumentation & Control Systems

6. Verification Instruction

6.1 Recurring Activities

6.1.1. Receiving Inspection

Receiving inspectors or QC inspectors assigned by QC section shall implement the receiving inspection in accordance with the "Receiving Inspection Procedure (Section 9-(1))" and the "Receiving Inspection Specification (Section 9-(2))." The verification results are recorded in the form of "Receiving Inspection Check List/Report (Section 7-(1))."

6.1.2. Review of Supplier Documents

The NICSD verifiers or independent reviewers perform review of the supplier documents. The results of the review are recorded in the "Design Verification Reports (Section 7-(4))." This activity is conducted at the first qualification and when a major design change which needs documents review occurs after the first qualification. The acceptance criteria are as follow;

- The design and test documents shall satisfy requirements from procurement documents, and shall be complete, correct, consistent, and accurate.

6.1.3 Special Test

The QC inspector of NICSD performs a special test to verify "Rated Power Output" supplementing the supplier testing. The acceptance criteria for verification of this CCA are as follows:

Table 6-1 Acceptance Criteria

Part No.	CCA No.	CCA	Acceptance Criteria
P001	2-1	Performance Characteristics - Rated Power Output	- At no load condition with 220VDC input, output voltages (+5VDC, +15VDC and -15VDC) are within the ranges as follows. +5VDC :+4.75 to +5.25VDC +15VDC :+14.25 to +15.75VDC -15VDC :-14.25 to -15.75VDC

This activity is performed in accordance with the System Test Specification (Reference (26)) with above criteria. The result is recorded in a test record in accordance with NQ-3015 (Reference (27)).

6.2 Periodic Activities

6.2.1. Environmental Conditions Qualification

Equipment qualification testing and EMC qualification testing are performed in a type test using test specimen. Successful completion and continued application of qualification testing verifies that the item is capable of performing its intended safety function. Any time a design change is made to the item or item is used in another application, impact on all previous qualification programs shall be evaluated to determine if re-qualification is required.

The responsible design engineers from NISD shall identify a test report in Section 7 of this CDI after qualification test, which shows successful compliance with qualification test requirements. If any changes are made to a configuration as the result of qualification test, the responsible design engineers shall identify a baseline after change in the CDI. The NICSD SD Team or responsible design engineers evaluates any changes to an item that are made after baseline establishment, determines the need for an additional qualification test, and documents the evaluation result in the CDI. In order to continuously purchase items with same configuration, the "Configuration Control and Traceability of Hardware" of supplier shall be verified through CG Surveys as described in Section 6.2.2.

6.2.2. Vendor Evaluation

NICSD shall perform CG Survey of PPDD and evaluation of [a,c] in accordance with Section 9.2 of the Commercial Dedication Instruction (Reference (8)).

7. Acceptance Documentation

(1) Receiving Inspection Check List/Report (Attachment to NQ-3024 (Reference (6))
(2) Certificate of Conformance (Attachment to Reference (1))
(3) Test record by supplier (As per supplier's form)
(4) Design Verification Report (Attachment to Reference (9))
(5) Test record for special test (As per NQ-3015 (Reference (27))
(6) Nuclear Instrumentation & Control Systems Department
Environmental Qualification Report for Safety-Related Oscillation Power Range Monitor (OPRM)
FC51-7513-1000 Rev.0 (5B8K0077 Rev.0)
(7) Nuclear Instrumentation & Control Systems Department
Dynamic Qualification Report for Safety-Related Oscillation Power Range Monitor (OPRM)

FC51-7513-1003 Rev.0 (5B8K0094 Rev.0)

(8) Nuclear Instrumentation & Control Systems Department
EMC Qualification Report for Safety-Related Oscillation Power Range Monitor (OPRM)
FC51-7513-1001 Rev.0 (5B8K0078 Rev.0)

8. References

(1) PURCHASE SPECIFICATON for in-house (5Q8K0018 Rev.2)
(2) LVPS Module Equipment Design Specification (5G8HA757 Rev.1)
(3) LVPS Module HNS0500 Series Module Design Specification (5G8HC111 Rev.1)
(4) Product Specification for LVPS module ([redacted] Rev.H)
(5) OPRM Unit Detailed Design Specification for Power Range Neutron Monitor (5B8K0041 Rev.2)
(6) Receiving Inspection Procedure, NQ-3024
(7) Standard Receiving Inspection Specification for Modules from Power Platform Development Department (5T8K0001 Rev.1)
(8) Commercial Dedication Instruction for Dedication of Modules from Commercial Supplier (Common Requirements) (9B8K0057 Rev.1)
(9) Design Verification Procedure, AS-200A002
(10) Outline Dimensional Drawing ([redacted] Rev.K)
(11) Parts List (Main Body) ([redacted] Rev.E)
(12) Parts List ([redacted] Rev.M)
(13) Parts List ([redacted] Rev.G)
(14) Parts List ([redacted] Rev.E)
(15) Parts List ([redacted] Rev.J)
(16) Parts List ([redacted] Rev.F)
(17) Parts List ([redacted] Rev.G)
(18) Circuit Diagram ([redacted] Rev.C)
(19) Circuit Diagram ([redacted] Rev.-)
(20) Coating Instruction ([redacted] Rev.B)
(21) Coating Instruction ([redacted] Rev.B)
(22) Coating Instruction ([redacted] Rev.B)
(23) Coating Instruction ([redacted] Rev.B)
(24) Coating Instruction ([redacted] Rev.B)
(25) Coating Instruction ([redacted] Rev.B)
(26) Nuclear Instrumentation & Control Systems Department System Test Specification for Safety-Related Oscillation Power Range Monitor (OPRM) (FC51-7012-1002 Rev.0)
(27) Toshiba Nuclear Instrumentation & Control Systems Department NQ-3015
"Test Control Procedure"
(28) Printed Circuit Board Diagram ([redacted] Rev.-)
(29) Printed Circuit Board Diagram ([redacted] Rev.-)
(30) Printed Circuit Board Diagram ([redacted] Rev.-)
(31) Printed Circuit Board Diagram ([redacted] Rev.-)
(32) Printed Circuit Board Diagram ([redacted] Rev.-)

9. Inspection and Test Procedure

(1) Receiving Inspection Procedure (Reference (6))

(2) Receiving Inspection Specification (Reference (7))

(3) Nuclear Instrumentation & Control Systems Department System Test Specification for Safety-Related Oscillation Power Range Monitor (OPRM) (Reference (26))

10. Supplements

N/A

変 更 記 録 REVISIONS						
変更記号 REV. MARK 変更発行日 REV. ISSUED	ページ PAGE	変更箇所・変更内容 CHANGED PLACE AND CONTENTS	承認 APPROVED BY	調査 REVIEWED BY	担当 PREPARED BY	保管 REGISTERED
① Aug.22, 2012	-	For detailed changed contents and impact evaluation, refer to DECN-9B8K0056-01 Rev.0.	K. Wakita Aug.22, 2012	T. Tarumi Aug.22, 2012	T. Furusawa Aug.20, 2012	K. Tamura Aug.22, 2012
② Jan.16.2014	-	For detailed changed contents and impact evaluation, refer to DECN-9B8K0056-02 Rev.0.	K. Wakita Jan.16.2014	T. Tarumi Jan.16.2014	T. Furusawa Jan.16 2014	H. Ito Jan.16.2014