

**ARKANSAS STATE HIGHWAY COMMISSION
ARDOT-EQUIPMENT AND PROCUREMENT DIVISION
BID INVITATION**

Contract Number: M-20-032H

BID OPENING LOCATION:
ARDOT Equipment and
Procurement Division
11302 West Baseline Road
Little Rock, AR 72209

MAIL TO:
ARDOT Equipment and
Procurement Division
P.O. Box 2261
Little Rock, AR 72203

DELIVER TO:
ARDOT Equipment and
Procurement Division
11302 West Baseline Road
Little Rock, AR 72209

Bid Opening Date: March 31, 2020 Time: 11:00 a.m.

Sealed bids for furnishing the commodities and/or services described below, subject to the Standard Bid Conditions of this Bid Invitation will be received at the above-noted mail and delivery locations until the above-noted bid opening date and time, and then publicly opened at the above-noted bid opening location. **Bids must be submitted on this form, with attachments when appropriate, or bids will be rejected. Late bids and unsigned bids will not be considered.**

In compliance with this Bid Invitation and subject to all the Conditions thereof, the undersigned offers and agrees to furnish any and all items upon which prices are quoted, at the price set opposite each item.

Company Name: _____

Name (Type or Print): _____

Address: _____

Title: _____

City: _____ State: _____ Zip: _____

Phone: _____ Fax: _____

E-mail Address: _____

Federal Tax ID or Social Security No.: _____

Signature: _____

Signature must be legible, original (not photocopied) and in ink.
Unsigned bids will be rejected.

Item No.	Description	Quantity	Unit	Unit Price	Amount
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1. Purchase and installation of Standby Generator Power for the main electrical service entrance of the Arkansas Department of Transportation Materials Complex located at 11301 West Baseline Road, Little Rock, Arkansas 72209. (Job #42-72)

LUMP SUM _____

Turnkey purchase and installation of equipment as per provided plans and specifications.

For questions about Bidding requirements contact Danny Keene (501-569-2674)

For questions about job specifications contact Cameron Parsons (501-569-2624)

A mandatory pre-bid meeting is scheduled for all potential bidders at the Materials Division Laboratory located at 11301 West Baseline Road, Little Rock, AR 72209 at 10:00 A.M. On March 11, 2020

All bidders should complete and return the Eligible Bidder Certification (Attachment A) and Disclosure Form (see Page 2 of Standard Bid Conditions – Item 18) issued with this bid. A current copy of the DFA Illegal Immigrant Contractor Disclosure Certification (see Page 2 of Standard Bid Conditions – Item 17) should also be submitted with bid.

Bid price shall include all labor, materials, and equipment necessary to perform the work as specified, and shall further include all licenses, fees, permits, royalties, and all taxes. Bid price shall represent full compensation for completion of the work. This provision supersedes Condition 5 on page 1 of Standard Bid Conditions. Payment will be made in accordance with Arkansas Department of Transportation Standard Specification and Applicable Special Provisions.

Subsection 105.04, 108.07, 109.01 and 109.02 of the Arkansas Department of Transportation Standard Specifications for Highway Construction, Edition of 2014, will be in effect. (Specifications are accessible on our website at www.arkansashighways.com.)

Bid Bond in the amount of 5% of total bid price is required of all bidders at time of bid opening or bid will be rejected. Personal and company checks are not acceptable as Bid Bonds. See Condition 4 on page 1 of Standard Bid Conditions. Performance Bond only (no checks of any kind allowed) in the amount of 100% will be required of successful bidder prior to providing goods/services. See Condition 4 on page 1 of Standard Bid Conditions.

The successful bidder for this project will be required to obtain Builder's Risk Insurance coverage in a minimum amount equal to the total amount bid for all building facilities included in the contract, and to provide coverage for all existing structures on the job site.

The successful bidder will be required to begin within 15 days after notice and complete within 200 calendar days

Arkansas Contractor's License No. _____.

Current Arkansas Contractor's License Number must be listed or bid will be rejected (A.C.A. ¶17-25-101 et. seq.).

ARDOT - STANDARD BID CONDITIONS

1. **GENERAL:** Any special terms and conditions included in the invitation for bid override these standard terms and conditions. The standard terms and conditions and any special terms and conditions become part of any contract entered into if any or all parts of the bid are accepted by the Arkansas Department of Transportation (ARDOT).
2. **ACCEPTANCE AND REJECTION:** ARDOT reserves the right to reject any or all bids, to accept bids in whole or in part (unless otherwise indicated by bidder), to waive any informalities in bids received, to accept bids on materials or equipment with variations from specifications where efficiency of operation will not be impaired, and to award bids to best serve the interest of the State.
3. **PRICES:** Unless otherwise stated in the Bid Invitation, the following will apply: (1) unit prices shall be bid, (2) prices should be stated in units of quantity specified (feet, each, lbs., etc.), (3) prices must be F.O.B. destination specified in bid, (4) prices must be firm and not subject to escalation, (5) bid must be firm for acceptance for 30 days from bid opening date. In case of errors in extension, unit prices shall govern. Discounts from bid price will not be considered in making awards.
4. **BID BONDS AND PERFORMANCE BONDS:** If required, a **Bid Bond** in the form of a cashier's check, certified check, or surety bond issued by a surety company, in an amount stated in the Bid Invitation, must accompany bid. Personal and company checks are not acceptable as Bid Bonds. Failure to submit a Bid Bond as required will cause a bid to be rejected. The Bid Bond will be forfeited as liquidated damages if the successful bidder fails to provide a required Performance Bond within the period stipulated by ARDOT or fails to honor their bid. When a bidder claims and can show clear and convincing evidence that a material mistake was made in the bid and was not the bid intended, the bidder may be permitted to withdraw their bid prior to award without forfeiture of bid bond. Cashier's checks and certified checks submitted as Bid Bonds will be returned to unsuccessful bidders; surety bonds will be retained. The successful bidder will be required to furnish a **Performance Bond** in an amount stated in the Bid Invitation and in the form of a cashier's check, certified check, or surety bond issued by a surety company, unless otherwise stated in the Bid Invitation, as a guarantee of delivery of goods/services in accordance with the specifications and within the time established in the bid. Personal and company checks are not acceptable as Performance Bonds. In some cases, a cashier's check or certified check submitted as a Bid Bond will be held as the Performance Bond of the successful bidder. Cashier's checks or certified checks submitted as Performance Bonds will be refunded shortly after payment has been made to the successful bidder for completion of all terms of the bid; surety bonds will be retained. Surety bonds must be issued by a surety company that is authorized to do business in the State of Arkansas and that is listed on the current United States Department of the Treasury Listing of Approved Sureties. Surety bonds must be executed by a resident or non-resident agent who is licensed by the Arkansas State Insurance Commissioner to represent the surety company executing the bond, and the resident or non-resident agent shall file with the bond the power of attorney of the agent to act on behalf of the bonding company. Certain bids involving labor will require Performance Bonds in the form of surety bonds only (no checks of any kind allowed). These bonds shall not only serve to guarantee the completion of the work, but also to guarantee the excellence of both workmanship and material until the work is finally accepted and the provisions of the Plans, Specifications, and Special Provisions fulfilled. In such cases, the company issuing the surety bond must comply with all stipulations herein and must be named in the U. S. Treasury listing of companies holding Certificates of Authority as acceptable sureties on Federal Bonds and as acceptable reinsuring companies. Any excess between the face amount of the bond and the underwriting limitation of the bonding company shall be protected by reinsurance provided by an acceptable reinsuring company. Annual Bid and Performance Bonds on file with E & P Division must have sufficient unencumbered funds to meet current bonding requirements, or the bid will be rejected, unless the balance is submitted as set forth above, prior to bid opening.
5. **TAXES:** The ARDOT is not exempt from Arkansas State Sales and Use Taxes, or local option city/county sales taxes, when applicable, and bidders are responsible to the State Revenue Department for such taxes. These taxes should not be included in bid prices, but where required by law, will be paid by the ARDOT as an addition thereto, and should be added to the billing to the ARDOT. The ARDOT is exempt from Federal Excise Taxes on all commodities except motor fuels; and excise taxes should not be included in bid prices except for motor fuels. Where applicable, tax exemption certificates will be furnished by the ARDOT.
6. **"ALL OR NONE" BIDS:** Bidders who wish to bid "All or None" on two or more items shall so stipulate on the face of bid sheet; otherwise, bid may be awarded on an individual item basis.
7. **SPECIFICATIONS:** Complete specifications should be attached for any substitution or alternate offered, or where amplification is necessary. Bidder's name must be placed on all attachments to the bid.
8. **EXCEPTIONS TO SPECIFICATIONS:** Any exceptions to the bid specifications must be stated in the bid. Any exceptions to manufacturer's published literature must be stated in the bid, or it will be assumed that bidder is bidding exactly as stated in the literature.
9. **BRAND NAME REFERENCES:** All brand name references in bid specifications refer to that commodity or its equivalent, unless otherwise stated in Bid Invitation. Bidder should state brand or trade name of item being bid, if such name exists.
10. **FREIGHT:** All freight charges should be included in bid price. Any change in common carrier rates authorized by the Interstate Commerce Commission will be adjusted if such change occurs after the bid opening date. Received common carrier bills that reflect ICC authorized rate changes must be furnished.

11. **SAMPLES, LITERATURE, DEMONSTRATIONS:** Samples and technical literature must be provided free of any charge within 14 days of ARDOT request, and free demonstrations within 30 days, unless ARDOT extends time. Failure to provide as requested within this period may cause bid to be rejected. Samples, literature and demonstrations must be substantially the same as the item(s) being bid, unless otherwise agreed to by ARDOT. Samples that are not destroyed will be returned upon request at bidders expense. Samples from successful bidders may be retained for comparison with items actually furnished.
12. **GUARANTY:** Unless otherwise indicated in Bid Invitation, it is understood and agreed that any item offered or shipped on this bid shall be newly manufactured, latest model and design, and in first class condition; and that all containers shall be new, suitable for storage or shipment and in compliance with all applicable laws relating to construction, packaging, labeling and registration.
13. **BACKORDERS OR DELAY IN DELIVERY:** Backorders or failure to deliver within the time required may constitute default. Vendor must give written notice to the ARDOT, as soon as possible, of the reason for any delay and the expected delivery date. The ARDOT has the right to extend delivery if reasons appear valid. If reason or delivery date is not acceptable, vendor is in default.
14. **DEFAULT:** All commodities furnished will be subject to inspection and acceptance by ARDOT after delivery. Default in promised delivery or failure to meet specifications authorizes the ARDOT to cancel award or any portion of same, to reasonably purchase commodities or services elsewhere and to charge full increase, if any, in cost and handling to defaulting vendor. Applicable bonds may be forfeited.
15. **ETHICS:** *"It shall be a breach of ethical standards for a person to be retained, or to retain a person, to solicit or secure a State contract upon an agreement of understanding for a commission, percentage, brokerage, or contingent fee, except for retention of bona fide employees or bona fide established commercial selling agencies maintained by the contractor for the purpose of securing business."* (Arkansas Code, Annotated, Section 19-11-708).
16. **NOTICE OF NONDISCRIMINATION:** The Arkansas State Highway Commission, through ARDOT, complies with all civil rights provisions of federal statutes and related authorities that prohibit discrimination in programs and activities receiving federal financial assistance. Therefore, ARDOT does not discriminate on the basis of race, sex, color, age, national origin, religion (not applicable as a protected group under the Federal Motor Carrier Safety Administration Title VI Program), disability, Limited English Proficiency (LEP), or low-income status in the admission, access to and treatment in the ARDOT's programs and activities, as well as the ARDOT's hiring or employment practices. Complaints of alleged discrimination and inquiries regarding the ARDOT's nondiscrimination policies may be directed to Joanna P. McFadden Section Head – EEO/DBE (ADA/504/Title VI Coordinator), P. O. Box 2261, Little Rock, AR 72203, (501)569-2298, (Voice/TTY 711), or the following email address: joanna.mcfadden@ardot.gov. Free language assistance for Limited English Proficient individuals is available upon request. This notice is available from the ADA/504/Title VI Coordinator in large print, on audiotape and in Braille.
17. **PROHIBITION OF EMPLOYMENT OF ILLEGAL IMMIGRANTS:** Pursuant to Arkansas Code Annotated 19-11-105, all bidders must certify prior to award of a contract that they **do not** employ or contract with any illegal immigrant(s) in its contract with the state.
18. **DISCLOSURE:** Failure to make any disclosure required by Governor's Executive Order 98-04, or any violation of any rule, regulation, or policy adopted pursuant to that order, **shall** be a material breach of the terms of this contract. Any contractor, whether an individual or entity, who fails to make the required disclosure or who violates any rule, regulation, or policy **shall** be subject to all legal remedies available to the agency.

ATTACHMENT A

ELIGIBLE BIDDER CERTIFICATION

The Bidder represents and warrants for itself, its employees and its subcontractors and certifies they:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
2. Have not within a three-year period preceding this Bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
3. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph two (2) of this Certification;
4. Have not within a one-year period preceding this application/Bid had one or more public transactions (Federal, State, or local) terminated for cause or default; and

The Bidder represents, warrants and acknowledges the understanding that restrictions placed on the employment of labor or on the scale of pay for the work on a contract will be the requirements of the Fair Labor Standards Act (Federal Wage-Hour Law) of 1938, 28 USC §201 et seq., and other applicable labor laws.

The person executing this Certification further represents, warrants and affirms the truthfulness and accuracy of the contents of the statements submitted on or with this Certification and understands that the provisions of 31 USC §3801 et seq. are applicable thereto.

BIDDER NAME

BY: _____

Signature

TITLE: _____

RESTRICTION OF BOYCOTT OF ISRAEL CERTIFICATION

Pursuant to Arkansas Code Annotated § 25-1-503, a public entity **shall not** enter into a contract valued at \$1,000 or greater with a company unless the contract includes a written certification that the person or company is not currently engaged in, and agrees for the duration of the contract not to engage in, a boycott of Israel.

By signing below, the Contractor agrees and certifies that they do not boycott Israel and will not boycott Israel during the remaining aggregate term of the contract.

If a company does boycott Israel, see Arkansas Code Annotated § 25-1-503.

Bid Number/Contract Number	M-20-032H
Description of product or service	Standby Generator Materials Lab
Contractor name	

Contractor Signature: _____
Signature must be hand written, in ink

Date: _____

ILLEGAL IMMIGRANT CERTIFICATION

Pursuant to Arkansas Code Annotated § 19-11-105, Contractor(s) **shall** certify with OSP that they do not employ or contract with illegal immigrants.

By signing below, the Contractor agrees and certifies that they do not employ illegal immigrants and will not employ illegal immigrants during the remaining aggregate term of the contract.

Bid Number/Contract Number	M-20-032H
AASIS Number	N/A
Description	Standby Generator Materials Lab
Contractor name	

Contractor Signature: _____
Signature must be hand written, in ink

Date: _____

CONTRACT AND GRANT DISCLOSURE AND CERTIFICATION FORM

Failure to complete all of the following information may result in a delay in obtaining a contract, lease, purchase agreement, or grant award with any Arkansas State Agency.

SUBCONTRACTOR: _____

Yes No

IS THIS FOR:

Goods? Services? Both?

TAXPAYER ID NAME: _____

FIRST NAME: _____

M.I.: _____

ADDRESS: _____

STATE: _____

ZIP CODE: _____

COUNTY: _____

AS A CONDITION OF OBTAINING, EXTENDING, AMENDING, OR RENEWING A CONTRACT, LEASE, PURCHASE AGREEMENT, OR GRANT AWARD WITH ANY ARKANSAS STATE AGENCY, THE FOLLOWING INFORMATION MUST BE DISCLOSED:

FOR INDIVIDUALS*

Indicate below if: you, your spouse or the brother, sister, parent, or child of you or your spouse is a current or former: member of the General Assembly, Constitutional Officer, State Board or Commission Member, or State Employee:

Position Held	Mark (<input checked="" type="checkbox"/>)		Name of Position of Job Held <small>(senator, representative, name of board/ commission, data entry, etc.)</small>	For How Long?		What is the person(s) name and how are they related to you? <small>(i.e., Jane Q. Public, spouse, John Q. Public, Jr., child, etc.)</small>	Relation
	Current	Former		From MM/YY	To MM/YY		
General Assembly							
Constitutional Officer							
State Board or Commission Member							
State Employee							

None of the above applies

FOR AN ENTITY (BUSINESS)*

Indicate below if any of the following persons, current or former, hold any position of control or hold any ownership interest of 10% or greater in the entity: member of the General Assembly, Constitutional Officer, State Board or Commission Member, State Employee, or the spouse, brother, sister, parent, or child of a member of the General Assembly, Constitutional Officer, State Board or Commission Member, or State Employee. Position of control means the power to direct the purchasing policies or influence the management of the entity.

Position Held	Mark (<input checked="" type="checkbox"/>)		Name of Position of Job Held <small>(senator, representative, name of board/ commission, data entry, etc.)</small>	For How Long?		What is the person(s) name and what is his/her % of ownership interest and/or what is his/her position of control?	Ownership Interest (%)	Position of Control
	Current	Former		From MM/YY	To MM/YY			
General Assembly								
Constitutional Officer								
State Board or Commission Member								
State Employee								

None of the above applies

Contract and Grant Disclosure and Certification Form

Failure to make any disclosure required by Governor's Executive Order 98-04, or any violation of any rule, regulation, or policy adopted pursuant to that Order, shall be a material breach of the terms of this contract. Any contractor, whether an individual or entity, who fails to make the required disclosure or who violates any rule, regulation, or policy shall be subject to all legal remedies available to the agency.

As an additional condition of obtaining, extending, amending, or renewing a contract with a state agency I agree as follows:

1. Prior to entering into any agreement with any subcontractor, prior or subsequent to the contract date, I will require the subcontractor to complete a **CONTRACT AND GRANT DISCLOSURE AND CERTIFICATION FORM**. Subcontractor shall mean any person or entity with whom I enter an agreement whereby I assign or otherwise delegate to the person or entity, for consideration, all, or any part, of the performance required of me under the terms of my contract with the state agency.
2. I will include the following language as a part of any agreement with a subcontractor:

Failure to make any disclosure required by Governor's Executive Order 98-04, or any violation of any rule, regulation, or policy adopted pursuant to that Order, shall be a material breach of the terms of this subcontract. The party who fails to make the required disclosure or who violates any rule, regulation, or policy shall be subject to all legal remedies available to the contractor.
3. No later than ten (10) days after entering into any agreement with a subcontractor, whether prior or subsequent to the contract date, I will mail a copy of the **CONTRACT AND GRANT DISCLOSURE AND CERTIFICATION FORM** completed by the subcontractor and a statement containing the dollar amount of the subcontract to the state agency.

Signature _____	Title _____	Date _____
Vendor Contact Person _____	Title _____	Phone No. _____

Agency Use Only			
Agency Number _____	Agency Name _____	Agency Contact Person _____	Contact Phone No. _____
			Contract or Grant No. _____

**ARKANSAS DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION
JOB 42-72
BUILDER'S RISK INSURANCE**

The successful bidder for this project will be required to obtain Builder's Risk Insurance coverage in a minimum amount equal to the total amount bid for all building facilities included in the contract, and to provide coverage for all existing structures on the job site.

The Builder's Risk Insurance Policy shall name the Commission and the Contractor as named insureds, as their interests may appear, and shall include coverage for loss caused by fire, lightning, the extended coverage perils and vandalism and malicious mischief. The coverage shall remain in force until the building or buildings have been completed and accepted by the Commission.

The insurance policy, certifies and endorsements shall be submitted to the Engineer prior to the issuance of a Work Order.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

January 30, 2020

**JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
LITTLE ROCK ARKANSAS
PULASKI COUNTY**

ARKANSAS DEPARTMENT OF TRANSPORTATION
10324 Interstate 30 P.O. Box 2261
Little Rock, Arkansas 72203

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

DIVISION 01 - GENERAL REQUIREMENTS

01 10 00 SUMMARY
01 20 00 PRICE AND PAYMENT PROCEDURES
01 25 00 SUBSTITUTION PROCEDURES
01 26 00 CONTRACT MODIFICATION PROCEDURES
01 30 00 ADMINISTRATIVE REQUIREMENTS
01 60 00 PRODUCT REQUIREMENTS
01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS

DIVISION 03 - CONCRETE

03 30 00 CAST-IN-PLACE CONCRETE

DIVISION 26 - ELECTRICAL

26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
26 05 33 LOW VOLTAGE TRANSFORMERS
26 23 13 EMERGENCY/STANDBY POWER SYSTEMS GENERATOR SET PARALLELING
 EQUIPMENT
26 24 16 PANELBOARDS
26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS
26 32 00 PACKAGED GENERATOR ASSEMBLIES
26 36 00 TRANSFER SWITCHES

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 PROJECT INFORMATION

- A. Project Identification: Materials Lab Standby Generator Installation.
 - 1. Project Location: 11301 West Baseline Road Little Rock, AR 72209.
- B. Owner: Arkansas Department of Transportation.
 - 1. Owner's Representative: Cameron Parsons, Project Coordinator
9003 Mabelvale Pike,
Little Rock, Arkansas 72209
Ph: (501) 569-4951
- C. The Work consists of: Cutting and patching concrete and installing two diesel generators per plans and specifications.

1.2 WORK COVERED BY THE CONTRACT DOCUMENTS

- A. Installation of two standby generators located at Little Rock, AR for the Arkansas Department of Transportation, Materials Lab as indicated on the Plans, and as called for in these Specifications, or as directed by the Engineer.
- B. The work shall include all labor, materials, equipment, construction tools, machines, services, utilities, and fuel, required to construct the work and place the facilities constructed into operation to form a complete, operating system.
- C. Project shall be constructed under a single prime contract and shall include provision for a complete one (1) year warranty period for all aspects of the project with the exception of damage due to normal wear conditions. The warranty period shall commence upon acceptance of the work following a Semi-Final Inspection (as defined in Section 01 77 00). With partial acceptance of work, only the warranty applicable to that portion of the work shall be deemed to be in effect. This warranty will be in addition to specific product or installation warranties from suppliers or subcontractors.

1.3 WORK RESTRICTIONS

- A. Contractor's Use of Premises: During construction, Contractor will have limited use of building indicated. Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project and as follows:

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

1. Owner will occupy premises during construction. Perform construction only during normal working hours 6 AM to 6 PM Monday thru Friday, other than holidays, unless otherwise agreed to in advance by Owner. Clean up work areas and return to usable condition at the end of each work day.
 2. Service interruptions: Service interruptions shall require a 48 hour notice to owner. Service interruptions for final connections shall be done over the weekend.
 3. Driveways, Walkways, and Entrances: Keep driveways, parking, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 6 a.m. to 6 p.m., Monday through Friday, unless otherwise indicated.
1. Weekend Hours: Work shall be permitted on the weekend. Provide 48 hour notice to allow access.

END OF SECTION 01 10 00

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 PAYMENT PROCEDURES

- A. Submit a Schedule of Values before Preconstruction Meeting. Break down the Contract Sum into at least one-line item for each Specification Section in the Project Manual table of contents. Coordinate the schedule of values with Contractor's construction schedule.
 - 1. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 - 2. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - 3. Provide separate line items in the schedule of values for initial cost of materials and for total installed value of that part of the Work.
 - 4. Provide a separate line item in the schedule of values for each allowance.

- B. Application for Payment Forms: Use forms acceptable to Owner as form for Applications for Payment.

- C. Submit electronic copies of each application for payment according to the schedule established in Owner/Contractor Agreement.
 - 1. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - a. Include insurance certificates, proof that taxes, fees, and similar obligations were paid, and evidence that claims have been settled.
 - b. Include affidavit of payment of debts and claims.
 - c. Include affidavit of release of liens.
 - d. Include consent of surety to final payment.
 - e. Submit final meter readings for utilities, a record of stored fuel, and similar data as of the date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 20 00

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUBSTITUTION PROCEDURES

- A. Substitutions include changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use CSI Form 13.1A.
 - 2. Submit requests within 10 days after the Notice to Proceed.
 - 3. Identify product to be replaced and show compliance with requirements for substitutions. Include a detailed comparison of significant qualities of proposed substitution with those of the Work specified, a list of changes needed to other parts of the Work required to accommodate proposed substitution, and any proposed changes in the Contract Sum or the Contract Time should the substitution be accepted.
- C. Owner will review proposed substitutions and notify Contractor of their acceptance or rejection. If necessary, Owner will request additional information or documentation for evaluation.
 - 1. Owner will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- D. Do not submit unapproved substitutions on Shop Drawings or other submittals.

END OF SECTION 01 25 00

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 CONTRACT MODIFICATION PROCEDURES

- A. Owner will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.
- B. Owner-Initiated Proposal Requests: Owner will issue a detailed description of proposed changes in the Work.
 - 1. Proposal Requests are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 14 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time.
- C. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Owner.
- D. On Owner's approval of a Proposal Request, Owner will issue a Change Order for signatures of Owner and Contractor, for all changes to the Contract Sum or the Contract Time.
- E. Owner may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- F. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

END OF SECTION 01 26 00

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 PROJECT MANAGEMENT AND COORDINATION

- A. Subcontract List: Submit a written summary identifying individuals or firms proposed for each portion of the Work. Use CSI Form 1.5A.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. List e-mail addresses and telephone numbers.
- C. Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work.
- D. Requests for Information (RFIs): On discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI. Use forms acceptable to Owner.
- E. Schedule and conduct progress meetings at Project site at weekly intervals. Notify Owner of meeting dates and times. Require attendance of each subcontractor or other entity concerned with current progress or involved in planning, coordination, or performance of future activities.
 - 1. Record minutes and distribute to everyone concerned, including Owner and Owner.

1.2 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Owner for Contractor's use in preparing submittals.
 - 1. Owner will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Owner makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Owner.
- B. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

1. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
- C. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with unique identifier, including project identifier, Specification Section number, and revision identifier.
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Owner.
- D. Identify options requiring selection by Owner.
- E. Identify deviations from the Contract Documents on submittals.
- F. Contractor's Construction Schedule Submittal Procedure:
1. Submit required submittals in the following format:
 - a. Working electronic copy of schedule file, where indicated.
 - b. PDF electronic file.
 2. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - a. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
 3. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections.
1. Submit electronic submittals via email as PDF electronic files.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- a. Owner will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2.2 ACTION SUBMITTALS

- A. Submit 1 copy of each submittal unless otherwise indicated.
- B. Product Data: Mark each copy to show applicable products and options. Include the following:
 1. Manufacturer's written recommendations, product specifications, and installation instructions.
 2. Wiring diagrams showing factory-installed wiring.
 3. Printed performance curves and operational range diagrams.
 4. Testing by recognized testing agency.
 5. Compliance with specified standards and requirements.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Submit on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches. Include the following:
 1. Dimensions and identification of products.
 2. Fabrication and installation drawings and roughing-in and setting diagrams.
 3. Wiring diagrams showing field-installed wiring.
 4. Notation of coordination requirements.
 5. Notation of dimensions established by field measurement.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture and for a comparison of these characteristics between submittal and actual component as delivered and installed. Include name of manufacturer and product name on label.
 1. If variation is inherent in material or product, submit at least 1 set of paired units that show variations.

2.3 INFORMATIONAL SUBMITTALS

- A. Informational Submittals: Submit 1 copy of each submittal unless otherwise indicated. Owner will not return copies.
- B. Qualification Data: Include lists of completed projects with project names and addresses, names and addresses of Owners and owners, and other information specified.
- C. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

2.4 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Owner.

- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit 1 copy of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

2.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type schedule within 30 days of date established for the Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
- C. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
- D. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and indicate date by which recovery will be accomplished.

PART 3 - EXECUTION

3.1 SUBMITTAL REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Owner.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- B. Owner will review each action submittal, make marks to indicate corrections or modifications required, will stamp each submittal with an action stamp, and will mark stamp appropriately to indicate action.
- C. Informational Submittals: Owner will review each submittal and will not return it, or will return it if it does not comply with requirements. Owner will forward each submittal to appropriate party.
- D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribute copies of approved schedule to Owner, Owner, subcontractors, testing and inspecting agencies, and parties identified by Contractor with a need-to-know schedule responsibility. When revisions are made, distribute updated schedules to the same parties.

END OF SECTION 01 30 00

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
- B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced.
 - 1. Show compliance with requirements for comparable product requests.
 - 2. Architect will review the proposed product and notify Contractor of its acceptance or rejection.
- C. Basis-of-Design Product Specification Submittal: Show compliance with requirements.
- D. Compatibility of Options: If Contractor is given option of selecting between two or more products, select product compatible with products previously selected.
- E. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Deliver products to Project site in manufacturer's original sealed container or packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 3. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 4. Store materials in a manner that will not endanger Project structure.
 - 5. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
- F. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. Provide products that comply with the Contract Documents, are undamaged, and, unless otherwise indicated, are new at the time of installation.
1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.
 2. Where products are accompanied by the term "as selected," Architect will make selection.
 3. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Where the following headings are used to list products or manufacturers, the Contractor's options for product selection are as follows:
1. Products:
 - a. Where requirements include "one of the following," provide one of the products listed that complies with requirements.
 - b. Where requirements do not include "one of the following," provide one of the products listed that complies with requirements or a comparable product.
 2. Manufacturers:
 - a. Where requirements include "one of the following," provide a product that complies with requirements by one of the listed manufacturers.
 - b. Where requirements do not include "one of the following," provide a product that complies with requirements by one of the listed manufacturers or another manufacturer.
 3. Basis-of-Design Product: Provide the product named, or indicated on the Drawings, or a comparable product by one of the listed manufacturers.
- C. Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
- D. Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

2.2 COMPARABLE PRODUCTS

- A. Architect will consider Contractor's request for comparable product when the following conditions are satisfied:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications.
 3. List of similar installations for completed projects, if requested.
 4. Samples, if requested.

END OF SECTION 01 60 00

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 EXECUTION REQUIREMENTS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- B. Cutting and Patching:
 - 1. Structural Elements: When cutting and patching structural elements, notify Owner of locations and details of cutting and await directions from Owner before proceeding. Shore, brace, and support structural elements during cutting and patching.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Owner's opinion, reduce the building's aesthetic qualities.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.2 CLOSEOUT SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.
- C. Operation and Maintenance Data: Submit 3 copies of manual.
- D. PDF Electronic File: Assemble manual into a composite electronically indexed file. Submit on digital media.
- E. Record Drawings: Submit 3 set(s) of marked-up record prints.
- F. Record Digital Data Files: Submit data file and one set(s) of plots.
- G. Record Product Data: Submit PDF electronic files and directories of each submittal.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

1.3 SUBSTANTIAL COMPLETION PROCEDURES

- A. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
- B. Submittals Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:
1. Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other sections, including project record documents, operation and maintenance manuals, property surveys, similar final record information, warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 3. Submit maintenance material submittals specified in other sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner.
 4. Submit test/adjust/balance records.
 5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Advise Owner of changeover in heat and other utilities.
 6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 7. Remove temporary facilities and controls.
 8. Complete final cleaning requirements, including touchup painting.
 9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Owner will proceed with inspection or advise Contractor of unfulfilled requirements. Owner will prepare the Certificate of Substantial Completion after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

1.4 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting inspection for determining final completion, complete the following:
1. Submit a final Application for Payment.
 2. Submit certified copy of Owner's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Owner. Certified copy of the list shall state that each item has been completed or otherwise resolved.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
- B. Submit a written request for final inspection for acceptance. On receipt of request, Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Owner will prepare final Certificate for Payment after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
- B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

2.2 OPERATION AND MAINTENANCE DOCUMENTATION

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- B. Organization: Unless otherwise indicated, organize manual into separate sections for each system and subsystem, and separate sections for each piece of equipment not part of a system.
- C. Organize data into three-ring binders with identification on front and spine of each binder, and envelopes for folded drawings. Include the following:
 - 1. Manufacturer's operation and maintenance documentation.
 - 2. Maintenance and service schedules.
 - 3. Maintenance service contracts. Include name and telephone number of service agent.
 - 4. Emergency instructions.
 - 5. Spare parts list and local sources of maintenance materials.
 - 6. Wiring diagrams.
 - 7. Copies of warranties. Include procedures to follow and required notifications for warranty claims

2.3 RECORD DRAWINGS

- A. Record Prints: Maintain a set of prints of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued. Mark to show actual installation where installation varies from that shown originally. Accurately record information in an acceptable drawing technique.
 - 1. Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Owner. When authorized, prepare a full set of corrected digital data files of the Contract Drawings.
 - 1. Format: Annotated PDF electronic file.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
- B. Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

1. Verify compatibility with and suitability of substrates.
 2. Examine roughing-in for mechanical and electrical systems.
 3. Examine walls, floors, and roofs for suitable conditions.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Take field measurements as required to fit the Work properly. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.
- E. Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- F. Surface and Substrate Preparation: Comply with manufacturer's written recommendations for preparation of substrates to receive subsequent work.

3.2 CONSTRUCTION LAYOUT AND FIELD ENGINEERING

- A. Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks.

3.3 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 3. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations.
- C. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- D. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed.
- E. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Owner.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- F. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- G. Use products, cleaners, and installation materials that are not considered hazardous.

3.4 CUTTING AND PATCHING

- A. Provide temporary support of work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- D. Cutting: Cut in-place construction using methods least likely to damage elements retained or adjoining construction.
 - 1. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
- E. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
 - 1. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - 2. Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance.
 - 3. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

3.5 CLEANING

- A. Clean Project site and work areas daily, including common areas. Dispose of materials lawfully.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - 3. Remove debris from concealed spaces before enclosing the space.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion:
1. Clean Project site, yard, and grounds, in areas disturbed by construction activities. Sweep paved areas; remove stains, spills, and foreign deposits. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 2. Sweep paved areas broom clean. Remove spills, stains, and other foreign deposits.
 3. Remove labels that are not permanent.
 4. Clean transparent materials, including mirrors. Remove excess glazing compounds.
 5. Clean exposed finishes to a dust-free condition, free of stains, films, and foreign substances. Sweep concrete floors broom clean.
 6. Vacuum carpeted surfaces and wax resilient flooring.
 7. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and foreign substances. Clean plumbing fixtures. Clean light fixtures, lamps, globes, and reflectors.
 8. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

3.6 OPERATION AND MAINTENANCE MANUAL PREPARATION

- A. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- B. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are unavailable and where the information is necessary for proper operation and maintenance of equipment or systems.
- C. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

3.7 DEMONSTRATION AND TRAINING

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Include a detailed review of the following:
 - 1. Include instruction for basis of system design and operational requirements, review of documentation, emergency procedures, operations, adjustments, troubleshooting, maintenance, and repairs.

END OF SECTION 01 70 00

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, concrete mix designs, and submittals required by ACI 301.
- B. Ready-Mixed Concrete Producer Qualifications: ASTM C 94/C 94M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ACI 301, "Specification for Structural Concrete," and with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

2.2 MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain Steel Wire: ASTM A 82/A 82M, as drawn.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, as drawn, flat sheet.
- D. Portland Cement: ASTM C 150, Type I or II.
- E. Fly Ash: ASTM C 618, Class C or F.
- F. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- G. Silica Fume: ASTM C 1240, amorphous silica.
- H. Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded, with at least 10 years' satisfactory service in similar applications.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
- I. Air-Entraining Admixture: ASTM C 260.
- J. Chemical Admixtures: ASTM C 494, Admixtures will only be allowed to achieve proper slump. Do not use calcium chloride or admixtures containing calcium chloride.
- K. Synthetic Fiber: ASTM C 1116/C 1116M, Type III, polypropylene fibers, 1/2 to 1-1/2 inches long.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- L. Vapor Retarder: Reinforced sheet, ASTM E 1745, Class A.
- M. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- N. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. SpecChem, LLC.
- O. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.3 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301.
- B. Normal-Weight Concrete:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.40.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.
 - 4. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of floor slabs to receive troweled finishes to exceed 3 percent.
 - 5. For concrete exposed to deicing chemicals, limit use of fly ash to 25 percent replacement of portland cement by weight and granulated blast-furnace slag to 40 percent of portland cement by weight; silica fume to 10 percent of portland cement by weight.
- C. Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116.
 - 1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

PART 3 - EXECUTION

3.1 CONCRETING

- A. Construct formwork according to ACI 301 and maintain tolerances and surface irregularities within ACI 347R limits of Class A, 1/8 inch for concrete exposed to view and Class B, 1/4 inch for other concrete surfaces.
- B. Place vapor retarder on prepared subgrade, with joints lapped 6 inches and sealed.
- C. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- D. Install construction, isolation, and contraction joints where indicated. Install full-depth joint-filler strips at isolation joints.
- E. Place concrete in a continuous operation and consolidate using mechanical vibrating equipment.
- F. Protect concrete from physical damage, premature drying, and reduced strength due to hot or cold weather during mixing, placing, and curing.
- G. Formed Surface Finish: Smooth-formed finish for concrete exposed to view, coated, or covered by waterproofing or other direct-applied material; rough-formed finish elsewhere.
- H. Slab Finishes: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces. Provide the following finishes:
 - 1. Scratch finish for surfaces to receive mortar setting beds.
 - 2. Float finish for surfaces to receive waterproofing, roofing, or other direct-applied material.
 - 3. Troweled finish for floor surfaces and floors to receive floor coverings, paint, or other thin film-finish coatings.
 - 4. Trowel and fine-broom finish for surfaces to receive thin-set tile.
 - 5. Nonslip-broom finish to exterior concrete platforms, steps, and ramps.
- I. Cure formed surfaces by moisture curing for at least seven days.
- J. Begin curing concrete slabs after finishing. Apply membrane-forming curing and sealing compound to concrete.
- K. Owner will engage a testing agency to perform field tests and to submit test reports.
- L. Protect concrete from damage. Repair and patch defective areas.

END OF SECTION 03 30 00

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.

2.2 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- C. Conductor Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Feeders and Branch Circuits: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Service Entrance: Type THHN/THWN, single conductors in raceway.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- C. Feeders and Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN, single conductors in raceway.
- D. Class 2 Control Circuits: Type THHN/THWN, in raceway.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- B. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."
- C. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.
- D. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- E. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."
- F. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- G. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway. Use manufacturer-approved pulling compound or lubricant where necessary.
- H. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- I. Make splices, terminations, and taps that are compatible with conductor material. Install conductor at each outlet, with at least 6 inches of slack.
- J. Identify conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

3.3 FIELD QUALITY CONTROL

- A. Contractor will engage a qualified testing agency to perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding all critical equipment and services for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Cables will be considered defective if they do not pass tests and inspections.

- B. Test and Inspection Reports: Prepare a written report showing procedures used, results complying with requirements, and corrective action taken to achieve compliance.

END OF SECTION 26 05 19

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data for each type of product indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 GROUNDING MATERIALS

- A. Conductors: Solid for No. 8 AWG and smaller; stranded for No. 6 AWG and larger unless otherwise indicated.
 - 1. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable code or authorities having jurisdiction.
 - 2. Bare, Solid-Copper Conductors: Comply with ASTM B 3.
 - 3. Bare, Stranded-Copper Conductors: Comply with ASTM B 8.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Pipe and Equipment Grounding-Conductor Terminations: Bolted.
- B. Underground Connections: Welded.
- C. Connections to Structural Steel: Bolted.
- D. Install grounding conductors routed along shortest and straightest paths possible unless otherwise indicated or required by code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- E. Install ground rods driven into ground until tops are 2 inches below final grade or 4 inches above finished floor slab unless otherwise indicated.
- F. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape.
- G. Make connections without exposing steel or damaging coating if any.
- H. Install bonding straps and jumpers in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
- I. Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
- J. Bond to equipment mounted on vibration isolation hangers and supports so vibration is not transmitted to rigidly mounted equipment.
- K. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding-conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- L. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

1. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
2. Perform tests by fall-of-potential method according to IEEE 81.
3. Report measured ground resistances that exceed 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Shop Drawings for custom enclosures and cabinets.
- B. Seismic qualification certificates for enclosures, cabinets, conduit racks, and mounting provisions.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Galvanized Rigid Conduit (GRC): Comply with ANSI C80.1 and UL 6.
- C. Intermediate Metal Conduit (IMC): Comply with ANSI C80.6 and UL 1242.
- D. Electrical Metallic Tubing (EMT): Comply with ANSI C80.3 and UL 797.
- E. Flexible Metal Conduit (FMC): Comply with UL 1; zinc-coated steel.
- F. Liquidtight Flexible Metal Conduit (LFMC): Flexible steel conduit with PVC jacket, complying with UL 360.
- G. Raceway Fittings: Specifically designed for raceway type used in Project.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Electrical Nonmetallic Tubing (ENT): Comply with NEMA TC 13 and UL 1653.
- C. Rigid Nonmetallic Conduit (RNC): Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Raceway Fittings: Specifically designed for raceway type used in Project.
 - 1. agency, and marked for intended location and application.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

PART 3 - EXECUTION

3.1 INSTALLATION

A. Outdoor Raceways Applications:

1. Exposed or Concealed: GRC.
2. Underground, Single Run: RNC.
3. Connection to Vibrating Equipment: LFMC.
4. Boxes and Enclosures: Metallic, NEMA 250, Type 3R or Type 4.

B. Indoor Raceways Applications:

1. Exposed or Concealed: EMT.
2. Underslab: RNC.
3. Connection to Vibrating Equipment: FMC; in wet or damp locations, use LFMC.
4. Damp or Wet Locations: IMC.
5. Boxes and Enclosures: Metallic, NEMA 250, Type 1, unless otherwise indicated.

C. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.

D. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

E. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch-thick concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Install conduit larger than 1-inch trade size, parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.

F. Install pull wires in empty raceways.

G. Install raceways and cables concealed within finished walls, ceilings, and floors unless otherwise indicated.

H. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

I. Installation of Hangers and Supports:

1. Comply with NECA 1 and NECA 101 for installation requirements, except as specified in this article.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

2. Separate dissimilar metals and metal products from contact with wood or cementitious materials by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.
3. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, as permitted in NFPA 70.
4. Multiple Raceways or Cables: Install on trapeze-type supports fabricated with steel slotted channel.
5. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
6. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods, unless otherwise indicated or required by Code:
 - a. To Wood: Fasten with lag screws or through bolts.
 - b. To New Concrete: Bolt to concrete inserts.
 - c. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - d. To Existing Concrete: Expansion anchor fasteners.
 - e. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - f. To Light Steel: Sheet metal screws.
 - g. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.
7. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.3 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

END OF SECTION 26 05 33

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data.
2. Seismic Qualification Certificates: For transformers, accessories, and components, from manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Transformers constructed to withstand seismic forces specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- B. Comply with NFPA 70 and UL 1561.
- C. Transformers Rated 15 kVA and Larger: Comply with NEMA TP 1 energy-efficiency levels as verified by testing according to NEMA TP 2.

2.2 DISTRIBUTION TRANSFORMERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Acme Electric Corporation.
 2. Hammond Power Solutions Inc.
 3. Schneider Electric USA (Square D).
- B. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service. Electrical components, devices, and accessories to be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Enclosure: Ventilated, NEMA 250, Type 3R.
- D. Coils: Continuous windings without splices except for taps.
 1. Internal Coil Connections: Brazed or pressure type.
 2. Coil Material: Aluminum or Copper.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

3. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Taps:
1. Transformers 3 kVA and Smaller: None.
 2. Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
 3. Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- F. Transformers that are K-factor rated will comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
1. Unit shall meet requirements of NEMA TP 1 when tested according to NEMA TP 2 with a K-factor equal to one.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten transformers securely in place, with provisions for thermal and structural movement. Install with concealed fasteners unless otherwise indicated.
- B. Separate dissimilar metals and metal products from contact with wood or cementitious materials by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.
- C. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 1. Brace wall-mounted transformers as specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- D. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions.

END OF SECTION 26 22 00

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

**SECTION 26 23 13 - EMERGENCY/STANDBY POWER SYSTEMS GENERATOR SET
PARALLELING EQUIPMENT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Project drawings and contract documents requirements apply to this section.

1.2 SUMMARY

- A. This section describes requirements for controls and switchgear for paralleling generator sets and distributing alternate source power. Equipment provided shall be new factory assembled paralleling equipment with dedicated purpose microprocessor-based controls designed for fast, reliable operation and including the functions described herein. Generator and Switchgear package shall be by the same Manufacturer.
- B. Related sections of the project specifications include:
 - 1. Division 16, Emergency/Standby Power System, Generator Sets.

1.3 DEFINITIONS

- A. ATS: Automatic Transfer Switch
- B. GFP: Ground Fault Protection.
- C. HMI: Human-Machine Interface
- D. PLC: Programmable Logic Controller. A device with associated accessory components that is designed to accept programmable inputs and provide completely field-programmable logically controlled outputs.
- E. Manufacturer: The entity that maintains engineering design control for the equipment provided, provides service and maintenance documentation, provides service direction, and provides warranty support.
- F. Supplier: The entity that provides manufacturer-authorized local sales and service support for the manufacturer's equipment.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

1.4 SUBMITTALS

- A. Product Data: Provide the noted technical data for the controls, switchgear, and transfer equipment described in this section. Materials required include:
 - 1. Technical data fully describing the critical design features of the equipment proposed, and substantiating compliance to the requirements of this specification. This material shall include 3rd party certifications and listing details for all equipment provided, including seismic certifications described herein.
 - 2. Data shall include a complete description of the features and function of the proposed equipment, described on the manufacturer's published literature or manufacturer's letterhead with a manufacturer's employee signature validating its accuracy.
 - 3. Include a listing of all setting ranges and factory default settings.
- B. Include a detailed sequence of operation for the specific equipment provided.
- C. Shop Drawings: For each control enclosure, switchgear section, or independent piece of equipment provide:
 - 1. Elevation and other Drawings: Describing physical dimensions, weights, mounting provisions and requirements, mechanical and wiring access points.
 - 2. Wiring Diagrams: Interconnecting wiring details including recommended control conduit configurations.
 - 3. Submit names, qualifications, and locations of individuals who will service and support the equipment.
- D. Source Quality Control Test Reports: Provide sample factory test report plan for integrated generator controls and paralleling system.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications
- B. The paralleling equipment manufacturer shall be certified to ISO 9001 International Quality Standard
- C. Source Limitations: The paralleling switchgear shall be designed, manufactured, and warranted by the generator set manufacturer to provide a single source of responsibility for all the products provided. Warranty documents shall be provided verifying compliance to this requirement. Supplier shall directly employ service technicians specifically trained and qualified on the diagnosis and repair of engines, alternators, power transfer equipment, and paralleling equipment. The technicians shall be trained in the installation and commissioning of complex generator systems, including line voltage generator paralleling equipment. Switchgear manufacturer shall have more than (15) years experience to ensure quality. Documentation for similar projects shall be provided upon request.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- D. The paralleling system, including generator sets and paralleling equipment, shall be serviced by a single local service organization that is trained and factory certified in both generator set and paralleling equipment service. The technicians serving the site shall be specifically trained and certified by the manufacturer in the diagnosis and repair of the synchronizing, paralleling, and load sharing equipment provided. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
- E. The manufacturer shall maintain model and serial number records for the paralleling equipment for at least 20 years.
- F. Equipment provided shall conform to the requirements of the following codes and standards to the extent that they are applicable:
 - 1. UL891 – Switchboards and Controls. Control equipment provided in switchboard enclosures shall be listed and labeled under this standard.
 - 2. UL 489 – Molded Case Circuit Breakers
 - 3. EN55011, Class B Radiated Emissions
 - 4. EN55011, Class B Conducted Emissions
 - 5. EN60947-6-1 Standard for Low-voltage switchgear IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity. Similar waveforms are described in ANSI/IEEE 62.41-1991
 - 6. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
 - 7. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
 - 8. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
 - 9. IEC 1000-4-6 Conducted Field Immunity
 - 10. IEC 1000-4-11 Voltage Dip Immunity
 - 11. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
 - 12. NFPA110 – Emergency and Standby Power Systems. All equipment provided shall meet all requirements for Level 1 systems.
 - 13. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paralleling system equipment in section sizes that can be moved past all obstructions in the physical site.
- B. All paralleling equipment shall be stored indoors in a temperature controlled environment, in accordance with manufacturers temporary storage instructions. At a minimum, equipment shall be protected from moisture, dirt, and physical damage.
- C. With written approval of the equipment manufacturer, equipment may be stored outdoors, as long as it is protected according to the manufacturer's instructions, including protection from condensation, rain, dust/dirt, and physical damage.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

1.7 EXTRA MATERIALS

- A. Provide additional items to support the paralleling system equipment, completely programmed and tested, packaged and labeled consistently with designations in system drawings.
 - 1. One set of fuses of each type used in the system
 - 2. Submit one racking handle(s) with equipment. A charging handle shall be furnished on each breaker mechanism.
 - 3. For all switchgear with circuit breakers in upper compartments, provide [one] circuit breaker lifting device - portable, floor-supported with a roller base.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on microprocessor-based paralleling equipment manufactured by Cummins Power Generation.

2.2 GENERATOR PARALLELING MONITOR AND CONTROL SYSTEM

- A. Acceptable Manufacturers
 - 1. Cummins Power Generation (No alternates)
 - a. Equipment specifications for this project are based on microprocessor-based paralleling equipment manufactured by Cummins Power Generation.
- B. Individual Generator Monitoring and Control Panel: Provide a paralleling control panel for each generator set in the emergency/standby power system. The paralleling control functions shall be integrated with the generator set control functions, and provided in a single, dedicated purpose microprocessor-based control designed and manufactured by the generator set manufacturer. Each paralleling control panel shall contain the functions as described in this section. No PLC-based control shall be used to provide these functions. Each paralleling control shall be independent and autonomous, requiring no interaction with other controls for proper operation, except load sharing and paralleling breaker status functions.
 - 1. Operator Panel. Each paralleling control shall be provided with an operator panel to allow the operator to view the status and control operation of the specific generator set being paralleled. The operator panel shall be provided with the following features and capabilities.
 - a. 1% or better accuracy generator set AC output instruments; Ammeter, Voltmeter, Frequency Meter, Wattmeter, KW-hour meter, Power Factor Meter, or other means shall be provided to allow viewing of voltage and amperes for each phase shall be provided. For 3-phase/4-wire systems the voltmeter shall indicate line to

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- line and line to neutral conditions. Voltmeter, ammeter, frequency meter, kW meter and power factor meter shall have both analog and digital displays. Switches and/or other provisions shall be included to allow reading of bus voltage and frequency from this metering set.
- b. Synchronizer shall be an integral part of the multi-function digital generator set control. Independent synchronization swing panels are prohibited.
 - c. Running Time Meter, Start Counter
 - d. Generator Set Operator Panel: Panel shall provide manual and automatic functions for control of the generator set. Press the manual mode button to put the unit in manual mode if the operator does not press the Start button in 10 seconds, the control is put in the Off mode. Both manual and off modes prevent generator set from starting remotely or immediately shuts down the generator set if it is running. Press the auto mode button to put the unit in auto mode. The auto mode allows remote start, stop, breaker open, and breaker closed commands to be active. Generator controller must withstand voltage drops down to 8V DC upon engine starting.
 - e. Breaker trip/close switch with breaker status indicating lamps. The switch shall be interlocked with the control system such that breaker closure is not possible unless the mode select switch is in the run position and the generator set is synchronized with the system bus.
 - f. Control Reset push button switch with indicating lamp. Lamp shall flash to indicate that generator set is locked out due to a fault condition.
 - g. Lamp test push button switch. Operation of this switch shall cause all lamps on the panel to be simultaneously tested.
 - h. The control panel shall be provided with a set of DC-powered lamps with a switch to allow viewing of all functions on the front panel when normal lighting systems are not available.
 - i. Precision voltage and frequency raise lower function. The generator set frequency and voltage may be adjusted plus or minus 5% when the generator set is operating independently of the system bus. Voltage and frequency adjustments are integral to the generator set control, along with bus metering, breaker control switches, and manual paralleling controls for ease of use by the operator. The ability to make frequency and voltage adjustments shall be disabled when the paralleling breaker is closed. Voltage and frequency adjustments while the paralleling breaker is open shall not impact on the load sharing when the paralleling breaker is closed.
 - j. Alarm and status indicating panel to indicate the following conditions (alarm horn shall be located on master control)
2. Internal Controls. The following internal control functions shall be provided for each generator set in the system.
- a. Electronic isochronous kW load sharing control to operate the engine governors during synchronizing and to provide isochronous load sharing when paralleled. The control system shall allow sharing of real kW load between all generator sets in the system to within 1% of equal levels, without introduction of frequency droop into the system. The control system shall include all equipment required for kW load sharing with an infinite bus. The infinite bus governing controls shall allow the generator set to synchronize to an infinite bus, parallel, and ramp up to a preset

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

load level on the generator set. Additional controls shall be provided to cause the generator set to ramp up to a kW load level signaled by the system master control. The isochronous load sharing module and engine governor shall be a coordinated system of a single manufacturer.

- b. Load demand governing controls shall be provided to cause the generator set to ramp down to zero load when signaled to shut down in a load demand mode. On a signal to re-start, the load demand governing controls shall cause the generator set to synchronize to the system bus, close, and ramp up to its proportional share of the total bus load. The ramp rate of the generator set shall be operator-adjustable.
- c. Electronic kVAR load sharing control to operate the alternator excitation system while the generator set is paralleled. The control system shall allow sharing of reactive load between all generator sets in the system to within 1% of equal levels, without introduction of voltage droop into the system. The control system shall include all equipment required for VAR load sharing with an infinite bus in either a constant VAR or constant power factor mode for future application flexibility. (Mode and adjustments selectable by the operator)
- d. Equipment shall be provided to monitor the generator set as it is starting, and verify that it has reached at least 90% of nominal voltage and frequency before closing to the bus. The equipment provided shall positively prevent out of phase paralleling if two or more engine generator sets reach operating conditions simultaneously by providing a lockout signal to disable breaker closure for generator set(s) in the system which have not been selected to be the first units to close to the bus. Controls to recognize the failure of the first breaker signaled to close, and allow system operation to proceed in spite of this failure shall also be provided (breaker failure alarm). Systems using dead bus relay schemes without a disable signal to positively prevent out of phase paralleling shall not be acceptable under this specification. System shall include an independent backup to automatically operate in the event that the primary system fails.
- e. Synchronizer to electronically adjust the engine governor to match the voltage, frequency and phase angle of the bus. Synchronizer shall maintain the engine generator voltage within 1% of bus voltage and phase angle within 15 electrical degrees of the bus for 0.5 seconds before circuit breaker closing. Each unit shall have its own synchronizer; systems using a switching scheme to utilize a single system synchronizer will not be approved. Synchronizers and systems which utilize a motor driven pot for control of AC voltage during the synchronizing process will not be accepted. The system shall be provided with a fail to synchronize time delay that is adjustable from 10-120 seconds. Control logic for fail to synchronize function shall allow field adjustment of function for either alarm or shutdown of the generator set on failure condition.
- f. Controls shall include a permissive relay function to assure that the generator set does not attempt to close out of phase with the bus, due to errant operation of the synchronizer.
- g. Controls shall include a permissive (sync check) function, to be used with "generator synchronized" indicator during manual paralleling, to prevent accidental closure of the breaker with the generator set out of phase with the bus. Provisions to allow manual closure of the first generator set to a de-energized bus shall be included.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- h. Controls shall be provided to verify generator set and bus phase rotation match prior to closing the paralleling breaker.
- i. Electronic alternator overcurrent alarm and shutdown protection. This protection is required in addition to the overcurrent trip on the paralleling breaker, and shall sense current flow at the generator set output terminals. The overcurrent alarm shall be indicated when the load current on the generator set is more than 110% of rated current for more than 60 seconds. The overcurrent shutdown shall be matched to the thermal damage curve of the generator set, and shall not have an instantaneous function.
- j. Electronic alternator short circuit protection. This protection is in addition to the overcurrent trip on the paralleling breaker. The short circuit shall occur when the load current on the generator set is more than 175% of rated current and an aggregate time/current calculation indicates that the system is approaching the thermal damage point of the alternator. The equipment used shall not have an instantaneous function and shall be selectively coordinated with the feeder circuit breakers. This protective function shall be provided by equipment that is UL-listed as a utility grade protective relay.
- k. Provide overcurrent and short circuit protection for the conductors connecting the generator set to the paralleling switchgear. This protection may be integrated with alternator protection but must be positively coordinated to prevent tripping of the paralleling breaker prior to the operation of the alternator protective equipment.
- l. Controls shall be provided to sense reverse VAR conditions on the alternator while paralleled to the system bus. Reverse VAR protection shall be set to operate at not less than 20% of the kVAR rating of the alternator at standby conditions. A reactive capability curve shall be provided to allow proper setting of this protection.
- m. Generator set start contacts rated 10 amps at 32 VDC. A redundant network-based starting system shall also be provided.
- n. Cooldown time delay, adjustable: 0-600 seconds. The control panel shall indicate the time remaining in the time delay period when the generator set is timing for shutdown.
- o. Start time delay, adjustable: 0-300 seconds. The control panel shall indicate the time remaining in the time delay period when the generator set is timing for start.
- p. Controls shall be provided to shut down generator set and initiate alarm when the generator set is at less than 85% of nominal voltage for more than 10 seconds, more than 110% of nominal voltage for more than 10 seconds. When the control is set to operate as Inverse time, the unit will be more sensitive to voltage spikes and trip more rapidly.
- q. Provide all other components required, such as properly sized current transformers, transducers, terminal blocks, etc., for reliable system operation, as described herein under "SYSTEM OPERATION".

C. System Control Power

- 1. The generator set governing, voltage regulation, load sharing, synchronizing, and protection, shall be capable of proper operation with battery voltage levels down to 8vdc without external battery support. The master control shall be supplied with a station battery system rated to 10 amp minimum. The control power for the system master controls shall be derived from at least two different sets of generator set battery banks.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

2. Paralleling breaker control power for each paralleling breaker shall be derived from the generator set for opening, and closing the breakers.

D. SEQUENCE OF OPERATION

1. Normal Standby Conditions Genset Breakers are open and the Gensets are not running. System loads are supplied by the normal source and may be controlled manually or by a building management system.
2. Loss of Normal Power The Gensets receive a start signal from an ATS. The Gensets start automatically and independently and accelerate to rated voltage and frequency. The first Genset closes to the bus as dictated by the First Start System. The remaining Gensets synchronize to the Load Bus and close their respective Genset breakers. The Gensets proportionally share load on the Load Bus. The Load Demand feature will operate if it is enabled.
3. Return of Normal Power The ATS removes the start signal from the Gensets. The Genset Breakers open. The Gensets run in cool down mode and then shutdown. The system returns to a Standby mode of operation.
4. Failure Modes
 - a. Fail to Start If a unit fails to start after the overcrank time delay (time set in the genset control) expires, the unit shuts down and an alarm sounds on the Genset. The operator needs to check and rectify the problem on the Genset at this stage.
 - b. Fail to Synchronize If a unit fails to synchronize after a preset time delay, an alarm sounds and the unit continues attempting to synchronize until signaled to stop by an operator either on the PCC.
5. Run Hours Based Sequence Method In this mode, the control automatically select the shut down sequence for the generator sets based on the engine run hours of the Genset, and restarts generators sets in the opposite order. Again, the generator set as the lead or preferred unit never shuts down. The control balances the run hour of the generator sets by creating a sequence based on the current run hours of the generator sets. The generator set with the fewest run hours is set as the lead generator set. The control never shuts down the lead generator set. The generator set with most run hours is the first generator set that will be shut down. The control changes the generator shut down sequence to balance the run hours, based on a threshold set by the operator at the HMI Touch Screen. When the difference in run hours between two generator sets is greater than the threshold, the control switches the two generator sets in the sequence. Upon detection of the lead or preferred Genset failure, the alternative Genset will immediately start and transfer to the bus, releasing the other Genset for maintenance There are two time delays associated with the Load Demand feature. • The Initial time delay is the time delay for the system loads to stabilize before monitoring the load to see if Gensets can be shut down. • The Shutdown time delay is the time delay before issuing a Load Demand Stop to a generator while load conditions are such that the next Genset in the Load Demand sequence should be shutdown. The system returns to the normal load demand sequence described above.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

2.3 MANUFACTURED UNITS

A. The paralleling/distribution power equipment shall be configured as shown on the contract drawings, and rated for operation at voltage and current levels as shown on the contract drawings. It shall contain devices and equipment as shown on the drawings, in addition to meeting the requirements of this section.

B. Construction (Low Voltage Paralleling and Power Distribution Equipment):

1. Ratings

- a. The low voltage switchgear shall consist of an Outdoor non-walk-in enclosure containing circuit breakers and the necessary accessory components all factory assembled (except for necessary shipping splits) and operationally checked.
- b. The assembly shall be a self-supporting and floor mounted on a level concrete pad.
- c. The integrated switchgear assembly shall withstand the effects of closing, carrying and interrupting currents up to the assigned maximum short circuit rating.
- d. Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 volts maximum AC service. System voltage will be 277/480 Series Wye volt 3 phase 4 wire with ground.
- e. The ampacity of the Low Voltage Switchgear shall be determined by the loading of the feeder circuits. The main bus rating shall be 3000A.
- f. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 65kAIC.
- g. All circuit interruption shall be accomplished by the circuit breaker and without the aid of limiter fuses. The circuit breaker short-time ratings shall as specified on the drawings. **
- h. The assembly is designed for use on 60Hz electrical systems up to 600 Vac. The assembly shall be properly braced to the ratings of the circuit breaker installed within the assembly.
- i. Any items not specifically mentioned but which are obviously necessary for proper operation are implied in this specification.

C. Construction

1. General

- a. Each steel section shall contain one or more individual circuit breakers, or instrumentation compartments, and a rear compartment for the buses and outgoing cable connections.
- b. Rigid removable steel base channel shall be provided at the front and rear of each section.
- c. The finish shall be medium gray ANSI #61.

2. Dimensions

- a. Section widths should be 22, 30, or 36" wide dependent on the size of the circuit breakers being installed.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- b. The lineup shall provide adequate wire bending space for mains and feeders breakers using up to 750 kcmil wires.
 - c. Section depth shall be 54" minimum when using 800A feeders. Additional depth to the lineup shall be for the sole purpose of additional wire bending and conduit space.
 - d. Adequate conduit space shall be provided to allow all conductors to exit the structure at the same end.
3. Moving and Handling
- a. The Lineup shall be divided into shipping splits not to exceed 88" wide and shall be capable of being lifted overhead or by a forklift.
 - b. Each shipping split shall be provided with removable lifting straps.
 - c. Removable Base Channels shall be provided with prying slots for ease of final positioning at the job-site.
 - d. For circuit breakers, an overhead or floor mounted lifter shall be provided to ease the installation or removal of circuit breakers in excess of 75 pounds.
- D. Breaker Compartment
1. Circuit Breakers
- a. Each circuit breaker shall be mounted in its own barriered compartment.
 - b. Feeder circuit breakers rated 2000A or less shall be capable of being mounted in the uppermost compartment without de-rating.
 - c. The front of the circuit breaker shall protrude through the door of the switchboard allowing access to the operational buttons, the toggle mechanism, the trip unit and the display.
 - d. All mains and feeders shall be two-step stored energy circuit breakers and shall allow for closed door racking.
 - e. All circuit breakers shall be drawout-style construction.
 - f. Circuit breakers of like frame sizes shall be interchangeable as standard.
 - g. All prepared spaces shall be fully equipped for future devices, including the racking mechanism, bussing, and secondary contacts.
2. Secondary Connections
- a. All customer secondary control and communications connections shall be made from the front of the switchgear lineup.
 - b. A dedicated wiring area accessible from the front shall allow easy access to all control or communications terminations.
 - c. Control Connections shall be cage clamp terminals. All control wire shall be 14 gage SIS.
 - d. Dedicated conduit entry for control wires shall be provided at the top and bottom of each section, capable of landing up to 3 each 1 1/2" conduits and accessible from the front.
 - e. All interconnections between sections at shipping splits shall use locking-pull apart terminal blocks.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

3. Instrumentation

- a. Where additional space is required for instrumentation, CPT's, metering, etc., a barriered instrumentation compartment shall be used.
- b. The instrumentation compartment shall not inhibit the routing of control or communication wires.
- c. Individual component mounting surfaces and pans in the instrument compartments shall be painted white as standard.

E. Busing and Cable Compartment

1. Busing

- a. All vertical and horizontal distribution bussing shall be rated for the full ampacity of the lineup.
- b. All bus joints shall consist of Grade 5 hardware and conical spring (e.g. Belleville) washers to withstand mechanical forces exerted during short circuits. All joints shall consist of a minimum of 2 bolts.
- c. All bus bars shall be silver-plated copper.
- d. All runbacks from the circuit breaker compartment to the cable compartment shall be insulated.

2. Cable Compartment

- a. All incoming or outgoing power conductors shall be routed through this area.
- b. Feeder Breakers shall have adequate wire bending space regardless of the interrupting rating.
- c. Conduit area for each section shall be a minimum of 17" wide and provide adequate depth for all section conduits.

F. Circuit Breakers and Trip Units

1. Circuit Breakers

- a. The circuit breaker shall be listed to UL 489
- b. Circuit breakers shall be suitable for the required instantaneous rating without the use of current limiting fuses.
- c. All circuit breakers shall have field interchangeable electrical accessories including shunt trip, spring release, electrical operator, auxiliary contacts, and Trip Unit.
- d. All secondary connections shall be made directly to the front of the circuit breaker cradle.
- e. Each Circuit breaker shall have built in contact temperature and contact wear sensors.
- f. Circuit breaker must be equipped with an interlock to discharge the stored energy spring before the circuit breaker can be withdrawn from its cell. Circuit breaker must provide a positive ground contact check between the circuit breaker and cell when the accessory cover is removed while the circuit breaker is in the connected, test or disconnected positions.

ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL

2. Trip Units
 - a. All trip units shall be removable to allow for field upgrades.
 - b. Trip Units shall incorporate "True RMS Sensing", and have LED long-time pickup indications.
 - c. All trip units shall have the option of turning instantaneously to the off position.
 - d. Electronic trip unit functions shall consist of adjustable long-time pickup and delay, and instantaneous.
 - e. Adjustable long-time pickup (I_r) and delay shall be available in an adjustable rating plug that is UL Listed as field-replaceable. Adjustable rating plug shall allow for nine long-time pickup settings from 0.4 to 1 times the sensor plug (I_n). Other adjustable rating plugs shall be available for more precise settings to match the application. Long-time delay settings shall be in nine bands from 0.5–24 seconds at six times I_r.
 - f. Instantaneous settings on the trip units with LSI protection shall be available in nine bands from 2 to 15.
 - g. All trip units shall have the capability for the adjustments to be set and read locally by rotating a switch.
 - h. Trip unit shall provide local trip indication
 - i. Generator paralleling breakers shall be LSIA, feeder breakers shall be LSIG.

G. Outdoor NEMA 3R Enclosure

1. Outdoor NEMA Type 3R Walk-in Switchgear shall be enclosed in an outdoor walk-in NEMA type 3R enclosure.
2. The enclosure shall have a roof sloping toward the front and rear. Outer sections shall be the same widths as indoor structures. Appropriate spacing using standard equipment and dimensions shall be made on the left end of the lineup to adapt for the "door swing" of interior equipment.
3. The interior front aisle depth for walk-in structures shall be 42", minimum. Access doors shall be available on both ends of the aisle.
4. The enclosure shall be provided with rear hinged padlockable doors with wind stops for each section. Aisle doors shall be supplied with provisions for locking. A steel floor shall be provided in the walk-in aisle space. Full rear section bottom barriers shall be provided to prevent the entrance of rodents and vermin. Ventilating openings shall be provided complete with replaceable air filters.
5. Provide necessary space heaters thermostatically controlled for breaker, bus and cable compartments of adequate wattage to prevent the accumulation of moisture within the compartments. Provide panic door hardware on aisle doors at each end of the line-up. External locking of the aisle doors shall not prevent operation of the panic hardware from the interior of the enclosure. The construction of the enclosure shall be modular so future sections can be added without affecting NEMA3R integrity. Provide interior aisle fluorescent lights, 3-way switches and GFI protected receptacles.
6. Power for the space heaters, lights and receptacles shall be obtained from a (source as indicated on the drawings). Supply voltage shall be 120 volts AC.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The installer shall be responsible for inspection of the site and verification that the equipment can be installed and operated as required by the manufacturer.

3.2 INSTALLATION

- A. The equipment shall be installed as recommended by the equipment manufacturer.
- B. Remove temporary lifting provisions prior to commissioning.

3.3 Identification

- A. Mount permanent operating instructions at each transfer point, and at the system master control. Instructions shall include a one-line system drawing, description of the operating sequences of the system and the manual operation instructions for the panel where they are installed.
- B. A notice indicating location of the operation and maintenance manual shall be provided.
- C. A notice indicating service support information including supplier name, telephone numbers, and manufacturer's contact information shall be provided on each major piece of equipment.

3.4 Connections

- A. Ground each piece of equipment according to the requirements elsewhere in Division 26 "Grounding and Bonding for Electrical Systems", and in compliance with instructions in the drawings.
- B. Connect power conductors in compliance to appropriate instructions based on voltage class, elsewhere in Division 26.
- C. Provide control interconnection wiring and connect all control interconnections in strict compliance to the equipment manufacturers' instructions.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

3.5 Field Quality Control

- A. Prior to acceptance testing, test insulation resistance of each switchgear bus, component, connecting supply, feeder, and control circuit (in compliance with equipment manufacturer(s).) Test continuity of each circuit. Retain permanent records of this testing.
- B. A factory-authorized and certified service technician shall inspect all control wiring for type of wiring material and installation practice, verify that the wiring is properly installed by point to point testing, and complete installation and startup checks as required by the equipment manufacturer.

3.6 Adjusting

- A. Set all protective relaying according to the results as required by a coordination study. Set all other settings as recommended by the equipment manufacturer.
- B. Record all settings and provide in system operation and maintenance manuals.

3.7 Cleaning

- A. All equipment is to be thoroughly cleaned, with any shipping or installation damage repaired, prior to equipment commissioning and final test.

3.8 Protection

- A. Equipment shall be protected from the environment in compliance to manufacturer's recommendations. As a minimum, equipment shall be protected from moisture, dirt, and condensation.

3.9 Demonstration.

- A. **Factory Testing.** Before shipment of the equipment to the jobsite, the entire control system (including generator set controls) and all the new switchgear directly controlled by the control system shall have sequence of operation tested at the manufacturer's facility to demonstrate that it is fully functional prior to shipment to the jobsite. No exceptions to the requirements of this paragraph will be accepted.
- B. Factory acceptance testing shall be executed successfully prior to shipment from factory.
- C. The supplier of the paralleling system shall provide a manufacturer-certified representative to train the owners personnel in the proper operation and maintenance of the paralleling system.

END OF SECTION

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Seismic-Restraint Loading: Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- B. Enclosures: Surface-mounted cabinets; NEMA 250, type 3R.
- C. Service Equipment Label: Nationally Recognized Testing Laboratory (NRTL) labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- D. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- E. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices; listed and labeled for series-connected short-circuit rating by an NRTL.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

2.3 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. Schneider Electric USA (Square D).
 - 3. Siemens Industry, Inc., Energy Management Division.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Mains: Lugs only.
- E. Branch Overcurrent Protective Devices: Plug-in circuit breakers.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. Schneider Electric USA (Square D).
 - 3. Siemens Industry, Inc., Energy Management Division.
- B. Molded-Case Circuit Breaker: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - 2. Ground-Fault Circuit-Interrupter Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- C. Fused Switch: NEMA KS 1, Type HID; clips to accommodate specified fuses; lockable handle.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store, and install panelboards and accessories according to NECA 407.
- B. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- C. Mount top of trim 72" above finished floor unless otherwise indicated.
- D. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing.

END OF SECTION 26 24 16

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Fusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, that accommodate specified fuses, and with lockable handle interlocked with cover in closed position.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton.
 - b. Schneider Electric USA (Square D).
 - c. Siemens Industry, Inc., Energy Management Division.
 - 2. Single throw.
 - 3. Three pole.
 - 4. 600-V ac.
 - 5. 200 A and smaller.
 - 6. UL 98 and NEMA KS 1, horsepower rated.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. Schneider Electric USA (Square D).
 - 3. Siemens Industry, Inc., Energy Management Division.
- B. Description: Comply with UL 489 and NEMA AB 3, with interrupting capacity to meet available fault currents.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

1. Thermal-Magnetic Circuit Breakers: Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with field-adjustable instantaneous trip settings.
3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
5. GFEP Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

C. Features and Accessories:

1. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
2. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.4 ENCLOSURES

A. UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.5 SUPPORT AND ANCHORAGE COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly, and provide finish suitable for the environment in which installed.

1. Channel Dimensions: Selected for structural loading and applicable seismic forces.

B. Raceway and Cable Supports: As described in NECA 1.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and fittings.

D. Mounting, Anchoring, and Attachment Components:

1. Powder-Actuated Fasteners: Threaded-steel stud.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete.
3. Concrete Inserts: Steel or malleable-iron, slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

5. Through Bolts: Structural type, hex head, high strength; complying with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.
8. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings and matched to type and size of anchor bolts and studs used.
9. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings and matched to type and size of attachment devices used.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Install electrical equipment to allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
- D. Install electrical equipment to provide for ease of disconnecting the equipment with minimum interference to other installations.
- E. Install electrical equipment to allow right of way for piping and conduit installed at required slope.
- F. Install electrical equipment to ensure that connecting raceways, cables, wireways, cable trays, and busways are clear of obstructions and of the working and access space of other equipment.
- G. Install required supporting devices in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- H. Install fuses in fusible devices.

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections, and prepare test reports:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

END OF SECTION 26 28 16

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 26 32 00 - PACKAGED GENERATOR ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets suitable for use in mission critical applications with the features as specified and indicated. Engine generators will be used as the Standby power source for the system but shall be capable of providing reliable power with no run-time limitations while the primary source of power is unavailable.

1.3 DEFINITIONS

- A. Emergency Standby Power (ESP): Per ISO 8528: The maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 200 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers. The permissible average power output 750kW over 24 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.
- B. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
 - 3. Sound test data, based on a free field requirement.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Wiring Diagrams: Control interconnection, Customer connections.
- C. Certifications:
 - 1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for EPA, stationary emergency application.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control test reports.
 - 1. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.
 - 2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.
 - 3. List of factory tests to be performed on units to be shipped for this Project.
 - 4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.
- B. Warranty:
 - 1. Submit manufacturer's warranty statement to be provided for this Project.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 40 miles of project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).
- F. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.
- G. Comply with UL 2200.
- H. Noise Emission: Comply with specified noise level by owner for maximum noise level of 74.8 dB(A) at 7 meters (23 feet) due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: -9.44 deg C (15.0 deg F) to 50.0 deg C (122.0 deg F).
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 400.0 feet (121.92 m).

1.8 WARRANTY

- A. Base Warranty: Manufacturer shall provide base warranty coverage on the material and workmanship of the generator set for a minimum of twenty-four (24) months for Standby product and twelve (12) months for Prime/Continuous product from registered commissioning and start-up.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: The basis for this specification is Cummins Power Generation equipment, approved equals may be considered if equipment performance is shown to meet the requirements herein.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set (2).
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.
- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Electrical output power rating for Standby operation of not less than 750 kW, at 80 percent lagging power factor, 277/480, Series Wye, Three phase, 4-wire, 60 hertz.
 - 2. Alternator shall be capable of accepting maximum 3313.0 kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. The engine-generator nameplate shall include information of the power output rating of the equipment.
- D. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
 - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 - 5. Transient Frequency Performance: Not more than 15 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.
 - 6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.
9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.
10. Load Sharing: Engine generator shall share real and reactive load proportionally within plus or minus 3 percent with all other engine generators in the system.

2.3 ENGINE

- A. Fuel: ASTM D975 #2 Diesel Fuel
- B. Rated Engine Speed: 1800RPM.
- C. Lubrication System: The following items are mounted on engine or skid:
 1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
 2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions
- E. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
 1. Designed for operation on a single 240 VAC, Single phase, 60Hz power connection. Heater voltage shall be shown on the project drawings.
 2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

3. Provided with a 24VDC thermostat, installed at the engine thermostat housing
- G. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.
- H. Cooling System: Closed loop, liquid cooled
1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 50 deg C.
 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.
- I. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.
- J. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.
- K. Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
 3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.
5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:
 - a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
 - f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Sub Base-Mounted Fuel Oil Tank: Provide a double wall secondary containment type sub base fuel storage tank. The tank shall be constructed of corrosion resistant steel and shall be UL 142 listed and labeled. The fuel tank shall include the following features:
 1. Capacity: Fuel for 24 Hour(s) continuous operation at 100 percent rated power output.
 2. Tank rails and lifting eyes shall be rated for the full dry weight of the tank, genset, and enclosure.
 3. Electrical stub up(s)
 4. Normal & emergency vents
 5. Lockable fuel fill

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

6. Mechanical fuel level gauge
7. High and low level switches to indicate fuel level
8. Leak detector switch
9. Sub base tank shall include a welded steel containment basin, sized at a minimum of 110% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.
10. Fill port with overflow prevention valve (OFPV)
11. 5 gallon fill/spill dam or bucket
12. Tank design shall meet the regional requirements for the Project location

2.5 CONTROL AND MONITORING

- A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.
- B. Generators shall be capable of performing parallel operations without additional controls or equipment. Controls shall be capable of opening and closing circuit breakers location in switchgear.
- C. Control shall be capable of performing preferred alternate shut-down/start of either generator during operation due to requirements as designated by owner.
- D. Control shall be capable of communicating of all generator functions via PC and Smart phone. This function shall provide the customer with the ability to monitor and operate the generators from remote locations.
- E. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- F. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- G. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- H. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
1. AC voltmeter (3-phase, line to line and line to neutral values).
 2. AC ammeter (3-phases).
 3. AC frequency meter.
 4. AC kW output (total and for each phase). Display shall indicate power flow direction.
 5. AC kVA output (total and for each phase). Display shall indicate power flow direction.
 6. AC Power factor (total and for each phase). Display shall indicate leading or lagging condition.
 7. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
 8. Emergency Stop Switch: Switch shall be a red "mushroom head" pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
 9. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
 10. DC voltmeter (alternator battery charging).
 11. Engine-coolant temperature gauge.
 12. Engine lubricating-oil pressure gauge.
 13. Running-time meter.
 14. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.) The voltage and frequency adjustment functions shall be disabled when the paralleling breaker is closed.
 15. Fuel tank derangement alarm.
 16. Fuel tank high-level shutdown of fuel supply alarm.
 17. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR, reverse kW, over load (kW) short circuit, over current, loss of voltage reference,

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

and over excitation shut down protection. There shall be a ground fault alarm for generator sets rated over 1000 amps, overload warning, and overcurrent warning alarm.

18. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.
 19. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
 20. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
 21. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.
 22. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).
 23. Paralleling Breaker control switches: The control shall include manual open and close provisions for the paralleling breaker, and LED status lamps indicating whether the breaker is open or closed.
- I. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed as a utility grade protective device under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Protector shall perform the following functions:
1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm conditions when the current flow is in excess of 110% of rated current for more than 10 seconds.
 3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.
 4. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
 5. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.
 6. The protective system provided shall not include an instantaneous trip function.
 7. Circuit Breaker: The generators shall come with primary, factory installed, 100% rated line circuit breaker of 1200 amperes UL/IEC/Service Entrance Rated. Load side lugs shall be provided from the factory
- B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H
- D. Temperature Rise: 105 degree Class F environment.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.
- G. Enclosure: Drip-proof.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
- I. The alternator shall be provided with anti-condensation heater(s) in all applications where the generator set is provided in an outdoor enclosure, or when the generator set is installed in a coastal or tropical environment.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding. Alternators operating at voltage higher than 690VAC shall be provided with form-wound stator coils.
- K. Subtransient Reactance: 12 percent maximum, based on the rating of the engine generator set.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Sound Attenuated Steel housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.
- B. Construction:
 - 1. Louvers: Equipped with bird screen to permit air circulation when engine is not running while excluding birds and rodents. Outlet louver shall be gravity closed type to prevent heat loss during none operation periods.
 - 2. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.
 - 3. Exhaust System:
 - a. Muffler Location: Within enclosure.
 - 4. Hardware: All hardware and hinges shall be stainless steel.
 - 5. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
 - 6. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.
 - 7. Provide an internally mounted and wired electrical distribution panel to serve the engine generator and enclosure; including:

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- a. 100 amp distribution panelboard connected to a 120/240VAC utility service by the installer.
 - b. Two duplex GFI receptacles, one inside the enclosure, and a weatherproof receptacle on the outside of the enclosure.
 - c. Factory wired normal AC service from the panelboard to the engine coolant heater, alternator heater, and battery charger.
8. Catwalks shall be provided on outer sides of generator enclosures and in between generators for operators and maintenance personnel. Shall be 42" wide to provide clearance.
- C. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 50 deg C.
1. Louvers: Fixed-engine, cooling-air inlet and discharge.
- D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 74 dBA measured at any location 7 m from the engine generator in a free field environment.
- E. Site Provisions:
1. Lifting: Complete assembly of engine generator, enclosure, and sub base fuel tank (when used) shall be designed to be lifted into place as a single unit, using spreader bars.

2.9 VIBRATION ISOLATION DEVICES

- A. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.

2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.

- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
 2. Full load run.
 3. Maximum power.
 4. Voltage regulation.
 5. Steady-state governing.
 6. Single-step load pickup.
 7. Simulated safety shutdowns.
 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
- C. Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks' notice for testing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.
- B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
- E. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.
- F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- G. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

3.2 ON-SITE ACCEPTANCE TEST

- A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:
 - B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.
 - C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.
 - D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.3 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

3.4 SERVICE AND SUPPORT

- A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of \$3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.
- B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 100 miles of the site.
- C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.5 SERVICE AGREEMENT:

- A. The supplier shall include in the base price, a one-year service agreement. The maintenance shall be performed by factory authorized service technicians capable of servicing both the engine generator set and the transfer switch (es). This agreement shall include the following:
 - 1. Generator supplier must have an in-house rental fleet with equipment sized to back up this project site.
 - 2. All engine maintenance as recommended by the service manual.
 - 3. All electrical controls maintenance and calibrations as recommended by the manufacturer.
 - 4. All auxiliary equipment as a part of the emergency systems.
 - 5. The supplier shall guarantee emergency service.
 - 6. All expendable maintenance items are to be included in this agreement.
 - 7. A copy of this agreement and a schedule shall be given to the Owner at the time of his acceptance, showing what work is to be accomplished and when.

END OF SECTION

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic service entrance rated transfer switch shall be rated for 3000 amps continuous at 277/480 3 phase, 3 pole.
- B. Related Sections include the following:

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
 - 1. Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.
 - 2. Single Line Diagram: Show connections between transfer switch, power sources and load
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Dimensioned outline drawings of assembly, including elevations, sections, and details including minimal clearances, conductor entry provisions, gutter space, installed features and devices and material lists for each switch specified.
 - 2. Internal electrical wiring and control drawings.
 - 3. Interconnection wiring diagrams, showing recommended conduit runs and point-to-point terminal connections to generator set.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

4. Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.
- C. **Manufacturer and Supplier Qualification Data**
1. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.
 2. The manufacturer of this equipment shall have produced similar equipment for a minimum period of 10 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. **Operation and Maintenance Data:** For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Features and operating sequences, both automatic and manual.
 2. List of all factory settings of relays, timers and protective devices; provide setting and calibration instructions where applicable.
- E. Warranty documents demonstrating compliance with the project's contract requirements.

1.4 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** The equipment supplier shall maintain a service center capable of providing training, parts, maintenance and emergency repairs to equipment, including transfer switch generator sets and remote monitoring equipment (if applicable) at the site within a response period of less than (eight hours or appropriate time period designated for Project) from time of notification.
1. The transfer switch shall be serviced by technicians employed by, and specially trained and certified by, the generator set supplier and the supplier shall have a service organization that is factory-certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
 2. Submit names, experience level, training certifications, and locations for technicians that will be responsible for servicing equipment at this site.
 3. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- B. Source Limitations: All transfer switches are to be obtained through one source from a single manufacturer. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for products provided.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked as suitable for use in emergency, legally required or optional standby use as appropriate for the connected load.
- D. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
1. Transfer switches and enclosures shall be UL 1008 listed and labeled as suitable for use in emergency, legally required, and optional standby applications.
 2. CSA 282, Emergency Electrical Power Supply for Buildings, and CSA C22.2, No. 14-M91 Industrial Control Equipment
 3. NFPA 70, National Electrical Code. Equipment shall be suitable for use in systems in compliance with Articles 700, 701 and 702.
 4. Comply with NEMA ICS 10-1993 AC Automatic Transfer Switches
 5. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 6. EN55011, Class B Radiated Emissions and Class B Conducted Emissions
 7. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity
 8. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
 9. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
 10. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
 11. IEC 1000-4-6 Conducted Field Immunity
 12. IEC 1000-4-11 Voltage Dip Immunity
 13. IEEE 62.41, AC Voltage Surge Immunity
 14. IEEE 62.45, AC Voltage Surge Testing
- E. Comply with NFPA 99 – Essential Electrical Systems for Healthcare Facilities
- F. Comply with NFPA 110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems, regardless of the actual circuit level.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- G. The manufacturer shall warrant the material and workmanship of the transfer switch equipment for a minimum of two (2) year from the warranty start date. The warranty start date is the date of registered commissioning and start up or eighteen (18) months from date of shipment, whichever is sooner.
- H. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, and etc. during the minimum noted warranty period described above.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 - 1. Notify Owner no fewer than 2 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
 - 3. Do not energize any new service or distribution equipment without notification and permission of the Owner.

1.6 COORDINATION

- A. Size and location of concrete bases and anchor bolt inserts shall be coordinated. Concrete, reinforcement and formwork must meet the requirements specified in Division 03. See section "INSTALLATION" for additional information on installation

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cummins Power Generation, ASCO, Eaton
- B. Equipment specifications for this Project are based on automatic transfer switches manufactured by Cummins Power Generation. Switches manufactured by other manufacturers that meet the requirement of this specification are acceptable, if approved not less than two weeks before scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- C. Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Provide transfer switches in the number and ratings that are shown on the drawings.
- B. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.
- C. Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test.
- D. Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).
- E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- F. Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches).
- G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.
 - 2. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.
 - 3. Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
 - 4. Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.
 - 5. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

6. The transfer switch shall include the mechanical and control provisions necessary to allow the device to be field-configured for operating speed. Transfer switch operation with motor loads shall be as is recommended in NEMA MG1.
 7. Phase angle monitoring/timing equipment is not an acceptable substitute for this functionality
 8. Transfer switches designated on the drawings as "3-pole" shall have a full current-rated neutral bar with lugs.
 9. Transfer switches designated on the drawings as "service entrance" switches shall meet the requirements of section "SERVICE ENTRANCE TRANSFER SWITCHES" of this specification.
- H. Control: Transfer switch control shall be capable of communicating with the genset control, other switches and remote programming devices over a high-speed network interface.
- I. Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism
- J. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.
- K. Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:
1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.
 2. Exterior cabinet doors shall provide complete protection for the system's internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.
 3. Transfer switches shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Indicated current ratings:

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

1. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
 2. Main contacts shall be rated for 600 VAC minimum.
 3. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).
- C. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project.
- D. Control: Transfer switch control shall be provided with necessary equipment and software to communicate with the genset control, other transfer switches, remote annunciation equipment, and other devices over a high speed control network.
- E. Transfer switches that are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.
- F. Automatic Transfer Switch Control Features
1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
 2. All transfer switch sensing shall be configurable from an operator panel or from a Windows XP or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
 3. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device for load shedding purposes. On receipt of this signal, the transfer switch shall switch to a neutral position when connected to Source 2. If Source 1 is available when the load-shed signal is received, the transfer switch shall connect to Source 1.
 4. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 60 seconds.
 5. The control system shall be designed and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

6. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
 7. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational.
- G. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.
1. The indicator panel LEDs shall display:
 - a. Which source the load is connected to (Source 1 or Source 2)
 - b. Which source or sources are available
 - c. When switch is not set for automatic operation, the control is disabled
 - d. When the switch is in test/exercise mode
 2. The indicator shall have pushbuttons that allow the operator to activate the following functions:
 - a. Activate pre-programmed test sequence
 - b. Override programmed delays, and immediately go to the next operation
 - c. Reset the control by clearing any faults
 - d. Test all of the LEDs by lighting them simultaneously
 3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
 - a. AC voltage for all phases, normal and emergency
 - b. Source status: connected or not connected.
 - c. Load data, including voltage, AC current, frequency, KW, KVA, and power factor.
 4. The display panel shall be password-protected, and allow the operator to view and make adjustments:
 - a. Set nominal voltage and frequency for the transfer switch
 - b. Adjust voltage and frequency sensor operation set points
 - c. Set up time clock functions
 - d. Set up load sequence functions
 - e. Enable or disable control functions including program transition
 - f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

H. Control Functions: Functions managed by the control shall include:

1. Software adjustable time delays:
 - a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
 - b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
 - c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)
 - d. Engine cooldown: 0 to 30 minutes (default 10 min)
 - e. Programmed transition: 0 to 60 seconds (default 3 sec)
2. Voltage imbalance sensing:
 - a. Dropout: 2 to 10% (default 4%)
 - b. Pickup: 90% of dropout
 - c. Time delay: 2.0 to 20 seconds (default 5 sec)
 - d. Bar graph meter panel, to display 3-phase AC Amps, 3-phase AC Volts, Hz, KW load level, and load power factor. The display shall be color-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.
3. Phase rotation sensing:
 - a. Time delay: 100 msec
4. Loss of single-phase detection:
 - a. Time delay: 100 msec

I. Control features shall include:

1. Programmable genset exerciser: A field-programmable control shall periodically start and run the generator with or without transferring the load for a preset time period, then re-transfer and shut down the generator after a preset cool-down period.
2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.
3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.
4. Re-Transfer Inhibit Switch: Inhibits automatic re-transfer control so automatic transfer switch will remain connected to emergency power source as long as it is available regardless of condition of normal source.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

5. Transfer Inhibit Switch: Inhibits automatic transfer control so automatic transfer switch will remain connected to normal power source regardless of condition of emergency source.

J. Control Interface

1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

K. Engine Starting Contacts

1. One isolated and normally closed pair of contacts rated 10A at 32 VDC minimum.

2.4 SERVICE ENTRANCE TRANSFER SWITCHES

- A. Transfer switches must be specifically intended for service entrance applications, and labeled "Suitable for service entrance use only"
- B. Transfer switch shall meet NEC requirements for emergency, legally required and standby applications as specified in UL 1008.
- C. Entire transfer switch including enclosure must be listed and labeled to UL 1008; switches with only the mechanism listed are not acceptable.
- D. Molded case circuit breaker must be UL 489 listed.

2.5 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
 1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 2. Switch position.
 3. Switch in test mode.
 4. Failure of communication link.
- B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
 1. Indicating Lights: Grouped for each transfer switch monitored.
 2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 3. Switch in test mode.
 4. Lamp Test: Push-to-test or lamp-test switch on front panel.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

- C. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation. The remote annunciation system shall not prevent transfer to the alternate source when the primary power source fails, nor prevent return to the primary source if the alternate source fails

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Floor-mounted transfer switches (except drawout switches supported by wheeled carriages, which must be rolled out at floor level) shall be mounted on concrete bases complying with the following requirements:
 - a. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support.
- C. Identify components according to Division 26 Section "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
- C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

3.3 SOURCE QUALITY CONTROL

- A. Prior to shipping, factory shall test and inspect components, assembled switches, and associated equipment to ensure proper operation.
- B. Factory shall check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.
- C. Factory shall perform dielectric strength test complying with NEMA ICS 1.

3.4 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Service:** The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.
- B. **Manufacturer's representative** shall perform tests and inspections and prepare test reports.
- C. **After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.**
 - 1. Perform recommended installation tests as recommended in manufacturer's installation and service manuals.
 - 2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Verify time-delay settings.
 - c. Verify that the transfer switch is accurately metering AC voltage and current.
 - d. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- D. **Infrared Scanning:** After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. **Follow-up Infrared Scanning:** Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 - 2. **Instrument:** Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
JOB NO. 42-72
MATERIALS LAB STANDBY GENERATOR
PROJECT MANUAL**

3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 DEMONSTRATION

- A. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.
 1. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures.
 2. The class duration shall be at least 8 hours in length, and include practical operation with the installed equipment.

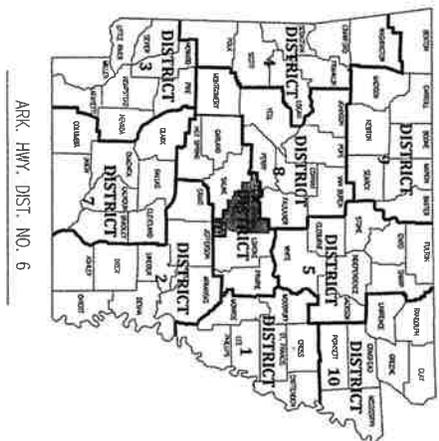
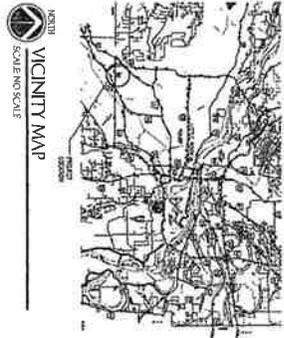
3.6 SERVICE AND SUPPORT

- A. The manufacturer shall supply the Service Provider with a complete set of the service and maintenance software required to support the product. The software shall be provided at a training class attended by the user, to qualify the user in proper use of the software. The software shall have the following features and capabilities:
 1. The software shall allow adjustment of all functions described herein, adjustment of operating levels of all protective functions, and programming of all optional functions in the controller. Adjustments shall be possible over modem from a facility that is remote from the generator set.
 2. The software shall be capable of storing and displaying data for any function monitored by the generator set control. This data shall be available in common file formats, and on graphical "strip chart" displays.
 3. The software shall automatically record all control operations and adjustments performed by any operator or software user, for tracking of changes to the control.
 4. The software shall display all warning, shutdown, and status changes programmed into transfer switch controller. For each event, the control shall provide information on the nature of the event, when it last occurred, and how many times it has occurred.

END OF SECTION 26 36 00

ARKANSAS DEPARTMENT OF TRANSPORTATION CONSTRUCTION PLANS:
MATERIALS LAB STANDBY GENERATORS

LITTLE ROCK, ARKANSAS
 PULASKI COUNTY
JOB 42-72



INDEX OF SHEETS

SHEET NO.	TITLE SHEET	SHEET TITLE
G1.1	1	TITLE SHEET
E1.1	2	PLANS AND DETAILS

COVER SHEET



**MATERIALS LAB STANDBY
 GENERATOR INSTALLATION**
 Little Rock, Arkansas
 Pulaski County



DATE: MAY 30, 2010
 JOB NO: 42-72
 DRAWING NO: E1.1
 REGION: 6

G1.1
 1 OF 2

