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LANL MASTER TECHNICAL EVALUATION AND ACCEPTANCE PLAN

for Commercial Grade Dedication of

High Confidence Reinforced Concrete per

LANL Master Specification Section 03 3021, Reinforced Concrete–High Confidence

Plan Revision 1, June 21, 2018

This TEA Plan template may be used when dedicating structural concrete for ML-1 (safety class) and ML-2 (safety significant) applications. Develop the final TEA Plan based on specific end-use applications (see Section 2.0) and safety functions (see Section 3.0) that must be validated as applicable by the engineer and Facility Design Authority Representative prior to use. For example, this TEA Plan does not consider safety functions associated with confinement or radiological shielding which may require additional critical characteristics such as permeability or a specific density of the concrete.

Commercial grade dedication (CGD) is used when the concrete supplier/batch plant is not on the Institutional Evaluated Suppliers List (has not been fully qualified by LANL Supplier Quality as complying with NQA-1 and specification requirements) or where a subcontractor (under their IESL-approved program) cannot qualify the concrete supplier.

This template should be used in addition to the typical QA, testing, and inspection requirements of the specific project specification (based on LANL Master Specification 03 3021), Verification Inspection and Test Plan (VIT), and applicable codes/standards including IBC code version (see Engineering Standards Manual [Chapter 16](http://engstandards.lanl.gov/ESM_Chapters.shtml#esm16)).

The project-specific TEA Plan and associated CGD Package for high-confidence reinforced concrete shall be reviewed and approved in accordance with the requirements of AP-341-703, *Commercial Grade Dedication.*

This template may also be used by Subcontractors performing CGD in accordance with their approved QA Program and CGD procedures; however, any technical evaluation, engineering reviews, independent verification, and approvals required by such program and Subcontract documents shall be performed and obtained prior to use.

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| **1.0 Technical Evaluation and Acceptance plan information** | | | | | | | | | | | | | | | | | |
| 1.1 title: High Confidence Reinforced Concrete | | | | | | | | | | | | | | | | | |
| 1.2 Commercial Grade Service: | | | 1.3 Commercial Grade Item:  Specific Item:  Generic Items: | | | | | | | | | | | | | | |
| 1.4 Project ID: | 1.5 Project Title: | | | | | | 1.6 New Item: | | | | Upgrade Item: | | | | Replacement Item: | | |
| 1.7 TA - | 1.8 Facility No.: | | | 1.9 Facility Name: | | | | | | | | | | | | | |
| 1.10 Technical Evaluation and Acceptance Plan Approval: | | | | | | | | | | | | | | | | | |
| **Responsible Engineer:** |  |  | | |  |  | |  |  | | |  |  | | |  |  |
| Name | | |  | Z Number | |  | Organization | | |  | Signature | | |  | Date |
| **Procurement Engineer:** |  |  | | |  |  | |  |  | | |  |  | | |  |  |
| Name | | |  | Z Number | |  | Organization | | |  | Signature | | |  | Date |
| **Quality Assurance SME:** |  |  | | |  |  | |  |  | | |  |  | | |  |  |
| Name | | |  | Z Number | |  | Organization | | |  | Signature | | |  | Date |
| **Cognizant System or Project Engineer** |  |  | | |  |  | |  |  | | |  |  | | |  |  |
| Name | | |  | Z Number | |  | Organization | | |  | Signature | | |  | Date |
| **Facility Design Authority Representative:** |  |  | | |  |  | |  |  | | |  |  | | |  |  |
| Name | | |  | Z Number | |  | Organization | | |  | Signature | | |  | Date |
| **Security Classification Review:** |  |  | | |  |  | |  | |  | | | |  |  | | |
|  | (Reviewed By) | | |  | Z Number | |  | | Review Date | | | |  | Classification | | |
| Note: The Engineering Documents that are UCNI or OUO must be marked in accordance with P204-1, Controlled *Unclassified* *Information*. The Engineering Documents that are Classified must be marked in accordance with P204-2, *Classified Matter Protection and Control* *Handbook*. | | | | | | | | | | | | | | | | | |

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| **2.0 commercial grade item Or Service information** | | | | | | |
| 2.1 Item/Service Management Level: | ML-1 (Safety Class) | | ML-2 (Safety Significant) | | | Safety Software |
| 2.2 Manufacturer: N/A | | 2.3 Manufacturer Part/Model No.: N/A | | | | |
| 2.4 Supplier: Los Alamos Transit Mix (LATM) | | 2.5 Supplier Part No.: Pre-Approved Mix 5000-8E | | | | |
| 2.6 Item or Service Description: Reinforced Concrete, excluding reinforcing materials | | | | | | |
| 2.7 End Use Description (including operating environment and seismic parameters):  Reinforced concrete SSCs categorized as NPH Design Category (NDC)-3 subject to moderate exposure for sulfate and corrosion protection and very severe for freeze thaw protection per ACI 349. | | | | | | |
| 2.8 Reference the Equipment Critical Characteristics Determination form (AP-341-607-FM01) as applicable.  N/A | | | | | | |
| 2.9 Does the item include embedded software/firmware (e.g. PLC)? Yes:  N/A:  If selected yes, identify how and/or if the embedded software/firmware affects the item’s safety function and how it will be controlled and/or verified. | | | | | | |
| 2.10 Software Information *(Complete this section for safety software only; embedded software/firmware is N/A)* N/A: | | | | | | |
| Software Name: | Software Version: | | | | Operating Environment: | |
| Software Safety Category: | | | | Software Risk Level: | | |

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| **3.0 Identification of SAfety Function** | | | | |
| 3.1 Safety Functions for Host Components or for Services: | | | | |
| No. | Safety Function | | Source Document | |
| 1 | The reinforced concrete structure/ building will support equipment and distribution systems during normal operation, as well as during and after the design basis earthquake (DBE). | | [Author—reference safety basis document whereby safety function of concrete SSC is specified] | |
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| 3.2 Functions for Subcomponents or Replacement Items: N/A | | | | |
| No. | | Function For Item(s) Being Dedicated | | Source Document |
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| **4.0 FAilure Modes and Effects Analysis** | | | | |
| 4.1 Credible Failure Modes and Effects Analysis: | | N/A:  Explain: | | |
| Credible Failure Modes | Failure Mechanism | | Effect on Safety Function | Potential Critical Characteristics |
| Flaws in the concrete materials or production process results in insufficient strength. | Lack of achieving specified strength could result in the inability of a structure to perform its design function. | | Concrete SSC fails to support equipment/items during normal operations or design basis earthquake. | Concrete Strength (f’c) = 5,000 psi @ 28 days |
| Flaws in the concrete materials or production process results in concrete with inadequate durability. | Premature cracking, pitting, crumbling leading to structural failure during design basis event. | | Concrete SSC fails to support equipment/items during normal operations or design basis earthquake. | * Concrete materials and their proportions listed on batch tickets must conform to Pre-Approved Mix Design 5000-8E * Produced concrete must conform to Pre-Approved Mix Design 5000-8E * f’c must meet minimum of 5,000 psi @ 28 days |

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| **5.0 Replacement item evaluation** | | | |
| 5.1 Replacement Item : | N/A: | Like-For-Like (Identical) Item | Equivalent Item: |
| 5.2 Identify the replacement item evaluation report that has been completed in accordance with AP-341-503. | | | |
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| **6.0 Identification of Critical Characteristics** | | | |
| 6.1 Critical Characteristics for Acceptance, Acceptance Criteria and Acceptance Methods | | | |
| 6.2 Identification Characteristics: | | | |
| Safety Function No: | Critical Characteristics | Acceptance Criteria (Including Tolerances) | Acceptance Methods |
| 1 | Concrete Conformity | Materials listed on batch tickets must conform to those included in Pre-Approved Mix Design 5000-8E   * + Cement conforms to Portland cement Type 1/II per ASTM C150   + Fly Ash conforms to ASTM C618 Class F   + Air-entraining admixture conforms to ASTM C260   + Water-reducing and hydration-stabilizing admixtures conform to ASTM C494 | Method 1, “Special Tests and Inspections”.   * Verify batch records are provided with delivery of cement and that they indicate conformance to ASTM C150 for Portland cement Type I/II * Verify documentation supplied with delivery of fly ash indicate compliance with ASTM C618 Class F * Verify documentation supplied with shipments of air-entraining admixtures indicate compliance to ASTM C260 * Verify documentation supplied with shipment of water-reducing and hydration-stabilizing admixtures indicate compliance to ASTM C494 |
| 6.3 Physical Characteristics: | | | |
| Safety Function No: | Critical Characteristics | Acceptance Criteria (Including Tolerances) | Acceptance Methods |
| 1 | Concrete Constituents | Materials used in concrete production comply with material requirements in Pre-Approved Mix Design 5000-8E   * Moisture content of fine and coarse aggregate is determined and accounted for on each batch ticket. * Aggregate, both fine and #67 coarse shall conform to ASTM C33 and be monitored for significant changes to gradation, fineness modulus and material finer than number 200 sieve. * Batch Plant computer entries for each mix constituent match and are traceable to the proportion prescribed by the Pre-Approved Mix Design 5000-8E * Minimum mixing time is 90 seconds   . | Method 3, “Source Verification”. Perform source verification during initial Batch Plant start up and daily if extended beyond one dayshift. Verify:   * + - * The moisture contents of the aggregates have been measured daily at the beginning of production per ASTM C566 and the amount of mix water has been adjusted accordingly.       * Verify the gradation, fineness modulus and material finer than number 200 sieve for the fine aggregate and #67 coarse aggregate per ASTM C131.       * The proportions for all concrete mix constituents entered into the plant batching computer match the Pre-Approved Mix Design 5000-8E.       * Verify that concrete is mixed a minimum of 90 seconds at the specified mixing speed prior to leaving the batch plant. |
| 1 | Concrete Material Weight | Compliance with Pre-Approved Mix Design 5000-8E per table below:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Material** | **Source** | **Description** | **Quantity** | **Tolerances** | | Cement | GCC-Tijeras, NM | Type I/II | 580 lbs per cu yd | +1% | | Fly Ash | Salt River Materials Group, 4 Corners | Class F | 193 lbs per cu yd | +1% | | Coarse Aggregate | Los Alamos Transit Mix, El Guique Pit, Espanola, NM | #67 | 1,600 lbs per cu yd | +2% | | Fine Aggregate | Los Alamos Transit Mix, El Guique Pit, Espanola, NM | Washed Sand | 1,162 lbs per cu yd | +2% | | Water | Los Alamos Transit Mix, Public Water Supply | Site Water | 255 lbs per cu yd | +3% | | Air Entraining Admixture (Note 1) | BASF | MasterAir AE 200 | 0.91 oz min – 11.6 oz max oz (oz per cu yd) | +3% | | Full Range Water Reducer (Note 1) | BASF | MasterGlenium 3030 | 23.2 oz min – 139.1 oz max (oz per cu yd) | +3% | | Hydration Stabilizer (Note 1) | BASF | Delvo | 15.5 oz min – 69.6 oz max (oz per cu yd) | +3% | | Note 1: Delvo quantity range results in about 1-hour of retardation at lower temperatures at 2-oz. dosage, and up to about 3 hours at higher temperatures at 9-oz. dosage. | | | | | | Method 1, “Special Tests and Inspections”. Confirm Mix Design materials through inspection of Batch Tickets for each load delivered:   * Compare brand, type/description, amounts, and sources for each constituent listed against Pre-Approved Mix Design, 5000-8E * Verify that the batched amount of each constituent is within the tolerance specified. |
| 1 | Concrete Mixed Quality | Concrete must conform to the Pre-Approved Mix Design 5000-8E for air content, slump, temperature, and density.  Sampling consecutive truckloads shall continue until batches are confirmed to be in compliance upon delivery with no adjustment required. Subsequent sampling shall be performed in accordance with the random sampling plan per Table 1 in Section 7.0.  Acceptance criteria:   * Temperature less than or equal to 95F during normal weather (i.e. not Hot or Cold Weather). * Air Content 6% +/- 1.5%. * Density between 137 and 143 pcf. * Slump: 4” minimum to 9.5” maximum * Concrete shall be placed within 2-1/2 hours from batching | Method 1, “Special Tests and Inspections”. The certified testing agency shall perform the field testing in accordance with ASME NQA-1-2008 with 2009 Addenda.  Obtain samples in accordance with ASTM C172, from the point of delivery (truck), starting with the first truckload and thereafter in accordance with the sampling plan, Table 1 in Section 7.0, based on planned pour volume and adjusted as necessary for the volume of concrete placed.  Document location of samples taken.  Additional testing shall be performed whenever strength cylinders are taken, however those test samples shall be taken from the point of placement as with the strength cylinders.  The first truckload shall be sampled for air, slump, temp, and density with the additional truckload samples randomly selected to meet the required frequency.   * Temperature in accordance with ASTM C1064. * Air content in accordance with ASTM C231. * Unit weight/density in accordance with ASTM C138. * Slump in accordance with ASTM C143. * Placement within 2-1/2 hours from batching based on time of batching specified on batch ticket. |
| 6.4 Performance Characteristics: | | | |
| Safety Function No: | Critical Characteristics | Acceptance Criteria (Including Tolerances) | Acceptance Methods |
| 1 | Concrete Strength | Concrete must meet minimum strength specified in Pre-Approved Mix Design 5000-8E   * Minimum compressive strength is 5,000 psi at 28 days. * Strength level is satisfactory if both of the following requirements are met:   + Every arithmetic average of any three consecutive strength tests equals or exceeds f’c;   + No individual strength test falls below f’c by more than 500 psi when f’c is 5000 psi or less. | Method 1, “Special Tests and Inspections”. The certified testing agency shall perform the laboratory testing in accordance with ASME NQA-1-2008 with 2009 Addenda.  Obtain, prepare cylinders and test concrete in accordance with ACI 301, ASTM C31, and ASTM C39. Frequency of testing shall be at least once per day or at least once for each 50 cubic yards placed:   * Perform compressive strength testing of cylinders per Specification 03 3021, ACI 301, ASTM C31 and ASTM C39. Samples for pumped or conveyer concrete must be taken at the end of the pump hose or end of the conveyer belt. * Take concrete strength test cylinders, 4 inch diameter x 8 inches tall or 6 inch diameter x 12 inches tall, in accordance with ASTM C31. * Testing agency must test the strength test cylinders in accordance with ASTM C39. |

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| 7.0 Sampling Plan Justification/Basis | | |
| 7.1 Is Sampling Plan Required? | Yes: | No: |
| |  | | --- | | If “Yes” is checked then provide basis for development/selection: *(batch traceability/ lot homogeneity requirements, additional quality required if destructive testing is utilized).* If “No” is checked then 100% is required to be inspected/tested | | | |
| **Acceptance Testing\*** (strength cylinders) will be collected from the point of placement. Take concrete strength samples from one batch every 50 cubic yards placed, minimum of once per day. The last truckload of the pour shall be acceptance tested to cover for any partial increment beyond the last 50 cubic yard test interval.  If the total Project pour of concrete is limited such that fewer than five sets of strength tests would be achieved at the rate of once per 50 cubic yards placed, strength tests shall be made from no less than five randomly selected truckloads.  Random selection shall be made by use of a random number generator on defined Lot increments prior to the pour to ensure acceptance testing of once per 50 cubic yards is achieved. Selections are to be confidential to Subcontractor and LANL until selected truckload arrives at jobsite.  See below for additional Field Testing to be taken at the point of placement at the time strength samples are taken.  **Field Testing** (air, slump, temp, and density) shall be collected from the back of the concrete truck and performed in accordance with Table 1, “Field Testing Normal Sampling Plan”. The random sampling shall be adjusted in process as necessary should the lot size change during the concrete pour.  Table 1 – Field Testing Normal Sampling Plan   |  |  | | --- | --- | | **Lot Size (number of truckloads)** | **Sample Size (frequency)** | | 1 | 1 | | 2-4 | 2 | | 5-6 | 3 | | 7-11 | 4 | | 12-20 | 5 | | 21-24 | 6 | | 25-28 | 7 | | 29-32 | 8 | | 33-41 | 9 | | 42-50 | 10 |   Random selection shall be made by use of a random number generator on defined Lot increments prior to the pour to ensure field testing sample size per Table 1 is achieved. Selections are to be confidential to Subcontractor and LANL until selected truckload arrives at jobsite.  The first truckload shall be sampled for Field Testing (at the back of the truck). Subsequent trucks shall be sampled until compliance with the acceptance criteria is achieved with no further adjustments either at the batch plant or at the truck. Additional trucks shall be sampled per the required frequency based on the planned pour volume and in accordance with the pre-selected random trucks.  **\***Additional Field Testing (air, slump, temp, and density) must be performed whenever acceptance testing samples are taken for strength cylinders; however, these Field Testing samples shall be taken from the point of placement consistent with the samples taken for the strength cylinders.  **Field Adjustments**  If a truckload is identified as being out of compliance with acceptance criteria, the batch will be adjusted as allowable by specification, documented, and the next subsequent truckload shall be sampled to verify compliance. Sampling consecutive truckloads shall continue until batches are confirmed to be in compliance upon delivery with no adjustment required in the field or at the batch plant.  Results of field testing with samples taken directly from the back of the concrete truck may vary from those samples taken at the point of placement due to changes in properties as a result of flow through the concrete pump to the point of delivery.  See Section 9.0 for Additional Sampling Justification. | | |

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| **8.0 Procurement Controls** |
| 8.1 If Method 2 Commercial Grade Survey is employed, identify the process controls to be invoked in the procurement (including document and revision level) per commercial grade survey report:  N/A |
| 8.2 If Method 3 Source Verification is employed, identify the source verification activities to be performed:  Source verification activities to be performed include verification of concrete materials and batching operations at batch plant. |

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| **9.0 Technical justification and supporting information** |
| The verification of the Critical Characteristics for acceptance shall be performed by a combination of Method 1, “Special Tests and Inspections” and Method 3, “Source Verification”. The testing agency performing the testing services shall be certified to AASHTO or to another nationally recognized accreditation service as allowed by ASTM C1077. Testing technicians, at a minimum, shall be certified as ACI Concrete Field Testing Technician – Grade 1. Personnel performing verification of batching operations shall be certified, at a minimum, as **NRMCA Certified Concrete Technologist, Level 3.** The certified testing agency shall perform the field and laboratory testing in accordance with ASME NQA-1-2008 with 2009 Addenda. Concrete placement and post placement activities such as curing and protection shall be conducted under an ASME NQA-1 quality program.  Sampling is a justified approach in the field testing of concrete as the delivered product is expected to exhibit a high degree of homogeneity due to the control of the concrete constituents and the production process. Factors that enhance homogeneity of the Pre-Approved Mix Design 5000-8E include:   * Traceability and conformance to the mix design is verified for concrete constituents including cement, fly ash, and admixtures * Aggregate is segregated, sampled, tested, and controlled for the project * 100% of the product is mixed and delivered from a singular batching facility * Batching is performed in accordance with ASTM C94 or ASTM C685 by a supplier who maintains NRMA Certification with oversight during batching by an NQA-1 Independent Test and Inspection Agency * Batch tickets by truckload are verified for conformance to the mix design * The Pre-Approved Mix Design 5000-8E, has been independently produced and tested by a third party   Concrete will be delivered to the jobsite by a singular central mix plant producing the batch and dispensing it by truckload in approximately nine (9) cubic yard quantities. The lot size for the concrete pour shall be defined by the Project total number of cubic yards of concrete volume planned, tracked and segmented by individual truckloads delivered. Lot increments will be defined prior the pour to ensure that the random selection method for acceptance testing intervals for each 50 cubic yards or once per day minimum and the field testing sample size per the EPRI Normal Sampling Plan are met. An example Random Number Generator is found at Research Randomizer (Version 4.0) from http://www.randomizer.org/. The random sampling shall be adjusted in process as necessary should the lot size change during the concrete pour. Regardless of the planned pour volume the first truckload delivered shall be tested for slump, temperature, density and entrained air.  ACI 349-13, *Code Requirements for Nuclear Safety Related Concrete Structures*, specifies that specimens for strength tests of each class of concrete placed each day shall be taken not less than once per day, nor less than once for each 100 cubic yards of concrete placed. Specification Section 03 3021, *Reinforced Concrete–High Confidence* requires field testing (slump, temperature, density and entrained air) be performed when concrete test specimens are taken, i.e., each 50 cubic yards placed. Use of the Normal Sampling Plan from the EPRI Guideline will invoke more frequent testing intervals in accordance with the Normal Sampling Plan, Table 1, Section 7.0 herein.  Use of the Normal Sample Plan from the EPRI Guideline for the frequency of field testing concrete for slump, density, temperature and entrained air is more conservative than the ACI 349-13 standard and based on the homogeneity of the product as described above, provides an adequate basis for the sampling plan. |

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| **10.0 REference Documents** | | |
| 10.1 Reference Documents (including national codes and standards, safety basis classification, specifications, drawings, catalog cut sheets etc.): | | |
| Document No. | Rev. | Document Title |
| ACI 301 | 2005 | ACI 301-05, Specifications for Structural Concrete |
| ACI 349 | 2013 | ACI 349-13, Code Requirements for Nuclear Safety Related Concrete Structures |
| ASTM C150 | NA | ASTM C150/C150M, Standard Specification for Portland Cement |
| ASTM C618 | NA | ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete |
| ASTM C260 | NA | ASTM C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete |
| ASTM C494 | NA | ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete |
| ASTM C33 | NA | ASTM C33/C33M, Standard Specification for Concrete Aggregates |
| ASTM 566 | NA | ASTM C566, Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying |
| ASTM C131 | NA | ASTM C131/C131M, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C172 | NA | ASTM C172/C172M, Standard Practice for Sampling Freshly Mixed Concrete |
| ASTM C1064 | NA | ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Concrete |
| ASTM C231 | NA | ASTM C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method |
| ASTM C138 | NA | ASTM C138/C138M, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete |
| ASTM C143 | NA | ASTM C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete |
| ASTM C31 | NA | ASTM C31/31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field |
| ASTM C39 | NA | ASTM C39/39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C1077 | NA | ASTM C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation |
| ASTM C94 | NA | ASTM C94/C94M, Standard Specification for Ready-Mixed Concrete |
| ASTM C685 | NA | ASTM C685/C685M, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing |
| EPRI NP-5652 | 1 | EPRI NP-5652 and TR-102260 Final Report, Plant Engineering: Guideline for the Acceptance of Commercial-Grade Items in Nuclear Safety-Related Applications, Revision 1, September 2014 |
| TR-017218 | 1 | TR-017218-R1, Guideline for Sampling in the Commercial-Grade Item Acceptance Process, January 1999 |
| NA | 2013 | Urbaniak, G. C., & Plous, S. (2013). Research Randomizer (Version 4.0), http://www.randomizer.org/ |

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| **11.0 List of attachments** | |
| **Attachment No.** | **Document Title** |
| A | e.g., catalog cut sheet |
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| **12.0 revisions of technical evaluation and acceptance plan** | | | | |
| Rev No. | Description | Impact on Installed Items | Impact on Items in Stock | Impact on Open Purchase Orders |
| 0 | Initial Approved Issue |  |  |  |
|  |  |  |  |  |