

Enclosure I to ET 07-0039

**Nutherm International Dedication Plan WCN-9715DP, Revision 2**

# **NUTHERM**

## **DEDICATION PLAN**

### **FOR**

### **REPLACEMENT MSFIS SYSTEM**

**WOLF CREEK NUCLEAR OPERATING CORPORATION**  
**PURCHASE ORDER NO. 734527**

**NUTHERM DOCUMENT NUMBER WCN-9715DP, REV. 2**

Prepared By:

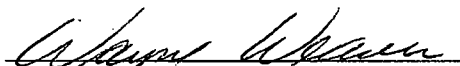


Date:

8/29/07

Tom Sterbis  
Project Engineering Manager

Reviewed and  
Approved By:



Date:

8/29/07

Wayne Weaver  
EQ Manager

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**REVISIONS**

The revision number is indicated at the top of each page, for all revisions. To delineate the exact location of a given revision, a vertical line is used on the right margin. However, for a complete report rewrite, no vertical lines are used.

**REVISION LOG**

| REVISION | DATE    | PAGE  | SECTION                            | REFERENCE                             |
|----------|---------|-------|------------------------------------|---------------------------------------|
| 1        | 5/31/07 | 5-24  | Dedication Description             | Complete Rewrite                      |
| 2        |         | All   | All                                | Renumbered pages                      |
|          |         | 4     | Applicable Standards and Documents | Revised WC specification Revision     |
|          |         | 5     | Device Description                 | Clarified safety function             |
|          |         | 6-7   | General                            | Clarified general dedication process  |
|          |         | 7     | MSFIS Replacement System           | Revised description                   |
|          |         | 9-21  | Critical Characteristics Matrix    | Revised Matrix                        |
|          |         | 22-23 | Physical Characteristics           | Clarified process description         |
|          |         | 24-25 | Performance                        | Clarified performance testing purpose |
|          |         | 25-26 | Dependability                      | Clarified dedication activities       |

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## **PURPOSE**

The purpose of this dedication plan is to present and define the critical characteristics and the applicable processes and standards which will be used to dedicate the commercial grade items described in the "Device Descriptions" section of this document.

This dedication plan addresses critical characteristics primarily. Additional testing and verification, beyond that required for dedication of the units described in the "Device Descriptions" section of this document, will be performed (as applicable) to ensure items purchased through Nutherm International are the items described in the customers specification sheets and/or Purchase Order.

All qualification work is accomplished in accordance with customer purchase order and specification requirements, Nuclear Regulatory Commission Guidelines, and applicable Institute of Electrical and Electronic Engineers Standards.

## **APPLICABLE STANDARDS AND DOCUMENTS**

- IEEE 344-1975 – "Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations."
- IEEE 323-1974 – "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations"
- 10CFR50, Appendix B. – "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"
- Nutherm International, Inc. Quality Assurance Manual No.: QA-N-10179-5.
- EPRI NP-5652- "Guideline for the Utilization of Commercial Grade Items in Nuclear Safety Related Applications"
- EPRI TR-102260- "Supplemental Guidance for the Application of EPRI NP-5652 on the Utilization of Commercial Grade Items"
- EPRI TR-102323-R2-1997 – "Guidelines for Electromagnetic Interference Testing in Power Plants"
- Regulatory Guide 1.180-R1- "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems"
- IEEE 649-1991 – "Standard for Qualifying Class 1E Motor Control Centers for Nuclear Power Generating Stations"
- Wolf Creek Generating Station Specification J-105A(Q)

- EPRI TR-106439 – “Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment of Nuclear Safety Applications”

## **DEVICE DESCRIPTION**

The Main Steam and Feedwater Isolation System (MSFIS) has two distinct functions:

- Steam Line Isolation System (SLIS) – Main Steam Line Isolation minimizes the uncontrolled cool down of the Reactor Coolant System (RCS) that would result from a main steam line rupture. Input signals pass from the detectors through the Solid State Protection System (SSPS) to the MSFIS cabinet where the output signal is generated.
- Feedwater Isolation System (FWIS) – Feedwater isolation minimizes the potential for excessive post-trip cool down of the RCS due to overfilling the steam generators. It also prevents moisture carryover caused by high steam generator levels, and isolates normal Feedwater in the event of a high Energy Line Break inside containment.

MSFIS will include a safety-related logic-controller-based system to perform the control functions of the Main Steam Isolation Valves (MSIVs) and Main Feedwater Isolation Valves (MFIVs) with system-medium actuators. The MSFIS System has two redundant subsystems located in separate cabinets:

MSFIS Channel I (1) located in MSFIS Cabinet SA075A (Train A)

MSFIS Channel IV (4) located in MSFIS Cabinet SA075B (Train B)

Each MSFIS cabinet is capable of supplying the control logic outputs required for operating each of the 4 Main Steam Isolation Valves and 4 Main Feedwater Isolation Valves.

Dedication activities will be performed by Nutherm International Inc. on the control system ALS Racks and Assembly Panels for Channels I and IV.

The safety function of the replacement MSFIS controls is to close the MSIV and MFIV when requested by input conditions.

## **DEDICATION DESCRIPTION**

### **GENERAL**

EPRI TR106439 states in Section 1.2:

"The guidance in this document is intended for use by utilities or by other organizations who perform dedication of commercial grade equipment which ultimately is supplied to utilities.

The approach taken in developing this guidance is based on the conclusions reached by the working group that: (1) the existing process for commercial grade dedication can, with appropriate supplemental guidance, be applied to digital equipment, and (2) supplemental guidance provided for digital-specific issues should be consistent with the existing framework established for design and licensing of digital upgrades. Accordingly, this document supplements and is consistent with existing industry guidance contained in:

EPRI NP-5652, "Guideline for the Utilization of Commercial Grade Items in Nuclear Safety Related Applications."

EPRI TR-102348, "Guideline on Licensing Digital Upgrades," and

IEEE 7-4.3.2-1993, "Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations.""

Following the recommended practice in EPRI TR106439, Nutherm will base dedication activities on EPRI Report 5652 with "appropriate supplemental guidance" applied to digital-specific issues. As part of that supplemental guidance, Table 4.1, "Critical Characteristics Matrix for Digital Equipment," and Table 6-4, "ESFAS Programmable Logic Controller Characteristics) in EPRI TR-106439 were used as a basis for the development of the dedication activities.

The dedication process, per EPRI Report 5652, assumes that "the design requirements of the item have been satisfactorily translated into specification requirements as reflected in the procurement document." The guideline goes on to describe three fundamental issues which, once addressed, provide a foundation for the acceptance process of a particular item. The three fundamental issues as described in EPRI Report 5652 are as follows:

- Determine the safety function of the item
- Confirm the item is commercial grade
- Identify critical characteristics.

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These three fundamental issues are addressed during the technical review process and a Component Dedication Planner (CDP) is generated for each item to be dedicated. In the case of more complex systems such as the MSFIS system a Critical Characteristic Matrix is used to quantify Critical Characteristics and the Verification methods used. The CDP or Critical Characteristic Matrix documents the results of the engineering evaluation performed to identify the design and performance attributes necessary to perform the item's safety function. The Critical Characteristic Matrix for the replacement MSFIS system has been incorporated into this Dedication Plan.

EPRI NP-5652 is used as a guideline for the dedication process of commercial grade items. As stated in section 1.3.4, "the methods in the guideline are in conformance with existing regulatory requirements. The methods for accepting commercial grade items are consistent with the provisions of Criterion VII of Appendix B to 10CFR50 which states:"

"Measures shall be established to assure that purchased material, equipment, and services, whether purchased directly or through contractors and subcontractors, conform to the procurement documents. These measures shall include provisions, as appropriate, for source evaluation and selection, objective evidence of quality furnished by the contractor or subcontractor, inspection at the contractor or subcontractor, inspection at the contractor or subcontractor source, and examination of products upon delivery."

Nutherm International has incorporated the guideline into its QA program and in-place procedures for the dedication of commercial grade items. See Figure 1 for a block diagram of the generic dedication process. The methods referred to (Method 1 thru 4) are described in detail in EPRI NP-5652. Nutherm International employs a combination of method 1 and other acceptance methods. In the case of the MSFIS system, all four acceptance methods will be used. Figure 2 is a schematic logic diagram for employing method 1, taken from EPRI NP-5652. Though not all inclusive, the diagram provides a general feel for the dedication process using this method.

## **MSFIS REPLACEMENT SYSTEM**

The critical characteristics are divided into three general categories; Product Information, Physical Attributes, and Performance. EPRI TR-106439 incorporated Product Information in the Physical Attributes categories and added Dependability. Since the MSFIS system may be considered a software based digital system that does not run on a software platform, or a software based hardware driven system, many of the critical characteristics and dedication activities described in EPRI TR-106439 are applicable and have been incorporated into this Dedication Plan. The critical characteristics of this system are varied enough that all four acceptance methods will be used to verify acceptability. For newer, more complex systems this is not unusual. System and other experts will be used, as applicable, to provide any necessary technical expertise throughout the dedication process. 10CFR21 states:



501 South 11<sup>th</sup> Street  
Mt. Vernon IL 62864

PHONE: 618-244-6000  
FAX: 618-244-6641



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“dedication is an acceptance process undertaken to provide reasonable assurance that a commercial grade item to be used as a basic component will perform its intended safety function and, in this respect, is deemed equivalent to an item designed and manufactured under a 10 CFR Part 50, appendix B, quality assurance program. This assurance is achieved by identifying the critical characteristics of the item and verifying their acceptability by inspections, tests, or analyses”

As previously stated, a Critical Characteristics Matrix was developed as part of the dedication process. This matrix lists each Critical Characteristic along with its Acceptance Criteria. For each characteristic the matrix also lists the Validation Document(s) and Validation Method(s) which will be used in the dedication process. Following the matrix a more detailed explanation of each characteristic category and applicable characteristics is included. EPRI TR-106439, 1996, “Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications”, section 4.2 “Guidance on Defining and Verifying Critical Characteristics”, states:

“Translation of design requirements into critical characteristics for a commercial grade item is a key element in the dedication process. It is the link between the technical evaluation, which defines requirements, including hardware, software, human-machine interface, quality and reliability requirements, is an important prerequisite for dedication of a commercial grade item.”

A thorough review of Wolf Creek Generating Station Specification J-105A(Q), was performed to generate the Critical Characteristics Matrix, with Acceptance Criteria directly linked to Specification requirements, as applicable.

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**CRITICAL CHARACTERISTIC MATRIX**

| CRITICAL CHARACTERISTICS           | ACCEPTANCE CRITERIA                          | VALIDATION DOCUMENT   | VALIDATION METHOD |
|------------------------------------|--|---|-------------------|
| <b>Physical Characteristics:</b>   |  |   |                   |
| <b>Configuration-</b>              |  |   |                   |
| Manufacturer                       | Manufacturer is CS Innovations               | Nutherm Quality Assurance Procedure QAP 7.1.00,   | Visual Inspection |
| Model Number                       | Manufacturer Model No.                       | Nutherm Quality Assurance Procedure QAP 7.1.00,   | Visual Inspection |
| FPGA Flash Version Revision Number | Manufacturer FPGA Flash Version Revision No. | Nutherm Procedure, ALS Rack Component Verification, TPS-9062, Rev. 0  | Visual Inspection |
| Quality of Workmanship             | Quality equivalent to qualified unit         | NTL-NQI Comparison, Nutherm Form 58050-13-7, Nutherm Procedure, ALS Rack Component Verification, TPS-9062, Rev. 0 | Visual Inspection |
| General Configuration              | Enclosure same as qualified unit             | NTL-NQI Comparison, Nutherm Form 58050-13-7 Nutherm Dedication Plan, WCN-9715DP                                   | Visual Inspection |
| Mounting                           | Mounting same as qualified unit              | Nutherm Qualification Report WCN-9715R  | Visual Inspection |

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| CRITICAL CHARACTERISTICS                                | ACCEPTANCE CRITERIA   | VALIDATION DOCUMENT   | VALIDATION METHOD  |
|---|---|---|--|
| Component Configuration                                 | Components same as qualified unit   | NTL-NQI Comparison, Nutherm Form 58050-13-7 Nutherm Dedication Plan, WCN-9715DP                     | Visual Inspection  |
| Subcomponent Configuration                              | Subcomponents same as qualified unit  | NTL-NQI Comparison, Nutherm Form 58050-13-7 Nutherm Dedication Plan, WCN-9715DP                     | Visual Inspection  |
| <b>Interfaces</b>                                       |   |   |  |
| Power   | 125Vdc  | Nutherm Dedication Plan, WCN-9715DP, Nutherm Test Procedure TPS-9064 MSFIS Final Acceptance Test    | Direct Test and Inspection                                   |
| Point to Point Continuity Check and Wiring Verification | Wiring matches wiring diagram   | Nutherm Procedure, QCI-10.3.30  | Direct Test and Inspection                                   |
| Proper Bypass/Operate switch operation                  | Switches operate smoothly, see Functional section for operational tests and Acceptance Criteria | Nutherm Test Procedure TPS-9064 MSFIS Final Acceptance Test   | Direct Test and Inspection                                   |
| Human Machine Interface                                 | Wolf Creek Specification J-105A(Q)  | Nutherm Source Verification, SS-9715-02 Nutherm Test Procedure TPS-9064 MSFIS Final Acceptance Test | Source Verification Design Review Direct Test and Inspection |

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| CRITICAL CHARACTERISTICS  | ACCEPTANCE CRITERIA  | VALIDATION DOCUMENT  | VALIDATION METHOD   |
|---|--|--|---|
| <b>Performance Characteristics:</b>   |  |  |   |
| <b>Functional</b>   |  |  |   |
| 125 Vdc outputs to control solenoids to operate valves, verify output logic | Wolf Creek Specification J-105A(Q),<br>Section 5.2.1 a, b, e | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection  |
| Interchangeability of components/modules                                    | Wolf Creek Specification J-105A(Q),<br>Section 5.2.2         | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection  |
| Hot swap capability   | Wolf Creek Specification J-105A(Q),<br>Section 5.2.2         | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection  |
| Hot swap will not cause plant transient                                     | Wolf Creek Specification J-105A(Q),<br>Section 5.2.2         | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection  |
| Response <100 ms from input step change to output response                  | Wolf Creek Specification J-105A(Q),<br>Section 5.2.3         | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test<br>Nutherm Source Verification, SS-9715-02 | Direct Test and Inspection<br><br>Source Verification, thread audit |
| Momentary input signal, >100 ms will cause system response                  | Wolf Creek Specification J-105A(Q),<br>Section 5.2.4.a 2)    | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection  |

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| CRITICAL CHARACTERISTICS  | ACCEPTANCE CRITERIA                                      | VALIDATION DOCUMENT   | VALIDATION METHOD          |
|---|--|---|----------------------------|
| ESFAS contacts NC, open for response. All other inputs NO, close for response   | Wolf Creek Specification J-105A(Q)<br>Section 5.2.4.a 3) | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test | Direct Test and Inspection |
| Output signals: voltage and current capability, system capable of sourcing adequate current at min and max voltage  | Wolf Creek Specification J-105A(Q)<br>Section 5.2.4.c 1) | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test | Direct Test and Inspection |
| Output signal: switching 40-60 Henry loads at 1.28A nominal   | Wolf Creek Specification J-105A(Q)<br>Section 5.2.4.c 1) | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test | Direct Test and Inspection |
| Status outputs:<br>Outputs per Appendix B<br>Output at 125 Vdc if [supply fuses for MV5(6) sat] & [no test in system logic]<br>Output to status panel capable of 125 Vdc, <25 mA load | Wolf Creek Specification J-105A(Q)<br>Section 5.2.4.c 2) | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test | Direct Test and Inspection |
| Output states: table for each condition   | Wolf Creek Specification J-105A(Q)<br>Section 5.2.5.a 1) | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test | Direct Test and Inspection |

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| CRITICAL CHARACTERISTICS  | ACCEPTANCE CRITERIA                                      | VALIDATION DOCUMENT   | VALIDATION METHOD          |
|---|--|---|----------------------------|
| Four Commands:<br>All Close; Close output state for 60 sec, all 4 valves, then Keep Closed<br><br>ESFAS; 2 of 4, same output as All Close<br><br>Close; Close output state for associated valve, 60 sec delay then Keep Close<br><br>Open; open output state for associated valve | Wolf Creek Specification J-105A(Q)<br>Section 5.2.5.a 2) | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test | Direct Test and Inspection |
| Command priorities in OPERARE: All Close, ESFAS, Close same priority, Open ignored while above and time delay not timed out   | Wolf Creek Specification J-105A(Q)<br>Section 5.2.5.b 1) | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test | Direct Test and Inspection |
| Command priorities in BYPASS: All Close, Close, ESFAS, Open do not cause state change while in BYPASS,  | Wolf Creek Specification J-105A(Q)<br>Section 5.2.5.b 2) | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test | Direct Test and Inspection |

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| CRITICAL CHARACTERISTICS   | ACCEPTANCE CRITERIA   | VALIDATION DOCUMENT  | VALIDATION METHOD                 |
|--|---|--|-----------------------------------|
| <p>BYPASS/OPERATE mode selection:<br/>Independent selection for each valve</p> <p>Positive action to switch modes</p> <p>In BYPASS no output state change</p> <p>Output state Close, time delay not timed out, will not go to BYPASS</p> | <p>Wolf Creek Specification J-105A(Q)<br/>Section 5.2.6.a 1)</p>  | <p>Nutherm Test Procedure<br/>TPS-9064<br/>MSFIS Final Acceptance Test</p> | <p>Direct Test and Inspection</p> |
| <p>Indicating light for BYPASS</p>   | <p>Wolf Creek Specification J-105A(Q)<br/>Section 5.2.6.a 2)</p>  | <p>Nutherm Test Procedure<br/>TPS-9064<br/>MSFIS Final Acceptance Test</p> | <p>Direct Test and Inspection</p> |
| <p>BYPASS initiation</p> <p>a) Latch outputs</p> <p>b) De-energize status output</p> <p>c) Light BYPASS mode indication</p> <p>d) Close test contacts described in 5.2.6</p>   | <p>Wolf Creek Specification J-105A(Q)<br/>Section 5.2.6.a 3)</p>  | <p>Nutherm Test Procedure<br/>TPS-9064<br/>MSFIS Final Acceptance Test</p> | <p>Direct Test and Inspection</p> |
| <p>Return to OPERATE;<br/>open test contacts,<br/>unlatch outputs,<br/>extinguish BYPASS indication, release status output</p>   | <p>Wolf Creek Specification J-105A(Q)<br/>Section 5.2.6 .a 4)</p> | <p>Nutherm Test Procedure<br/>TPS-9064<br/>MSFIS Final Acceptance Test</p> | <p>Direct Test and Inspection</p> |
| <p>MSFIS power supplies will operate on 140-105 Vdc input power</p>  | <p>Wolf Creek Specification J-105A(Q)<br/>Section 5.6.3.a</p>     | <p>Nutherm Test Procedure<br/>TPS-9064<br/>MSFIS Final Acceptance Test</p> | <p>Direct Test and Inspection</p> |

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| CRITICAL CHARACTERISTICS   | ACCEPTANCE CRITERIA                                   | VALIDATION DOCUMENT  | VALIDATION METHOD          |
|--|---|--|----------------------------|
| 105-140 Vdc power supplies, can source sufficient current for loads<br><br>Hot swap replacement, two redundant power supplies per rack, one can carry the load<br><br>Load sharing capability<br><br>Trouble alarm on loss of a power supply, low "health" | Wolf Creek Specification J-105A(Q)<br>Section 5.6.3.b | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection |
| Proper operation in all power supply configurations w/o spurious trips or loss of control  | Wolf Creek Specification J-105A(Q)<br>Section 5.6.3.d | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection |
| Provide wiring harness   | Wolf Creek Specification J-105A(Q)<br>Section 5.6.4   | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test,<br>Point to point continuity check and wiring verification<br>QCI 10.3.30 | Direct Test and Inspection |
| Summary trouble alarm, NO contact, open to alarm   | Wolf Creek Specification J-105A(Q)<br>Section 5.6.7.a | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection |



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| CRITICAL CHARACTERISTICS  | ACCEPTANCE CRITERIA                                   | VALIDATION DOCUMENT   | VALIDATION METHOD                                 |
|---|---|---|---|
| Alarm conditions<br>1. loss DC pwr supply<br>2. card removed<br>3. external test equip installed<br>4. output sequence incomplete | Wolf Creek Specification J-105A(Q)<br>Section 5.6.7.b | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test,<br>Nutherm Source Verification, SS-9715-02 | Direct Test and Inspection<br>Source Verification |
| Indication of trouble alarm cause   | Wolf Creek Specification J-105A(Q)<br>Section 5.6.7.c | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test   | Direct Test and Inspection                        |
| Dielectric test on wire   | Wolf Creek Specification J-105A(Q)<br>Section 10.3.2  | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test   | Direct Test and Inspection                        |
| Apply all possible input trip combinations in all states  | Wolf Creek Specification J-105A(Q)<br>Section 10.4.3  | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test   | Direct Test and Inspection                        |
| Apply manual inputs   | Wolf Creek Specification J-105A(Q)<br>Section 10.4.4  | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test   | Direct Test and Inspection                        |
| Reset   | Demonstrate the Ability to Reset                      | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test   | Direct Test and Inspection                        |

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| CRITICAL CHARACTERISTICS                          | ACCEPTANCE CRITERIA  | VALIDATION DOCUMENT  | VALIDATION METHOD  |
|---|--|--|--|
| Signal conditioning, bistable and logic functions | Wolf Creek Specification J-105A(Q)   | Nutherm Dedication Report, Nutherm Source Verification, SS-9715-02 | Review of design, input modules, logic function through Source Verification<br>Review of Vendor Testing at CS Innovations<br>Review of Module Level Verification |
| <b>Performance Characteristics:</b>               |  |  |  |
| <b>Environmental</b>                              |  |  |  |
| EMI/RFI   | EPRI Document TR-102323-R2 and U.S. Nuclear Regulatory Commission Regulatory Guide 1.180   | Nutherm EMI/RFI Report WCN-9715ER                                  | Direct Test and Inspection   |
| Seismic   | IEEE 344-1987. TRS shall meet or exceed the RRS of S4000-RP-20 with at minimum a 10% margin. Meters shall exhibit proper operation as outlined in S4000-RP-20. | Nutherm Qualification Report WCN-9715R                             | Direct Test and Inspection   |
| Mild Environment Conditions                       | IEEE 323-1974. 65°F to 84°F at a Relative Humidity of 20% to 70%. System shall exhibit proper operation as outlined in Wolf Creek Specification J-105A(Q).     | Nutherm Qualification Report WCN-9715R                             | Direct Test and Inspection   |

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| CRITICAL CHARACTERISTICS  | ACCEPTANCE CRITERIA  | VALIDATION DOCUMENT  | VALIDATION METHOD   |
|---|--|--|---|
| <b>Abnormal Conditions &amp; Events (ACEs)</b>                        |  |  |   |
| Behavior under abnormal/faulted conditions, Vendor testing and design | Correct operation as described in Wolf Creek Specification J-105A(Q) | Nutherm Dedication Report, Nutherm Source Verification, SS-9715-02 | Review of Vendor testing including <ul style="list-style-type: none"> <li>• Board level verification, testing of failure detection, redundancy, integrity monitor circuit, debug features, diagnostics</li> <li>• Review of FMEA and verification testing</li> <li>• Review of hardware architecture, FPGA design review, V&amp;V activities, ALS board test plan</li> <li>• Review of Self diagnostic functions, including thread audit</li> </ul> |
| Loss and Return of Power  | No Loss of Configuration   | Nutherm Test Procedure TPS-9064 MSFIS Final Acceptance Test        | Direct Test and Inspection  |
| Power Over/Under Voltage  | 105-140 Vdc  | Nutherm Test Procedure TPS-9064 MSFIS Final Acceptance Test        | Direct Test and Inspection  |

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| CRITICAL CHARACTERISTICS                     | ACCEPTANCE CRITERIA   | VALIDATION DOCUMENT  | VALIDATION METHOD  |
|--|---|--|--|
| Loss and Return of Input Signals (1 or more) | Correct operation as described in Wolf Creek Specification J-105A(Q)  | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection   |
| Input Signal Over/Under Range (1 or more)    | Correct operation as described in Wolf Creek Specification J-105A(Q)  | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection   |
| Communication Interface Connection Fault     | No Loss of Configuration or Effect on System Operation  | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection   |
| Input Fault/Abnormal Input                   | No Loss of Configuration or Effect on System Operation  | Nutherm Test Procedure<br>TPS-9064<br>MSFIS Final Acceptance Test  | Direct Test and Inspection   |
| <b>Dependability Characteristics:</b>        |   |  |  |
| <b>Built-In Quality</b>                      |   |  |  |
| Quality of Design and Manufacture            | <p>Manufacturer maintains a QA program that is generally in compliance with a recognized standard, including as a minimum: QA Staff/Organization, QA Plans and Procedures. Evidence the QA program was applied in the production of the procured items.</p> <p>Vendor follows a digital system/software process including</p> <ul style="list-style-type: none"> <li>• Software development plan for VHDL coding</li> </ul> | Nutherm Dedication Report (NI Commercial Grade Survey of CSI). Nutherm Quality Plan, Nutherm Source Verification, SS-9715-02 | <p>Commercial Grade Survey and/or Source Inspection including:</p> <ul style="list-style-type: none"> <li>• Review of CSI QA program against relevant standards</li> <li>• Review of CSI procedures for digital system/software development, V&amp;V, testing</li> </ul> |

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| CRITICAL CHARACTERISTICS    | ACCEPTANCE CRITERIA  | VALIDATION DOCUMENT   | VALIDATION METHOD   |
|-----------------------------|--|---|---|
|                             | <ul style="list-style-type: none"> <li>• Documented design requirements, including software requirements</li> <li>• Requirements traceability</li> <li>• Documented software design descriptions</li> <li>• Documented V&amp;V plan</li> <li>• Validation testing</li> </ul> <p>Evidence the digital system/software development process has been followed for the latest revision, revision tracking.</p> <p>Documented incorporation of latest change/revision in software/hardware design</p> |   | <p>for each module</p> <ul style="list-style-type: none"> <li>• Thread audits checking actual practices for QA and software development and control</li> <li>• Check of the degree to which QA program and software development process were applied</li> <li>• Check of degree to which experience with previous design/revision were applied</li> </ul> |
| System Reliability Analysis | Wolf Creek Specification J-105A(Q)   | WC/Baseline Engineering SRA Report, Nutherm Dedication Report | Analysis  |
| Hardware Design Process     | Evidence the QA program (DO-254) was applied in the hardware design  | Nutherm Dedication Report (NI Commercial Grade Survey of CSI) | Commercial Grade Survey and/or Source Inspection  |
| Configuration Control       | <p>Configuration control program that includes:</p> <ul style="list-style-type: none"> <li>• Version control of FPGA design files</li> <li>• Version control of FPGA design tools</li> </ul>   | Nutherm Dedication Report (NI Commercial Grade Survey of CSI) | Commercial Grade Survey and/or Source Inspection  |

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| CRITICAL CHARACTERISTICS         | ACCEPTANCE CRITERIA  | VALIDATION DOCUMENT  | VALIDATION METHOD  |
|----------------------------------|--|--|--|
|                                  | Documented Plan & Procedures   | Nutherm Dedication Report (NI Commercial Grade Survey of CSI)  | Commercial Grade Survey and/or Source Inspection                                 |
|                                  | Baseline Maintenance   | Nutherm Dedication Report (NI Commercial Grade Survey of CSI)  | Commercial Grade Survey and/or Source Inspection                                 |
|                                  | Change Control   | Nutherm Dedication Report (NI Commercial Grade Survey of CSI)  | Commercial Grade Survey and/or Source Inspection                                 |
|                                  | Error-Reporting Process  | Nutherm Dedication Report (NI Commercial Grade Survey of CSI)  | Commercial Grade Survey and/or Source Inspection                                 |
|                                  | Software Life Cycle Management   | Nutherm Source Verification, SS-9715-02  | Source Verification to include evaluation of vendor procedure and implementation |
| Software Development and Control | Established development and control procedures.  | Nutherm Source Verification, SS-9715-02  | Source Verification, Review of Process and Documentation                         |
| Tool Acceptance Methodology      | Verification and Validation on tool output performed and documented  | Nutherm Source Verification, SS-9715-02  | Source Verification, Review of Process and Documentation                         |
| Failure Modes/Failure Analysis   | A Failure Modes and Effects Analysis (FMEA) is prepared as part of the WC Engineering Package (EP) process. FMEA performed and documented by the vendor at both component and system level | WC/Baseline Engineering FMEA Report, Nutherm Dedication Report Nutherm Source Verification, SS-9715-02 | Analysis Source Verification   |

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| CRITICAL CHARACTERISTICS | ACCEPTANCE CRITERIA  | VALIDATION DOCUMENT    | VALIDATION METHOD                                |
|--------------------------|--|------------------------|--|
| Problem Reporting        | Established error-reporting procedures. Seller will also provide reporting to Purchaser. | Nutherm Quality Manual | Commercial Grade Survey and/or Source Inspection |

### **PHYSICAL CHARACTERISTICS**

Physical characteristics are those characteristics of the item that deal with its construction, materials, shape, form and fit, etc. The critical characteristics classified as physical attributes are determined during the Technical Review and listed on the Critical Characteristics Matrix. The Project Manager evaluates critical physical attributes based on the item's safety function and determines the best method to verify them. Typically, for dedication, these characteristics are compared with a qualified part in the Nutherm International, Inc. Test Specimen Library and/or manufacturers published product information (e.g. drawings, cutsheets, etc.) as applicable. The comparison is documented, then reviewed and evaluated by the Nutherm Engineering department. Any differences between the qualified part and the dedicated item are evaluated with respect to the level that the item is being dedicated to (e.g. Seismic, Mild Environment) and documented either on the Comparison sheet or a Record of Dedication. Through the comparison process, reasonable assurance is gained of the physical similarity between the item to be dedicated and the item previously tested.

MSFIS System critical physical characteristics are listed above. Similarity will be established to the qualified part as well as design documents during the dedication process, with any differences noted and evaluated for impact on qualification by Nutherm Engineering Department.

Product information verification is required to provide reasonable assurance that the item ordered is in fact the item received, as is part of the Physical Characteristic category of Critical Characteristic. This portion of the dedication process includes, but is not limited to, Part Number/Model Number verification and Manufacturer verification. Product information verification is performed and documented at receipt inspection in accordance with Nutherm International, Inc. Quality Assurance Manual No.: QA-N-10179-5 and the applicable approved procedures. Section 1.3.3 of EPRI NP-5652 states;

"Part number verification is an integral step in the acceptance of commercial grade items and is included in each of the four acceptance methods. Verification of a part number and the utilization of the acceptance methods in this guideline provide assurance of acceptability. Since suppliers furnish commercial grade items for general industrial use, they may change the product design or the manufacturing process, and not the part number. These actions are taken without concern for the nuclear end user's design requirements. The methods described in this



501 South 11<sup>th</sup> Street  
Mt. Vernon IL 62864

PHONE: 618-244-6000  
FAX: 618-244-6641

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guideline provide various means to accept a commercial grade item without sole reliance upon part number verification."

Because of possible changes by the manufacturer, Product Information alone is an insufficient basis for acceptance of commercial grade items for nuclear safety related applications. This is especially true of complex digital equipment. By combining Product Information verification with the applicable testing, comparisons, etc. of an item's Physical Attributes, Performance characteristics, and Dependability characteristics reasonable assurance of acceptability can be achieved.

Each cabinet of the MSFIS System contains the following which will be verified during the dedication process:

- 2 ALS Control System Racks; one Main Steam (MS) rack and one identical Feed Water (FW) rack. Each Rack contains the following boards:
  - 1 Core Logic board (CLB)
  - 2 Digital Input boards (IPB)
  - 1 Solid-State Output board (SOB)
  - 3 Solid State FET & Sensor Output boards (FSB)
  - 1 Service & Test board (STB)
  - 2 Redundant Power Supply Modules (PSU)
- 1 Assembly panel, with MS and FW components as follows:
  - 125V Terminal and Distribution Block
  - 125V Fuse Blocks for Solenoid Outputs
  - 125V Fuse Block and Suppression Filter to Power Supplies

In addition to Nutherm's normal receipt and visual inspection procedures, each board of each rack will be subject to visual inspection in accordance with Nutherm Procedure TPS-9062, "ALS Rack Component Verification". Each board revision and part number will be recorded along with any other distinguishing marks such as lot numbers, date codes, etc. Software Revision Number for the FPGA logic will be recorded and verified against design documents. Each component on every board will be compared to the manufacturer Bill of Materials (BOM) and Board Layout drawings, as applicable, with any discrepancies noted and addressed in the Dedication Report. Quality of workmanship, such as soldering and overall construction, will be compared with the



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quality of the qualification unit with any discrepancies noted and addressed in the Dedication Report.

Component verification against design documents, BOM, and Board Layout drawings provides objective evidence that design control by the manufacturer has been implemented.

**PERFORMANCE**

Though the performance testing outlined in this plan is thorough, it is not intended to imply that testing alone is sufficient to complete the dedication process. The purpose of a thorough test regime is to enhance and support the judgment, reached through a combination of *all* the dedication activities outlined in this plan, that the items dedicated are suitable for their safety related application.

The Performance section of the dedication plan lists the operational critical characteristics determined during the technical evaluation. Performance characteristics are verified through testing, analysis, or, in the case of UL listings, comparison with manufacturer cutsheets. Performance testing is typically performed at the Nutherm Testing Facility, in accordance with approved procedures. Test results are documented, evaluated by the Nutherm Engineering Department for acceptability, and reviewed by Nutherm QA.

All testing at the Nutherm Test Laboratory is performed by technicians Certified Level II (minimum) in accordance with ANSI N45.2.6 and the requirements of the Nutherm Quality Assurance Program. All quantitative data is taken using measuring and test equipment (M&TE) which is calibrated under the Nutherm Quality Assurance Program, by calibration facilities which operate under Nutherm approved 10CFR50, Appendix B Quality Assurance programs. Standards used in performance of calibration are traceable to NIST. When no national standards exist, the basis for calibration is otherwise documented. In all cases, the accuracy of the M&TE used is equal to or greater than the accuracy requirement specified by the engineering department for the test. The description of the test equipment used is presented on the test data sheets.

Performance testing will be performed on the MSFIS systems to verify proper operation and compliance with the applicable sections of Wolf Creek specification J-105A(Q). A Factory Acceptance Test (FAT), TPS-9064, will be performed on the supplied MSFIS control system. A detailed test procedure for FAT testing has been developed by Nutherm in cooperation with CS Innovations, for approval by Wolf Creek prior to the start of testing. The test procedure was developed based on design documents from CS Innovations as well as WC specification requirements. Actual system response to stimulus is compared to designed response as delineated in design documents through Acceptance Criteria. As part of the FAT abnormal conditions and events testing will be performed to verify proper system response to abnormal conditions.

In addition to verifying the performance critical characteristics, thorough testing of the supplied equipment provides objective evidence of design control and built-in quality, adding to the reasonable assurance that the dedicated equipment is suitable for the specified safety related application. The role of additional testing is to supply supporting, documented verification of critical characteristics such as design control and built-in quality, not to replace other dedication processes. For example, Commercial Grade Survey and Source Verification activities are the primary vehicle through which the design control and built-in quality characteristics are verified as described in this plan and recommended in EPRI TR106439.

System Acceptance Testing will be witnessed at CS Innovations as part of the Performance area characteristic verification. Test procedures and performance will be reviewed during the Source Verification. A review of vendor documentation including design tests, logic function testing, and response under abnormal conditions shall be conducted.

#### **DEPENDABILITY**

The Dependability category of critical characteristics is described in detail in EPRI TR-106439. These characteristics are difficult to verify through testing and inspection alone. Because built-in features can have a significant impact on the robustness of electronic devices, dedication activities will continue throughout the design and prototype phases following the life cycle approach. Various verification and validation steps with appropriate documentation will be performed at the different phases of the life cycle as described in the Critical Characteristics Matrix. To gain reasonable assurance in the dependability of the MSFIS system, a combination of inspections, vendor process reviews, verification and validation steps, and product development and documentation review will be used to verify the critical characteristics listed in this plan.

As EPRI TR-106439 recommends, close interaction between the manufacturer and the dedicating entity promotes the development of reasonable assurance that the final product is suitable for the specified safety related application. Nutherm has worked with CS Innovations and WC throughout the design, qualification, and dedication processes through trips to CS Innovations and regular phone conferences. Surveillance activities, including thread audits, were performed to verify and document vendor testing, vendor FMEA performance and documentation, software procedures and implementation, and other critical characteristics as specified in the Matrix.

The following is a more detailed explanation of some of the steps/processes involved in verifying the built-in quality critical characteristics:

- An initial Commercial Grade Survey was performed at CS Innovations (CSI). Follow-up surveys and source inspections will be performed to verify continued compliance with the CSI QA program.

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- A source inspection will be performed to provide objective evidence that the CSI QA program was applied to the production of the dedicated items.
- A System Reliability Analysis (SRA) was performed under the Wolf Creek (WC) Quality Assurance program. The SRA report will be reviewed and approved by qualified WC personnel and included in the final Dedication Package. WC will provide documentation and attestation that the SRA critical characteristic has been adequately verified.
- Surveys and source inspections, as required, will be performed to verify that CSI QA program was applied to the hardware design. The CSI process follows the recommendations of DO-254, "Design Assurance Guidance for Airborne Electronic Hardware". DO-254 describes in detail the Hardware Design Life Cycle and the data which will be developed as evidence of compliance. The surveys and inspections will provide assurance that this process was followed and the appropriate data is available.
- Surveys and source inspections, as required, will be performed to verify that CSI implements appropriate configuration control. The processes and procedures used by the manufacturer will be evaluated. In particular, version control of FPGA design files and design tools will be verified. Design documents will be verified against delivered equipment as further objective evidence that design control was implemented. The other aspects of configuration control which will be verified include; documented plans and procedures, baseline maintenance, change control, and error reporting processes.
- Selection of the FPGA and design tools was documented. Said documentation will be included in the final Dedication Report.
- A Failure Modes and Effects (FMEA) analysis was performed under the WC QA program. The FMEA report will be reviewed and approved by qualified WC personnel and included in the final Dedication Package. WC will provide documentation and attestation that the FMEA critical characteristic has been adequately verified. In addition, the CSI FMEA and safety analysis will be reviewed, including system and component failure analysis documentation.
- Problem reporting is incorporated in the Nutherm Quality Assurance Manual. Surveys and source inspections, as required, will be performed to verify that CSI has error-reporting procedures. Conformance to such procedures will be verified.
- Thread audits, as recommended in EPRI TR-106439, will be performed as part of the review of CSI documentation and processes. Software development and control, implementation of CSI QA program, and adherence to established coding practices are some of the areas that shall be subjected to thread audits.

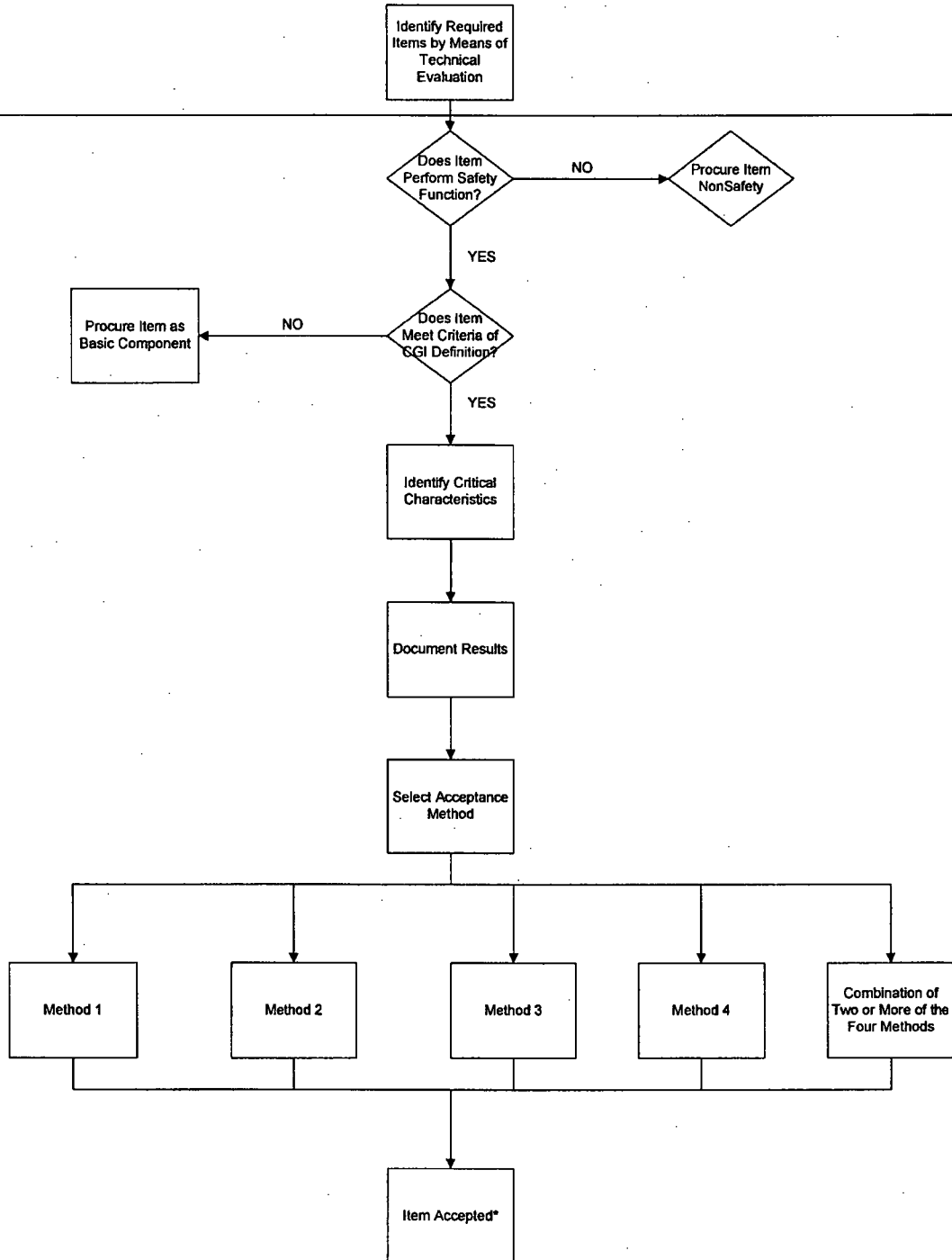
**VERIFICATION AND VALIDATION**

Verification and Validation performed by Nutherm will involve several steps and processes. Quality Control Inspections (QCI) in accordance with Nutherm procedures will be performed on the production items. These inspections will include Visual Inspections, Point to Point Continuity Verification, Verification of Specified Parts, as well as a detailed inspection and comparison of board components, BOM's, and board layout drawings. A Final Acceptance Test will be performed in accordance with an approved procedure to verify conformance to purchase order and specification requirements. The Critical Characteristics Matrix lists the performance characteristics which will be verified through testing.

DO-254, "Design Assurance Guidance for Airborne Electronic Hardware", contains detailed requirements for Verification and Validation. Surveys and source inspections will be performed, as required, to verify that the CSI V&V processes, plans, and implementation conform with the requirements of DO-254.

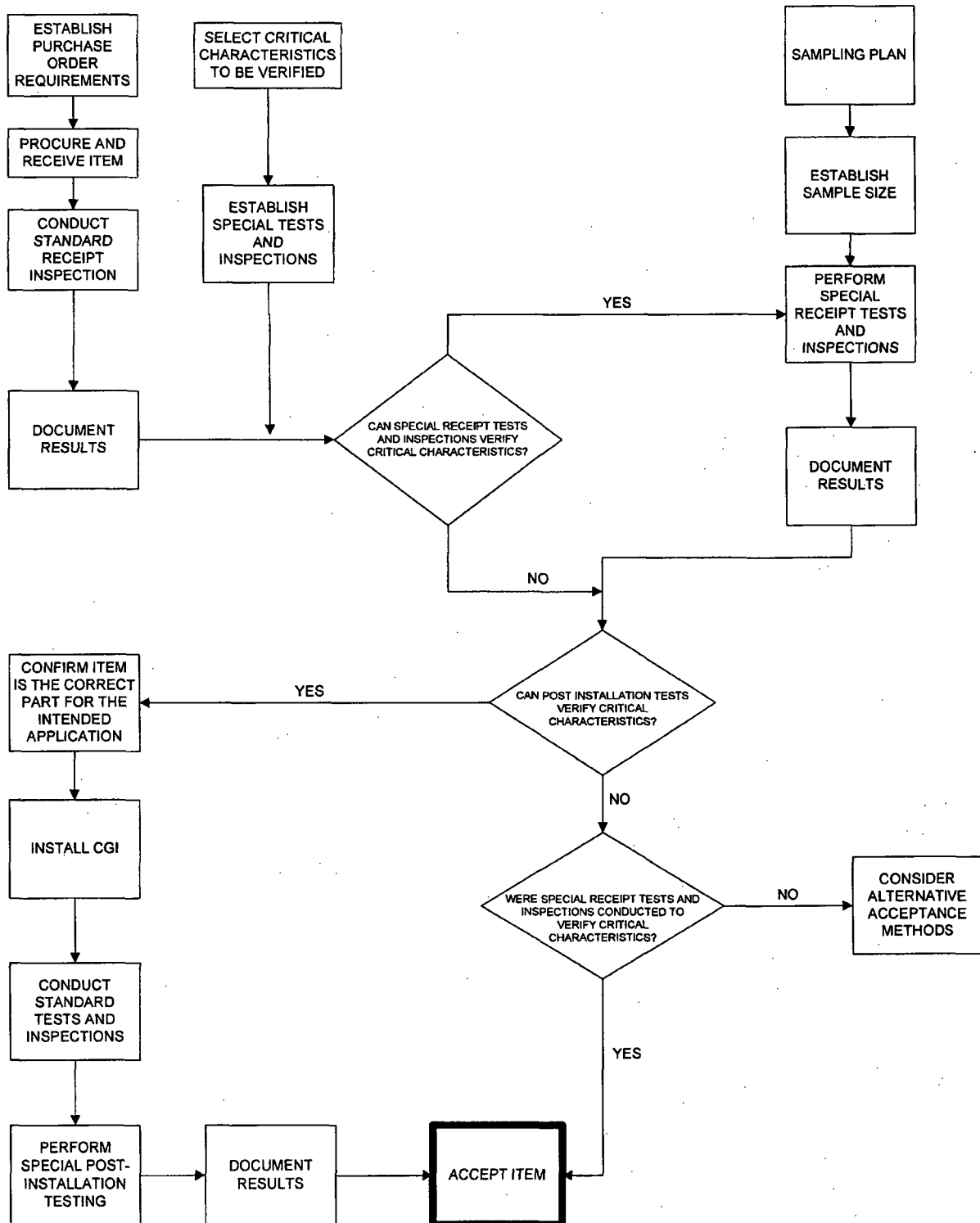
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**Figure 1. Generic Process for acceptance of Commercial Grade Items Used in Safety Related Applications, Per EPRI NP-5652**



\*Deficiency reporting responsibility accepted.

FIGURE 2 Method 1 - Special Tests and Inspections



**LETTER OF TRANSMITTAL**  
**Transmittal No. 127431**  
**Page 1 of 1**

**SUBMITTED TO:**

Gregg Clarkson  
Wolf Creek Nuclear Operating  
Corp.  
P.O. Box 411  
Burlington, KS 66839

**SHIPPED VIA**

Email [grclark@wcnoc.com](mailto:grclark@wcnoc.com)

**DATE:**

08/30/07

**CLIENT REFERENCE**

734527

**NUTHERM REF. NO.**

WCN-9715

**PROJECT**

Wolf Creek

**ITEM DESCRIPTION**

1 Nutherm Dedication Plan

**DOCUMENT NO./REV.**

WCN-9715DP, Rev. 2

**SUBMITTAL  
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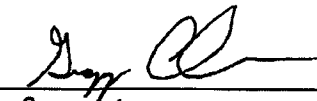
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**COMMENTS:**

Receipt  
Acknowledged By

  
Gregg Clarkson WCNOC PM

Date: 8/30/2007

**SUBMITTAL CODES**

1) APPROVAL

2) INFORMATION

3) RECORD