

**SOLICITATION ADDENDUM
DORFP #2
WATER PRODUCTION JOC
CITY OF BUCKEYE
CONSTRUCTION & CONTRACTING DIVISION**

ADDENDUM #1

NOTE: Attach to Original DORFP. However, if Proposal has already been returned, complete this Addendum and return for attachment to your Proposal no later than **3:00 PM, February 17, 2022 local time.**

City of Buckeye
530 East Monroe Avenue
Buckeye, Arizona 85326
Attn: Debby Fasano
623-349-6174

SOLICITATION: DORFP #2: Construction of City of Buckeye Well #13

Bid Due Date and Time: **February 17, 2022 no later than 3:00 PM local time**

Last Day for Questions: **February 4, 2022 by 5:00 PM local time**

NOTICE TO CONTRACTORS:

This Addendum forms a part of the Contract and clarifies, corrects, or modifies the original Delivery Order Request for Proposal documents prepared by the City of Buckeye.

THE FOLLOWING CHANGES AND COMMENTS ARE BEEN MADE:

1. The release date was changed from January 20, 2022 to January 18, 2022 for of the Delivery Order Request for Proposal.
2. The Bid Due Date and Time has been changed to February 17, 2022 no later than 3:00 PM local time.
3. Page 7-2 of Well Design report - Please use either a Promag 300 Flowmeter (Meter Mounted Display) with Ethernet IP or Promag 500 (remote display) with internet IP in lieu of a Promag 53 that was called out.
4. As a point of caution, spec section 13206G requires the hydrotank vendor to provide a complete system package. Allowing a contractor to piecemeal the hydrotank system together, should not be considered.

THE FOLLOWING QUESTIONS WERE ASKED BY CONTRACTORS:

1. **Q.** The specification says at least 3HP air compressor. What are the CFM requirements?
A. Please see Spec Section 13206G.2.03.B.2 "The hydropneumatic pressure control System Manufacturer shall select the compressor volumetric capacity and discharge pressure. The capacity and discharge pressure selected shall be sufficient for operation." Furthermore, 13206G requires that the vendor submit sizing calculations. The quoted model (from PULSCO) was 17 CFM.

2. **Q.** The specifications are calling for model 2475. However, 2475 model comes in 5HP and 7.5HP. Attached is the engineering data sheet, Attachment A. What horsepower is required?
A. The HP on single-line diagram is 5HP.
3. **Q.** Is NEMA4 required for the air compressor?
A. Minimum of NEMA3R per spec requirement 13206G.2.06.C.3.11.a.
4. **Q.** Is an oil/water separator required for the air compressor? See attached the brochure, Attachment B.
A. Yes, see "Coalescing filter" called out on drawings and in spec. Spec Section 13206G.2.05.D.
5. **Q.** Is a pressure regulator required for the air compressor? See attached brochure, Attachment C.
A. Per the drawings and specs a pressure regulator is not required However, a pressure regulator may be required as part of the hydro tank system supplier controls/panel design.
6. **Q.** Was section 16051 PREQUALIFICATION OF ELECTRICAL CONTRACTOR inadvertently left in the specification from a previous project? The prequalification is mainly about medium and high voltage.
A. Specification 16051 was updated to remove any mention of medium or high voltage Electrical Contractors, pursuant to Attachment D.
7. **Q.** The generator specs are titled "SINGLE DIESEL FUELED ENGINE GENERATOR ABOVE 200 KW". The one line shows a 150KW generator package, confirming that these specs are correct for the project.
A. Specification 16232 (Generator) is updated to remove the mention of "above 200KW", pursuant to Attachment E.
8. **Q.** The ATS specs are titled "Service Entrance Automatic Transfer Switchgear" which includes requirements for protective relaying. The one line drawings shows SES is separate from ATS. Confirming if there are other specifications requirements for the standard ATS.
A. Specification 16433 (SES/ATS) will be removed and replaced with 16491 & 16442, pursuant to Attachment F.
9. **Q.** What color is the integral color masonry wall?
A. Note 2 on sheet S-05 calls to match Well 14 in appearance. Contractors will have the opportunity to view Well 14 during site walk. Contractor must provide a block sample/submittal which will be subject to owner approval. Please also refer to note J below which was extracted from the City well site standards.
 - "8"x8"x16: CMU solid grouted block wall with low-profile City approved spiked Barrier. Ultra barrier or equal to match the style, color, and finish of adjacent development them walls".
10. **Q.** It was confirmed at the Prebid Meeting that the Specification Section 16051 "Prequalification of Electric Contractor" will not be required with the bid for this project.
A. Not required.
11. **Q.** Please confirm that the Specification Section 17051 "Prequalification of Instrumentation and Control System Contractor" is no required with the bid for this project.

- A. Not required.
12. **Q.** Specifications include Section 16232 titled “Single Diesel Fueled Generator above 200KW”, while the Plan Drawings show the generator being sized as 150KW. This implies that there is a different specification for generators under 200KW. Should a different spec be issued?
A. Specification 16051 was updated to remove any mention of medium or high voltage Electrical Contractors, pursuant to Attachment G.
13. **Q.** Do the 16232 Specification requirements apply to a 150KW generator? If not, please provide the requirements for a generator smaller than 200KW (150KW).
A. Specification 16232 (Generator) is updated to remove the mention of “above 200KW”, pursuant to Attachment E.
14. **Q.** Drawing T-E-02 Detail E200 Note 2 states the Radio Path Survey is to be conducted by the Owner, while Drawing E-01 Key Note 2 states the Contractor is to provide a Radio Path Study. Is the owner providing the Radio Path Study? If not, should the Contractor provided Radio Path Study be included in the bid?
A. This work will be done by Owner.
15. **Q.** Question from Integrator – Previous projects for the City of Buckeye have been using Allan-Bradly PLCs while the P&ID Drawing N-05 calls for a Modicon M580 specifically. Is Modicon the correct brand PLC to be provided for this project?
A. Use Allen Bradley Compact Logix PLC.
16. **Q.** Question from Integrator – Under spec section 17050-3.07.A.1.d (Owner Training) it states, as part of training, to “temporarily install a test PLC and 2 user workstations in the training area for PCIS system training classes conducted on-site: 1) Configure the workstation as full-function operator stations during the training classes. 2) Connect these components with a LAN in order to fully simulate system operation.” This training requirement seems excessive and would require integrator to bring in PLC manufacturer to complete this training. This would most likely require the PLC manufacturer to fly out a representative/trainer with all equipment necessary. This would be a significant cost. Please confirm this is indeed required. Normal PLC hardware training provided by integrator would include discussing components, manufacturers, hardwired logic, etc. that is currently located in the PLC panel built for this project (can be provided in classroom and field). Specific functions of current PLC application/Software training would be provided by Programmer.
A. Not required.
17. **Q.** SPECIFICATION SECTION 11904
Summary- 1.02 B refers to the ASTM Standard of A380 and B912 for passivation of Stainless Steels but the spec does not state whether Passivation of the vessels is required. Please confirm if Passivation and Pickling of vessels will be required.
A. Passivation will be required.

- 18. Q.** There is no light fixture, control switch for a light fixture or exhaust fan, outlets, load center (power panel) or wiring specified/shown on the drawing. Should they be included? If so, how many outlets will you need? Is schedule 40 PVC conduit acceptable?
- A.** It is assumed this question is in regards to the disinfection enclosure which is a prefabricate FRP structure (refer to Sheet No. M-04, Keynote 1). The enclosure comes equipped/prewired with a subpanel/lights/outlets/fan. The conduits and circuits that need to be routed to the enclosure are identified on the plans.
- 19. Q.** I only see one start/stop signal coming into the panel. In order to keep the price down we suggest using a terminal box on the pump skid. So two start/stop signals would need to come into the terminal box from the PLC/SCADA. One per pump. Going the terminal box route instead of a SCADA control panel will save a decent amount of money. The Blue White pumps we will quote will have all the required alarms with the wiring landed in the terminal box, is this an acceptable alternative?
- A.** This comes across as more of a statement rather than a question. Additional discrete output signals from the PLC can be provided as needed to work with specific equipment that is approved/provided. Please note that City Operations staff was very specific to wanting the Stenner chemical metering pumps the design is based on.
- 20. Q.** Can the pipe alignment be relocated 6' east of where it's currently laid out on the plans?
- A.** Contractors should base their bids on the location/alignment shown on the plans. The merits to shift the location/alignment and any cost savings associated with doing so can be evaluated during construction.
- 21. Q.** Can you define a storage area for laydown outside well 14?
- A.** The City does not have any easements outside of what is shown on the plans. Any additional area and or temporary construction easements needed for laydown/staging will need to be discussed/acquired from the landowner.

The balance of the specifications and instructions remain the same. Bidders must acknowledge receipt and acceptance of this Amendment by returning the attached Solicitation Amendment Acknowledgement Page only with the Bid.

PLEASE ACKNOWLEDGE YOUR FIRM'S RECEIPT OF THIS ADDENDUM BY SIGNING THE ATTACHED SOLICITATION ADDENDUM ACKNOWLEDGEMENT.

SOLICITATION ADDENDUM ACKNOWLEDGEMENT

DORRFP #2 – CONSTRUCTION OF CITY OF BUCKEYE WELL #13

ADDENDUM NUMBER 1

ADDENDUM ISSUE DATE: February 9, 2022

Bidder certifies that Bidder has read, understands, and will fully and faithfully comply with this Invitation to Bid, its attachments and any referenced documents. Bidder also certifies that this offer was independently developed without consultation with any of the other Bidders or potential Bidders.

Name of Company: _____

Authorized Signature: _____

Print Name Title: _____

Date: _____

Address: _____

City, State, Zip Code: _____

Telephone Number: _____

Email Address: _____

ATTACHMENT A

ENGINEERING DATA SHEET



2475
(Packaged and Configured)

CCN: 47725347
Rev: B ECO 1434180
Page: 1 of 3
Date: 28-Jan-21

Point of Manufacture - Campbellsville

Bare Details:

Specifications:

Bore: 4" & 2.5"
Stroke: 2.75"
Maximum pressure : 250(17.24) psig(bar)
Sheave OD: 13.75"
Sheave PD: 13.5"
Inlet size: 1" NPT
Discharge size: 0.5" NPT
Belt Type / Quantity: A/1
Min/Max RPM: 575/1600
Air-cooled Aftercooler CTD: 25°F

Lubrication:

Types: *XL300; **All-Season T30 Select; ***XL740Ht
Sump capacity: 1.30(1.23) qt(liter)

*Adjust viscosity to suit ambient conditions, XL300 should not be used in ambients below 40°F. Use premium quality, non-detergent, single-viscosity petroleum oils with R & O additives.
** Required for duty cycles above 70% load. Check lubricant compatibility sheet before using.
*** Required for ambients in excess of 100°F. Check lubricant compatibility sheet before using.

Tank Details:

Tank size / Configuration: 30 Gal/Horizontal (Gas / Diesel Only)
80 Gal/Vertical
80 Gal/Horizontal
120 Gal/Horizontal (Duplex Only)

Pressure rating: 200(13.8) psig(bar)
Codes: ASME Sec VIII & CRN

Drive Details:**AMP draw:**

	200-1-60	230-1-60	200-3-60	230-3-60	460-3-60	575-3-60
5HP	32.2	28	17.5	15.2	7.6	6.1
7.5HP		40	25.3	22.0	11	9.0

Note: Nominal Amps are based on NEC full load amperage rating for this size motor. Actual nameplate amps may vary according to motor design and/or motor manufacturer. Duplexes have the potential to run both motors at the same time, in this instance double the amp draw value.

	5 HP	7.5 HP	7.5 HP	13 HP	14 HP	9.3 HP
Configured = C)	P;C	P;C	P;C	P	P	P
Efficiency	*	*	*	N/A	N/A	N/A
Motor RPM	1775	3450	1775	3600	3600	3600

* Motors comply with EISA standards.

2475

CCN: 47725347

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Performance Data:

Bare	Power (HP)	Pressure	Pump	Flow	BHP
2475 (P;C)	5	75	1040	17.3	4.5
2475 (P;C)	5	125	1040	17.1	4.8
2475 (P;C)	5	175	1040	16.8	5.5
H2475 (C)	5	250	910	14.1	5.2
2475 (P;C)	7.5	75	1500	24.3	7.3
2475 (P;C)	7.5	125	1500	24.2	7.8
2475 (P;C)	7.5	175	1500	24.0	8.1
2475 - Gas-Honda (P)	13	175	1600	25.0	8.2
2475 - Gas-Kohler (P)	14	175	1600	25.0	8.2
2475 - Diesel-Yanmar (P)	9.3	175	1415	22.6	7.6
2475 - Diesel-Kohler (P)	8.5	175	1375	22.0	7.4

Note: Duplex units multiply capacity by two when both units are running.

Operating Environment:

Minimum operating temperature: 32(0) deg.F(deg.C)
 Maximum operating temperature: 100(37.78) deg.F(deg.C)

Electricals:

	Fully Packaged	Configured
Magnetic starter:	E-Series standard	E-Series standard; Deluxe optional
Pressure switch:	Non-adjustable standard	Non-adjustable standard; Adjustable
Alternator:	E-Series standard	E-Series standard; Deluxe optional

Dimensions & Shipping weight:

	5 HP 80 Gal. Vertical	5 HP 80 Gal. Horizontal	5 HP (Duplex) 120 Gal. Horizontal
L x W x H (in):	48 x 40 x 76	74 x 43 x 49	88 x 60 x 60
Weight (lbs):	670	500	1300

	7.5 HP 80 Gal. Vertical	7.5 HP 80 Gal. Horizontal	7.5 HP (Duplex) 120 Gal. Horizontal
L x W x H (in):	48 x 40 x 76	74 x 43 x 49	88 x 60 x 60
Weight (lbs):	675	525	1350

	Gas Engine Driven 30 Gal. Horizontal	Diesel Engine Driven 30 Gal. Horizontal	Gas Engine Driven Baseplate
L x W x H (in):	48 x 22 x 41	48 x 22 x 45	48 x 27 x 22
Weight (lbs):	455	515	390

Note: For model specific dimensions and weight, reference GA drawings.

2475



CCN: 47725347

Page: 3 of 3

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- Notes:**
- 1) For specific code requirements like CSA, CRN, ASME contact your channel marketing manager.
 - 2) For model specific GA, electrical schematic and fluid flow schematic or any specific information contact your channel marketing manager.

SPECIAL OPTIONS/FEATURES NOT AVAILABLE ON THESE UNITS

ATTACHMENT B



PolySep Oil Water Separators

2-65 m³/min (60-2,300 cfm)

Unique and efficient PolySep Oil Water Separators from Ingersoll Rand offer unrivaled performance that can easily separate, and permanently absorb, virtually all lubricants.

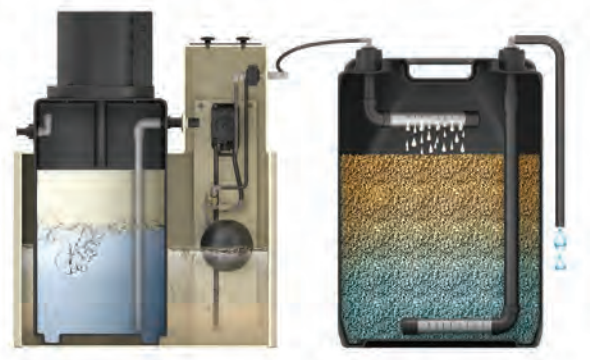


Unrivaled Performance and Efficiency

PolySep Oil Water Separators feature a specially coated Zeolite adsorption media that is able to withdraw and permanently adsorb virtually all lubricants. This proprietary filtration media can even handle highly emulsified lubricants like polyglycols, which are difficult to separate without the use of expensive, oversized separators as found in many competitive systems.

The Responsible Choice

By minimizing the cost associated with the disposal of fluids and keeping them out of the environment, PolySep Oil Water Separators help you to stay compliant with environmental regulations. The PolySep is also designed to operate with minimal maintenance or downtime, resulting in no mess or overflow.



The key to the PolySep's performance is the specially coated Zeolite adsorption media

PolySep Oil Water Separator Features

- **Proven PolySep Zeolite Filtration Media** works with all lubricants, including Ultra Coolant
- **Removes virtually everything** from water, including mineral oils, PAOs, polyolesters, diesters and polyglycols
- **Designed to handle all condensate flow requirements** up to 380 liters/hour (100 gallons/hour), even in hot and humid environments
- **Zeolite adsorption media has a long life**, only needing to be replaced once a year or after 4,000 hours of operation
- **Complies with environmental regulations** by minimizing fluid disposal costs
- **Minimal maintenance required**, resulting in no mess or overflow

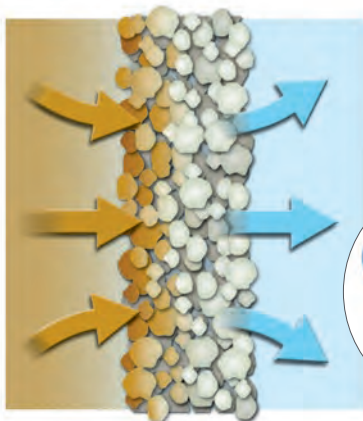
PolySep... Sized for Every Application

For large systems that require more than 18 m³/min (650 cfm), the PolySep AS is designed with a reliable and nearly maintenance-free pump-driven system for easier operation. For smaller systems, the PolySep PSG 7-30 offers a simple solution where maintenance and downtime are minimal.



Performance Data*							
Model	CCN Number	Replacement Module CCN	Air Flow (cfm)		Inlet NPT mm (in)	Max Water Flow 1/hr (gal/hr)	Dimensions mm (in)
			m ³ /min	(cfm)			
PolySep PSG7	38456992	38457008	2	(60)	12.7 (0.5)	2.1 (0.55)	527 H x 292 Dia (20.75 x 11.5)
PolySep PSG15	38339040	38339057	5	(175)	12.7 (0.5)	11.8 (3.1)	673 W x 483 L x 762 H (26.5 x 19 x 30)
PolySep PSG30	38465605	38465712	11	(390)	12.7 (0.5)	26.2 (6.9)	864 W x 533 L x 991 H (34 x 21 x 39)
PolySep AS65	17933051	42528521	18	(650)	12.7 (0.5)	378 (100)	See Operator's Manual
PolySep AS85	17933053	17928718	24	(850)	12.7 (0.5)	378 (100)	See Operator's Manual
PolySep AS115	17933054	42528539	32	(1,150)	12.7 (0.5)	378 (100)	See Operator's Manual
PolySep AS180	17933055	17928719	51	(1,800)	12.7 (0.5)	378 (100)	See Operator's Manual
PolySep AS230	17933056	17928720	65	(2,300)	12.7 (0.5)	378 (100)	See Operator's Manual

* Performance based on 90°F (32°C) ambient temperature and 70 % relative humidity.
 * For use with most types of compressor lubricants: PAG, AN, PAO, diesters and synthetics.



How PolySep Works

Compressor systems produce large amounts of condensate. This condensate contains lubricant contaminants that should be disposed of properly. Ingersoll Rand PolySep Oil Water Separators use unique, specially coated Zeolite adsorption media that effectively separates and permanently adsorbs the contaminants. When properly installed and sized correctly, the PolySep separators are capable of providing condensate discharge levels as low as 15 mg/l (15 ppm) and only need to be replaced once a year or after 4,000 hours of operation for optimal performance.



IngersollRandProducts.com

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ATTACHMENT C

PacE Pneumatic Flow Controller

Air Pressure Optimization

By effectively managing pressure, the PacE Flow Controller from Ingersoll Rand enables compressed air systems to operate at the lowest acceptable pressure level needed to maintain reliable operations.



The Cost of Unmanaged Pressure

Most compressed air systems experience fluctuating demand. This can cause unstable system pressure, requiring compressors to cycle on and off. The typical solution is to overcompensate by using additional compressors and/or by increasing overall system pressure. However, these approaches increase overall operating costs and air loss due to leaks as well as damage to compressors and point-of-use tools.

PacE Flow Controller Benefits

The PacE Pneumatic Flow Controller creates a buffer between air supply and demand. It enables more effective air storage, and continuously stabilizes system pressure by responding to demand fluctuations. When pressure is kept constant, the need to increase system pressure or add compressors can be eliminated...ultimately saving you money.

- Reduced energy consumption
- Improved compressor and production tool life
- Consistent pressure at point-of-use
- Less production waste; decreased downtime

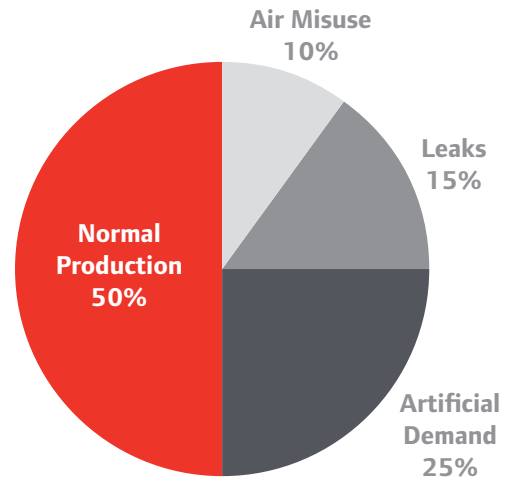
Unmanaged Air Costs More Than You Realize

On average, an estimated 50% of compressed air in an unmanaged system is used for production. The other half is wasted due to leaks, misuse and artificial demand. Consider a 40 hp compressor that runs 3,500 hours at \$0.10 per kW. If the compressor creates 125 psig, but the tools only demand 90 psig, adding the PacE controller can save up to \$1,281 per year in energy costs.

That's more than a 2x return on the initial investment of the controller in just one year!

Unnecessary wear on the compressors is another cost of running an unmanaged system. The units must cycle more frequently than normal and can't reach a fully unloaded state, resulting in higher maintenance costs and shortened lifespan. Point-of-use tools are also at risk when subjected to higher pressures than they are designed to tolerate.

Why put your equipment at risk by leaving your system unregulated?



50% of compressed air in an unmanaged system is typically wasted.

Maximize Efficiency

The PacE Pneumatic Flow Controller from Ingersoll Rand separates the demand and supply sides of your compressed air system and increases stored air energy. Effectively managing system air pressure minimizes the effects of demand spikes from point-of-use applications and reduces the amount of artificial demands placed on your system. Compressors can fully unload, which maximizes energy savings, and additional compressors previously needed to meet pressure requirements can typically be eliminated.

The PacE Controller gives you consistent pressure, reduces energy and maintenance costs while creating a more efficient air system.



So Much More than a Standard Regulator

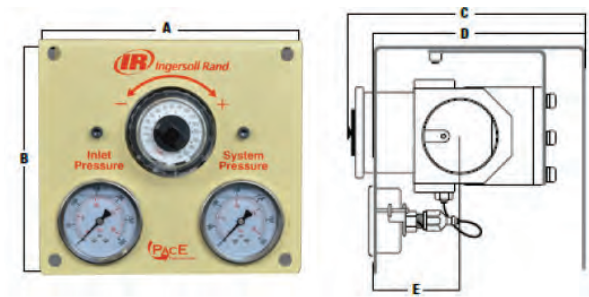
Unlike standard regulators, the PacE flow controller manages both pressure *and* flow. It can be used to manage unregulated demand across the entire system, not just at point-of-use.

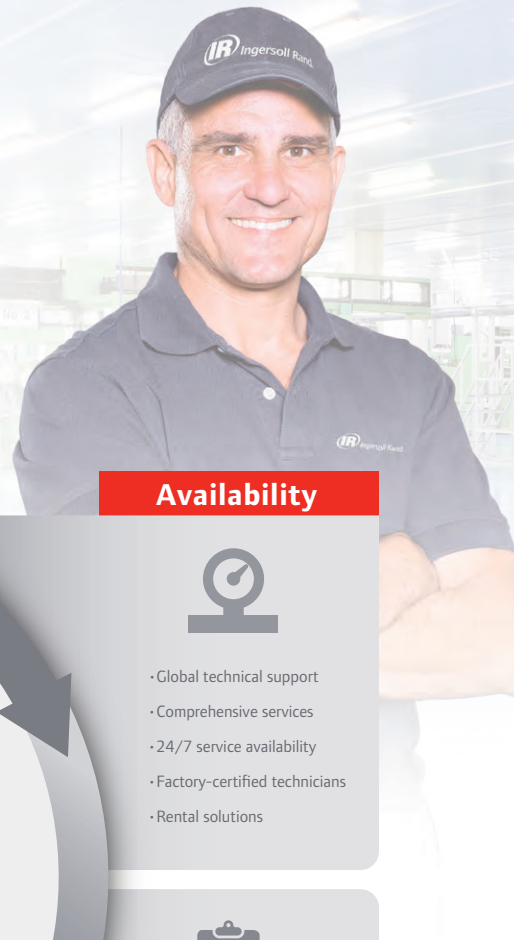
- **Accuracy.** The PacE Flow Controller has a sensitive dial for controlling set points to deliver precise pressure control (0.2% from set point within the full range).
- **Constant Pressure.** The flow controller valve responds immediately to changes in air demand, providing consistent pressure at point-of-use.
- **Reduced Cycling.** By separating the supply side from the demand side of your system, the controller creates additional stored capacity so your machines won't cycle as frequently to meet fluctuations in demand.
- **No Over-Pressurization.** The fixed pressure setting on the dial prevents users from exceeding the maximum desired pressure, protecting point-of-use tools from over-pressurization.

PacE Pneumatic Flow Controller Specifications									
Inlet Size	Max Flow scfm	Dimensions (inches)					Weight (lb)		
		A	B	C	D	E			
1/2"	75	8.11	7.28	8.57	7.36	1.89	8.4		
1"	200	8.11	7.28	8.57	7.36	2.21	10.45		
2"	1,000	8.11	7.28	8.57	7.36	2.78	14.65		
Inlet Size	Part Number	Flow Direction	Thread Type	Max Flow scfm	Max Inlet Pressure psig	Control Range psig	Temperature Range °F	Sensitivity % of full span	Repeatability % of full span
1/2"	49124399	Right to Left	NPT	75	300	0-160	-4 to +176	0.2%	± 0.5%
	49124365	Left to Right	NPT	75	300	0-160	-4 to +176	0.2%	± 0.5%
	49124456	Right to Left	BSP	75	300	0-160	-4 to +176	0.2%	± 0.5%
	49124423	Left to Right	BSP	75	300	0-160	-4 to +176	0.2%	± 0.5%
1"	49124407	Right to Left	NPT	200	300	0-160	-4 to +176	0.2%	± 0.5%
	49124373	Left to Right	NPT	200	300	0-160	-4 to +176	0.2%	± 0.5%
	49124464	Right to Left	BSP	200	300	0-160	-4 to +176	0.2%	± 0.5%
	49124431	Left to Right	BSP	200	300	0-160	-4 to +176	0.2%	± 0.5%
2"	49124415	Right to Left	NPT	1,000	300	0-160	-4 to +176	0.2%	± 0.5%
	49124381	Left to Right	NPT	1,000	300	0-160	-4 to +176	0.2%	± 0.5%
	49124472	Right to Left	BSP	1,000	300	0-160	-4 to +176	0.2%	± 0.5%
	49124449	Left to Right	BSP	1,000	300	0-160	-4 to +176	0.2%	± 0.5%

Product Features

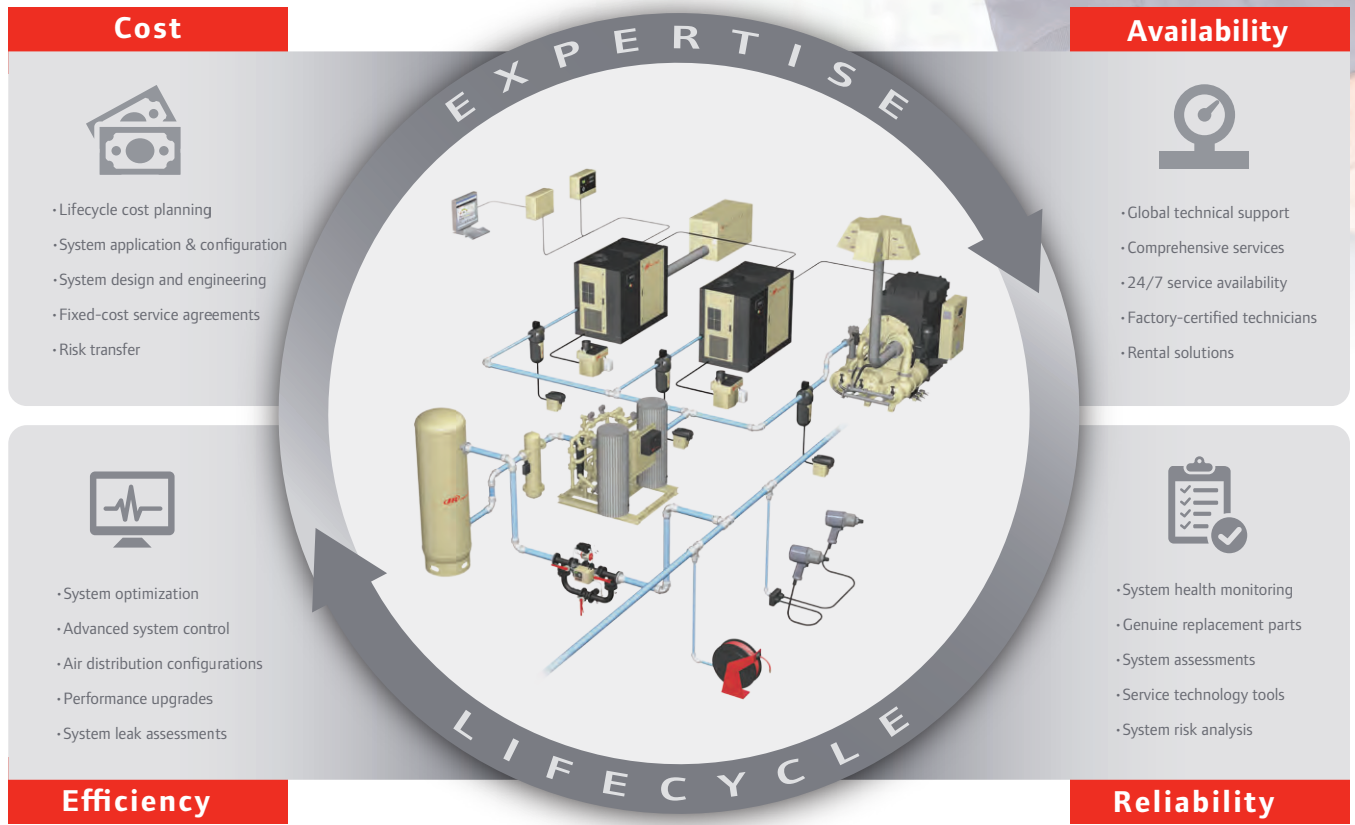
- **Nitrile seals** for high level of chemical resistance
- **NPT threads** for easy installation with existing delivery systems
- **Glycerine-filled, stainless steel, dual gauge design** for clear reference of pressure (both inlet and outlet)
- **Powder-coated steel chassis** for premium durability
- **Versatile directional flow** available
- **Compatible** with rotary and reciprocating technologies





Your Trusted Partner in Compressed Air

Ingersoll Rand products and services optimize total **Cost** of ownership, while maximizing **Availability, Reliability** and **Efficiency** for the entire lifecycle of your system.

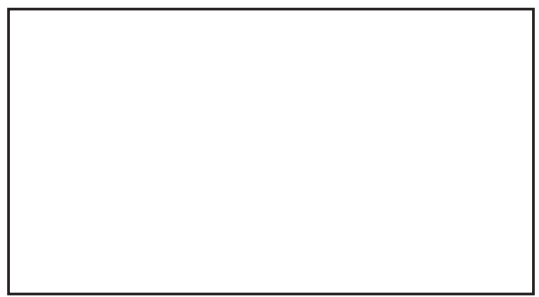


Design • Install • Commission • Operate • Maintain • Extend



ingersollrandproducts.com

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ATTACHMENT D

SECTION 16051

PREQUALIFICATION OF ELECTRICAL CONTRACTOR

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
1. Prequalification as an electrical contractor.
 2. Firms interested in submitting bids as the electrical contractor as described herein and in Section 16050 - Common Work Results for Electrical must submit a prequalification submittal as specified in this Section.
 3. Only those firms who, based on their prequalification submittals and related investigations, meet the minimum requirements defined in this Section, who are approved by the Owner and Engineer and are identified by addendum to the Contract Documents, shall be eligible to submit bids as the Contractor for this Project.

1.02 REFERENCES

- A. National Fire Protection Association (NFPA):
1. 70 - National Electrical Code (NEC).
 2. 70E - Standard for Electrical Safety in the Workplace®.
 3. 101 - Life Safety Code.
- B. Occupational Safety and Health Administration (OSHA):
1. 300 - Log of Work-Related Injuries and Illnesses.
 2. 300A - Summary of Work-Related Injuries and Illnesses.

1.03 DEFINITIONS

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Low voltage: 600 volts and below.
- C. Medium voltage: 2,400 volts to 69,000 volts.
- D. High voltage: 115,000 volts and above.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS

- A. General:
1. Prequalification submittals will be received at the office of Owner.
 2. Any submittal failing to present clearly all the requested information or failing to be the requested format may be considered unresponsive and rejected.
 3. Information contained in the prequalification submittal will be considered confidential, and reasonable precautions will be taken to ensure the security of the documents.

4. All submittals will become and remain the property of the Owner.
5. The Owner reserves the right to request an applicant clarify any part of his submittal. Response to such requests shall be made in writing and will become part of the submittal.
6. Unsolicited supplementary information and materials received after the deadline will not be considered in the evaluation.
7. If it is discovered at any time that any significant information in a prequalification submittal is incorrect, substantially misleading, or fraudulent, the submitting firm shall be subject to immediate disqualification from participation in the Project.

B. Submittal requirements:

1. Prequalification submittals shall be delivered in a sealed envelope or box, clearly addressed as instructed above, and clearly labeled:
"PREQUALIFICATION SUBMITTAL, ELECTRICAL CONTRACTOR, City of Buckeye Well 13.
2. Submit 4 copies of the prequalification submittal.

C. Format and information to be provided:

1. Prequalification submittal shall include the following information organized in the order outlined below:
 - a. General information on the proposing company:
 - 1) Document that the electrical contractor company has been actively involved in the water and wastewater business for a number of years and has adequate facilities, organization structure, manpower, and technical and managerial expertise to properly perform the Work in conformance with these Specifications.
 - 2) Submit a financial prospectus indicative of the corporation's financial state. This prospectus shall also include:
 - a) A letter from a financial institution indicating a current line of credit and bonding limit which can be applied to this Project.
 - b) Latest annual report or reviewed financial statement.
 - b. Document that the electrical contractor has a qualified permanent facility:
 - 1) Document in-house resource of permanent personnel experienced in the installation of the systems as required by these Specifications.
 - 2) Document the existence of a training program staffed by qualified instructors, to provide proper training in the operation and maintenance of equipment as described in these Specifications.
 - c. Similar project experience of the company:
 - 1) Provide a list of at least 3 successfully completed projects for a water and/or wastewater system of similar scope and complexity in which the proposing firm used components the same as those intended for use on this Project. The proposing firm must have performed, for each listed project, installation, documentation, field-testing, and start-up. In addition, provide the following information for each project:
 - a) Name of plant or system owner, contact name, and current telephone number. Design engineer's name, address, and telephone number. Failure to provide current contact information may result in the listed project being disqualified for use in meeting the minimum requirements for prequalification.
 - b) Brief description of the system.

- c) Contracted cost of the system, including change orders for the completed projects.
- d) Duration of the project and date of completion.
- d. Information on the proposed project team members:
 - 1) Provide the name and resume of the individual persons who will be responsible for each of the following:
 - a) Office engineering and management of this Project.
 - b) Individual who will be responsible for the installation crew.
 - c) Individual who will be responsible for field-testing, calibration, and start-up.
 - 2) All of these individuals must be permanent employees of the proposing firm.

1.06 QUALITY ASSURANCE

A. Responsibilities:

- 1. The electrical contractor shall perform the following Work with its own employees, as a minimum:
 - a. Perform all Work specified in the Electrical Specifications and Work shown on the Electrical Drawings, except where the Work is clearly indicated to be provided under the Specifications of another Division of the Contract Documents.
 - b. Prepare hardware submittals for the components and power system.
 - c. Procure all electrical system hardware.
 - d. Prepare technical manuals.
 - e. Prepare Record Drawings.
 - f. Additional requirements for the electrical contractor are specified in Section 16050 - Common Work Results for Electrical.

B. Prequalification minimum requirements:

- 1. To be prequalified to bid on the project as an electrical contractor, a proposing company must submit all required information and must meet the minimum requirements set forth in the following list based on the information submitted. For joint ventures, both firms must separately meet the requirements.
- 2. Firm has been in business at least 5 years.
- 3. Firm must have a business volume of at least \$15.0 million, annually.
- 4. Firm and officers do not have adverse criminal or legal records, such as criminal convictions, defaults, loss of licenses, etc.
- 5. Firm does not have a poor project performance record, such as repeated claims, litigation, defaults, etc.
- 6. Firm demonstrates completion of at least 3 similar (water or wastewater) projects in the past 5 years. Each similar project must include:
 - a. Project system cost of at least 1/2 of this Project's estimated cost.
 - b. Water or wastewater facility.
 - c. "Completion" means the similar project has been installed and is substantially complete.
- 7. Proposed personnel have adequate experience and credentials, including:
 - a. Project Manager and Project Engineer have served in similar roles on at least 1 comparable project(s) in the past 5 years.
- 8. Firm cannot be in bankruptcy.
- 9. The financial condition of the firm cannot be such that its financial ability to complete the Project is, in the opinion of the Owner, in doubt.

- C. Submittal evaluation:
1. A committee consisting of members of the Owner's staff, Engineer, and other consultants selected by Owner will evaluate the completed questionnaires. The Owner and Engineer will determine and identify the qualified bidders in accordance with the following timetable. Written notification of this determination will be sent to each bidder.
 2. The Owner and Engineer reserve the right to reject any or all prequalification submittals and to waive any irregularities in any submittal.
 3. The Owner reserves the right to relax the minimum requirements, in any way deemed to be in the best interest of the Owner, if, in the Owner's opinion, an insufficient number of firms can prequalify under the criteria specified above.
 4. The Owner's decision shall be final as to the acceptability of the proposing electrical contractor.
 - a. The Owner shall decide acceptability or unacceptability, and not offer or be required to provide any supporting statements or documentation concerning the decision.
 - b. The decision of "Not Prequalified" for a proposing contractor has no implied connotations and only states simply that the proposing contractor has failed to meet the submission or minimum requirements for this particular project.
- D. Notification of prequalification:
1. Each applicant will be notified as to its approval or disapproval for prequalification approximately 15 days before acceptance of bids for the complete facility project specified in the Contract Documents.
 2. Notification of the electrical contractor will be made in the form of an addendum to all plan holders, issued during the bidding phase of the Project.
- E. The Project team members identified in the prequalification submittal shall perform the roles described in the submittal, and not be substituted without the written permission of the Owner. Substitute personnel shall be subject to the review and approval of the Engineer, even in cases where the individuals named in the prequalification submittal are no longer employed by the proposing company at the time of contract award.
- F. Prequalification of a firm as an electrical contractor shall not be construed as an opinion by the Owner or Engineer that the prequalified firm is qualified to perform the subject Work. The review of prequalification submittals is solely for the purpose of determining, in the opinion of the Owner and Engineer, if interested firms meet the requirements for prequalification described above.
- G. Prospective bidders desiring to be prequalified are hereby reminded that they will be subject to, and must fully comply with, all of the requirements of the Bidding Documents, including the provision of a 100-percent payment bond and 100-percent performance bond, and all Affirmative Action Requirements and prevailing wage laws.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

- 1.11 WARRANTY (NOT USED)
- 1.12 SYSTEM START-UP (NOT USED)
- 1.13 OWNER'S INSTRUCTIONS (NOT USED)
- 1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS (NOT USED)

- 2.01 MANUFACTURERS (NOT USED)
- 2.02 EXISTING PRODUCTS (NOT USED)
- 2.03 MATERIALS (NOT USED)
- 2.04 MANUFACTURED UNITS (NOT USED)
- 2.05 EQUIPMENT (NOT USED)
- 2.06 COMPONENTS (NOT USED)
- 2.07 ACCESSORIES (NOT USED)
- 2.08 MIXES (NOT USED)
- 2.09 FABRICATION (NOT USED)
- 2.10 FINISHES (NOT USED)
- 2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION (NOT USED)

- 3.01 EXAMINATION (NOT USED)
- 3.02 PREPARATION (NOT USED)
- 3.03 INSTALLATION (NOT USED)
- 3.04 ERECTION, INSTALLATION, APPLICATION, AND CONSTRUCTION (NOT USED)
- 3.05 REPAIR/RESTORATION (NOT USED)
- 3.06 RE-INSTALLATION (NOT USED)
- 3.07 FIELD QUALITY CONTROL (NOT USED)
- 3.08 ADJUSTING (NOT USED)
- 3.09 CLEANING (NOT USED)

3.10 PROTECTION (NOT USED)

3.11 SCHEDULES

- A. Average Lost Workday Incident Rate (LWIR). Calculate LWIR for the past 3 complete years. The lost workday information is listed on OSHA Forms No. 300 and 300A and is available from worker's comp. insurance carrier.

$$\text{LWIR} = \frac{\text{Total number of lost workday incidents} \times 200,000}{\text{Total employee hours worked}}$$

Year	# of Lost Workday Incidents	Total Employee Hours Worked	Lost Workday Incident Rate
1-20			
2-20			
3-20			
Total			

- B. Average Recordable Incident Rate (RIR). Calculate RIR for the past 3 complete years. The Incident Rate information is listed on OSHA Forms No. 300 and 300A and is available from worker's comp. insurance carrier.

$$\text{RIR} = \frac{\text{Total number of recordable incidents} \times 200,000}{\text{Total employee hours worked}}$$

Year	# of Recordable Incidents	Total Employee Hours Worked	Recordable Incident Rate
1-20			
2-20			
3-20			
Total			

- C. Experience Modification Rate (EMR). Enter EMR for the most recent year from information is provided by worker's comp. insurance carrier).

Year	EMR	Is Your Firm Self-Insured in Arizona?
20__		No Yes Self-Insured No.

END OF SECTION

ATTACHMENT E

SECTION 16232

**SINGLE DIESEL FUELED ENGINE GENERATOR
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PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Packaged automatic "standby" diesel engine generator systems.

1.02 REFERENCES

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. ASTM International (ASTM):
 - 1. A106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
- C. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - 2. MG-1 - Motor and Generators.
- D. National Fire Protection Association (NFPA):
 - 1. 30 - Flammable and Combustible Liquids Code.
 - 2. 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
 - 3. 110 - Standard for Emergency and Standby Power Systems.
 - 4. 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
- E. Underwriters Laboratories (UL):
 - 1. 142 - Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids.
 - 2. 2200 - Standard for Stationary Engine Generator Assemblies.

1.03 DEFINITIONS

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. NEMA:
 - 1. Type 4X enclosure in accordance with NEMA 250.
- C. Specific definitions:
 - 1. Standby rated duty: Continuous operation for the duration of any power outage of a utility power source.

1.04 SYSTEM DESCRIPTION

- A. Provide a complete automatic diesel engine driven generator system, with all necessary components and accessories to make a complete and operating standby power supply.
 - 1. Coordinate the generator control system with the transfer equipment specified in the Electrical Specifications and as indicated on the Drawings.
- B. Provide such minor details of electrical, plumbing, or mechanical work not specified or indicated on the Drawings, which are necessary for the successful operation of the diesel engine-driven generator required by these Specifications.

1.05 SUBMITTALS

- A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

- B. Product data:
 - 1. General:
 - a. Manufacturer of:
 - 1) Engine.
 - 2) Generator.
 - 3) Governor.
 - 4) Voltage regulator.
 - 5) Generator control panel.
 - 6) Radiator.
 - 7) Battery charger.
 - 8) Batteries.
 - 9) Silencer.
 - 10) Enclosure.
 - 11) Fuel storage tank.
 - b. Wet weight of engine generator system:
 - 1) List weight of fuel separately.
 - c. Dimensions of engine generator system:
 - 1) Length.
 - 2) Width.
 - 3) Height.
 - d. Type and grade of fuel recommended.
 - e. Fuel oil consumption at:
 - 1) 50 percent load.
 - 2) 75 percent load.
 - 3) 100 percent load.
 - f. Type and grade lubricating oil recommended.
 - g. Amount of lubricating oil required per oil change.
 - h. Normal lubricating oil consumption.
 - i. Recommended lubricating oil change periods:
 - 1) By hours run.
 - 2) By time.
 - j. Heat rejection by engine generator to the room area.
 - k. Time interval from start-up contact closure until full load capabilities are available.
 - 2. Engine:
 - a. Number of cylinders, bore, stroke, and piston speed.
 - b. Displacement in cubic inches.
 - c. Compression ratio.
 - d. Engine RPM at 60 hertz.
 - e. Combustion air required.
 - f. Cooling air required.
 - g. Size of exhaust outlet.
 - h. Gauges.
 - i. Jacket water heater:
 - 1) Rating.
 - 2) Voltage and phase requirements.

3. Emissions:
 - a. Certification of EPA compliance.
 - b. Other exhaust emissions as required by the local air quality management district issuing the permit for the engine generator system.
 - c. Reported at rated speed and load as measured by SAE J177 and J215 or ISO 8178 recommended practices.
4. Generator (alternator):
 - a. Rated output:
 - 1) kW standby.
 - 2) Power factor.
 - 3) Voltage.
 - 4) Current.
 - b. Number of poles.
 - c. Number of leads and wires per lead.
 - d. Pitch.
 - e. Stator and field ratings including temperature rise at full and overload conditions.
 - f. Insulation system:
 - 1) Insulation class.
 - 2) Stator rise.
 - 3) Rotor rise.
 - 4) Heat dissipated (kW).
 - 5) Air flow (m³/min).
 - g. Impedances (per unit and ohms):
 - 1) Synchronous reactance: Direct axis (X_d).
 - 2) Synchronous reactance: Quadrature axis (X_q).
 - 3) Transient reactance: Saturated (X'_d).
 - 4) Subtransient reactance: Direct axis (X''_d).
 - 5) Subtransient reactance: Quadrature axis (X''_q).
 - 6) Negative sequence reactance (X_2).
 - 7) Zero sequence reactance (X_0).
 - h. Time constants:
 - 1) Open circuit transient: Direct axis.
 - 2) Short circuit transient: Direct axis.
 - 3) Open circuit subtransient: Direct axis.
 - 4) Short circuit subtransient: Direct axis.
 - 5) Open circuit subtransient: Quadrature axis.
 - 6) Short circuit subtransient: Quadrature axis.
 - 7) Exciter time constant.
 - 8) Armature short circuit.
 - i. Short circuit ratio.
 - j. Stator resistance.
 - k. Field resistance.
 - l. I²t or K (heating time constant).
 - m. Voltage and frequency variation and duration with the step application and removal of 25 percent, 50 percent, 75 percent, and 100 percent of resistive load maximum.
 - n. Generator efficiency at:
 - 1) 25 percent load.
 - 2) 50 percent load.
 - 3) 75 percent load.
 - 4) 100 percent load.

- o. Generator output characteristic curves:
 - 1) Open circuit.
 - 2) Short circuit.
 - 3) Zero power factor.
 - 4) Air gap.
- p. Reactive capability curve.
- q. Certified published engine horsepower curves showing manufacturer's engine rating for generator set standby and prime power application.
- r. Decrement curve.
- s. Thermal damage curve.
- 5. Governor.
- 6. Voltage regulator.
- 7. Generator control panel:
 - a. Dimensions:
 - 1) Length.
 - 2) Width.
 - 3) Height.
 - 4) Weight.
 - b. Power requirements.
 - c. Controls.
 - d. NEMA enclosure rating.
- 8. Space and ambient temperature requirements.
- 9. Battery system:
 - a. Battery charger:
 - 1) Dimensions:
 - a) Length.
 - b) Width.
 - c) Height.
 - d) Weight.
 - 2) Input power requirements.
 - b. Batteries:
 - 1) Number.
 - 2) Dimensions:
 - a) Length.
 - b) Width.
 - c) Height.
 - d) Weight.
 - 3) Amount of electrolyte.
 - 4) Enclosure or rack.
- 10. Silencer:
 - a. Grade.
 - b. Dimensions:
 - 1) Length.
 - 2) Width.
 - 3) Height.
 - 4) Weight.
- 11. Free field mechanical noise level at 23 feet. Provide overall decibels (dBA) rating referenced at 20 μ Pa.
- 12. Exhaust sound level in dBA at 5 feet from discharge end of silencer.
- 13. Recommended spare parts and special tools lists, specifying quantity of each item.

14. Weatherproof acoustical housing:
 - a. Dimensions: As Required.
 - b. Materials.
 - c. Acoustic rating.
 - d. Door locations and access requirements.
 - e. Finish.
- C. Shop drawings:
1. Provide detailed dimensional and to-scale layout drawings including:
 - a. A single drawing incorporating all equipment furnished:
 - 1) Submittals that consist solely of individual drawings for each component and require that these sheets be compiled by the Engineer, in order to view the entire piece of equipment, are not acceptable.
 - b. Conduit stub-out locations.
 2. Detailed electrical wiring diagrams of the engine and generator including:
 - a. Engine interconnection terminal box.
 - b. Generator interconnection terminal box.
 - c. Fuel system.
 - d. All interfaces between the engine driven generator skid and the transfer equipment.
 - e. All wire numbers and terminal block identifications:
 - 1) Wire numbers are to correspond to the wire number on the equipment.
 - 2) All wires are to be numbered.
 - f. Complete interior and exterior control panel layout:
 - 1) Scaled.
 - 2) With device descriptions.
 - 3) With nameplates.
 3. Piping connection and instrumentation diagrams.
 4. Mounting and installation drawings:
 - a. Detailing mounting requirements for the Project Site seismic requirements as specified in Section 16050 - Common Work Results for Electrical.
 - b. Prepared and sealed by a registered structural professional engineer in the state where the Project is being constructed.
- D. Operation and maintenance manuals:
1. Submit operating instructions and a maintenance manual presenting full details for care and maintenance of equipment of every nature furnished and/or installed under this Section.
 2. Operating manual:
 - a. The manual must detail the operational functions of all normally used controls that have been placed on the front of the control equipment.
 - b. Standard operational manuals normally furnished by the manufacturer.
 3. Maintenance manual:
 - a. Printed and bound instructions covering all details pertaining to care and maintenance of all equipment as well as data identifying all parts.
 - b. These manuals must include but are not limited to the following:
 - 1) Electrical controls:
 - a) Adjustment and test instructions covering the steps involved in the initial test, adjustment, and start-up procedures.

- b) Detailed control instructions, which outline the purpose and operation of every control device used in normal operation.
 - c) Description of the sequence of operation that outlines the steps the controls follow during normal power failure and normal power return conditions.
 - d) All schematic, wiring, and external diagrams. Also, internal device wiring and schematic diagrams for all sub-assemblies used in the equipment:
 - (1) Drawing to be furnished in a reduced 11-inch by 17-inch format and shall be fully legible at that drawing size.
- 2) Engine and generator:
 - a) Repair parts manuals normally furnished by the manufacturer.
 - (1) Detailing all parts and sub-assemblies, which are available as repair parts.
 - 3) Shop maintenance manuals:
 - a) Provide 1 shop manual on-site that is equivalent to the manual used by factory-authorized shop repair personnel.
 - b) Manuals for the following equipment:
 - (1) Engine.
 - (2) Radiator.
 - (3) Generator.
 - (4) Engine generator control panel.
 - c. Material safety data sheets:
 - 1) Complete MSDS forms for all substances.
 - 2) Located in O&M manual.
 - 3) Include separate manual labeled MSDS with additional copies of all MSDS forms.
4. Warranty Data.
 5. Maintenance Contract information (if applicable).
- E. Test reports:
1. Furnish complete test reports as specified in this Section.
- F. Certificates:
1. Certification of the emissions performance of the generator set engine by the engine manufacturer.
 2. Certification that a torsional analysis between the engine and generator has been completed.
 3. Seismic certification, as required.
 4. Certification letter from the Generator manufacturer that the generator(s) has been inspected and installed in accordance with the manufacturer's requirements.
 5. Upon completion of installation, manufacturer must issue a certification of compliance with the Contract Documents.
- G. Calculations:
1. Complete loading calculations to support the recommended size of the engine-generator based upon actual facility loads and specified maximum allowable voltage drop.
 2. Supply documentation identifying the maximum static pressure acceptable for the radiator fan. It is the manufacturer's responsibility to then provide calculations as part of the layout drawings, to ensure that the transition

- ductwork at the discharge of the radiator does not exceed the maximum static pressure acceptable for the radiator fan.
3. Submit exhaust system silencer noise attenuation curves.
 4. Structural support system, mounting, and seismic calculations to be signed and stamped by a licensed structural professional engineer, registered in the state where the Project is located:
 - a. Vibration isolator selection calculations.
 - b. Vibration isolator anchoring calculations.
 - c. Exhaust silencer structural support calculations on indoor applications.
 5. Submit factory certification of the radiator ambient capability.
 6. Submit exhaust system pressure loss calculations:
 - a. Include piping, fittings, silencer, and rain cap in loss calculations on indoor applications.
- H. Pre-qualification submittal requirements:
1. Identify the location of 4 similar engine-driven generator type automatic start systems of a similar nature and size installed within a 500-mile radius:
 - a. Furnish the names and the telephone numbers of the persons most familiar with the operations at these installations.
 2. Include a complete recommended spare parts list for the engine and generator along with certified documentation that the authorized dealer maintains 100 percent of these replacement parts in stock at all times.
 3. Submit certification that the authorized dealer has no less than 80 percent of all engine parts in stock at all times.
 4. Certification that authorized dealer or representative's personnel meet the manufacturer's factory standards and requirements.

1.06 QUALITY ASSURANCE

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Manufacturer qualifications:
1. The manufacturer of the engine, generator, and all major items of auxiliary equipment must be in current production of such equipment.
 2. A factory authorized parts and service facility located within 100 miles of the Project Site.
 3. Manufacturer is responsible for furnishing, testing, installation supervising, testing, and guaranteeing the system.
- C. Regulatory requirements:
1. In accordance with NFPA-110 Type 10 (ten second) transfer requirements.
 2. Fuel tanks:
 - a. UL listed.
 - b. Primary and secondary tanks shall be tested under pressure per the manufacturer's recommendation to check for leaks.
 - c. Comply with the following, if applicable:
 - 1) NFPA 30 - Flammable and Combustible Liquids.
 - 2) NFPA 37 - Standard for Installation and Use of Stationary Combustible and Gas Turbines.
 - 3) NFPA 110 - Standard for Emergency and Standby Power Systems.
 3. Regulations of the Fire Prevention Bureau of the fire department having jurisdiction.

4. Other applicable state and local codes.
5. EPA approved.
6. Requirements of local Air Quality Management District or Air Pollution Control District.
7. Comply with the Specifications that may be in excess of, and not contrary to, the regulations.

D. The generator set(s) shall be manufactured to the applicable specifications on file with UL and labeled with the UL 2200 mark.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Furnish the generator skid with removable lifting and jacking angles, eye bolts, etc., attached to the structural base to facilitate unloading and move-in operations.
- C. Provisions on skid for the use of "Multiton" type rollers for moving the generator skid into position and then removal of the "Multiton" rollers and then for setting the engine generator skid in place.
- D. Provide the services of a manufacturer's authorized representative to:
 1. Be present at the jobsite when the engine-driven generator arrives:
 - a. Act as an advisor in assisting the Contractor regarding the unloading and move-in operations.
 2. Coordinate the delivery of the shipment with the Contractor.

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 16050 - Common Work Results for Electrical.

1.09 SEQUENCING

- A. Complete factory prototype and factory production tests in accordance with NFPA 110 before equipment is shipped.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

- A. As specified in Section 16050 - Common Work Results for Electrical.

1.12 SYSTEM START-UP

- A. As specified in Section 16050 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE

- A. Furnish the following spare parts:
 1. 3 sets of lube oil filters, fuel filters, and gaskets.
 2. 2 sets of air filters.
 3. 2 spare lamps of each different lamp type.
 4. 2 fuses (for each control circuit).
 5. 1 set of crankcase breather filters, when used.

- B. Special tools: Furnish a set of specialty tools necessary for routine maintenance of the equipment.
 - 1. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts.
- C. Maintenance Service Contract:
 - 1. Provide maintenance contract for 1 year.
 - 2. Provide at a minimum the following services:
 - a. Monthly inspections and maintenance services, including but not limited to:
 - 1) Engine generator exercising.
 - 2) Oil changes, air filter changes, etc.:
 - a) Dispose of waste oil, filters, etc.
 - b) Provide oil type as recommended by engine manufacturer.
 - 3) Diagnostic checks, with associated diagnostic reports and checklist.
 - 4) Document all services and associated checks, parts, oil changes, filter changes, etc. made during each service visit.
 - 5) Oil sampling.
 - 6) Safety checks.
 - b. Coordinate all visits with Owner prior to visits to ensure that service times are convenient for Owner.
 - c. Include all maintenance parts, labor, travel, etc.
 - d. Include all component parts and repairs, parts, labor, travel, etc.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The following list of manufacturers is a general guideline and makes no statement as to the capability of the manufacturer to meet the Specification requirements. The burden of proof of conformance with these Specifications lies with the Contractor and manufacturer. Contractor must make special written application to use other than these named manufacturers:
 - 1. Engine generators:
 - a. One of the following or equal:
 - 1) Caterpillar.
 - 2) Cummins Power Generation.
 - 3) Kohler.
 - 4) MTU Onsite Energy.
 - 2. Governor:
 - a. One of the following or equal:
 - 1) Woodward.
 - 2) Isochronous electronic by engine manufacturer.
 - 3. Engine starting battery:
 - a. One of the following or equal:
 - 1) Auto Start.
 - 2) East Penn - Dekal.
 - 3) Hawker.
 - 4. Base mounted fuel tank:
 - a. One of the following or equal:
 - 1) Pryco.
 - 2) Tramont.
 - 3) Engine-generator manufacturer's equivalent.

5. Diesel fuel maintenance system:
 - a. The following or equal:
 - 1) Fuel additive:
 - a) Fuel Technologies International, LTSA-35A.

B. Exhaust system:

1. One of the following or equal:
 - a. Silencer:
 - 1) GTE Ind.
 - 2) Harco Manufacturing.
 - 3) Silex Innovations.
 - b. Corrugated, flexible engine connector:
 - 1) DME.
 - 2) GTE Ind.
 - 3) Engine-generator manufacturer's equivalent.
 - c. Expansion joint:
 - 1) DME, Inc.
 - 2) GTE Ind.
 - d. Expansion joint insulation:
 - 1) Pittsburgh-Corning/JPS Composite Materials Corp., Temp-Mat.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Characteristics of assembled unit:

1. The engine-driven generator consists of a diesel engine directly coupled to an electric generator providing electric power.
2. The engine shall start, attain full speed, voltage, and assume full load within a maximum of 10 seconds, with jacket water at 85 degrees Fahrenheit.
3. Furnish the engine-driven generator on a steel sub-base to support engine, generator, and accessories as a unit:
 - a. Base: Welded construction.
 - b. Engine direct connected through a flexible coupling to a single bearing generator.
 - c. System free of injurious torsional and bending vibrations within a speed range from 10 percent below to 10 percent above synchronous speed.
 - d. Engine-driven generator balanced such that the peak-to-peak amplitude of vibration velocity in any direction does not exceed the engine or generator manufacturer's published limits.
 - e. If shims are required under the feet of the generator for alignment purposes, use 1-piece laminated shim stock that covers at least 90 percent of the foot.
 - f. Provide a complete assembled engine-driven generator skid requiring only field electrical and mechanical connections.
4. Connections to engine-driven generator skid:
 - a. Flexible connections are required on all connections to the engine generator.

- b. These connections include but are not limited to:
 - 1) Exhaust.
 - 2) Fuel lines.
 - 3) Radiator discharge air ductwork.
 - c. The length of all flexible connections to exceed the flexible connector manufacturer's minimum length recommendations for the diameter used and for the misalignment as measured after installation.
- B. Generator system performance requirements:
- 1. Power output rating:
 - a. Minimum kilowatts and voltage as indicated on the Drawings.
 - b. 0.8 power factor.
 - c. 3-phase, 4-wire, 60 hertz.
 - d. In accordance with NEMA MG-1 temperature rise limits.
 - 2. It is the manufacturer's responsibility to properly size the engine generator based upon site conditions and actual loads:
 - a. Allowable voltage drop: 10 percent.
 - b. The Drawings and Specifications indicate a minimum size that the Engineer has determined based upon non-certified information.
 - c. No increase in Contract amount will be considered if the equipment size needs to be increased to meet the load requirements after bids have been submitted.
 - d. Provide all changes to the electrical system as required as a result of manufacturers sizing including but not limited to:
 - 1) Conduit.
 - 2) Wire: Provide Nehr-McGrath calculations to verify appropriate cable sizing in accordance with NEC when additional wire is required.
 - 3) Circuit breakers.
 - 4) Transfer equipment.
 - 3. Regulatory requirements:
 - a. Specifically designed to meet the discharge of gaseous pollutants to the atmosphere as required by the EPA statute and local agency issuing the permit for the engine generator system.

2.06 COMPONENTS

- A. Engine generator base:
 - 1. Support system:
 - a. Bolt the engine-driven generator to steel pads that are an integral part of structural support base.
 - b. Vibration isolators shall be provided with the engine-driven generator and be installed between the engine generator and structural support base or between the base and the floor:
 - 1) As recommended by the isolator manufacturer.
 - 2) Located for equal load distribution and deflection per isolator.
 - 3) Designed for the load and seismic conditions as identified for the site.
- B. Engine:
 - 1. Full compression ignition, 4-cycle, turbocharged, and aftercooled meeting the required emissions rating.
 - 2. The rated net horsepower of the engine with all accessories, including radiator fan, must not be less than that required to produce the minimum specified generator capacity at site altitude and maximum ambient temperature.

3. Equipped and designed as follows:
 - a. Spin-on type replaceable lube oil filters.
 - b. Spin-on type replaceable fuel filters.
 - c. Heat treated forged steel crankshaft:
 - 1) Dynamically balanced.
 - d. Forged steel connecting rods.
 - e. Crankshaft driven gear type lubricating pump.
 - f. Electric fuel shut-off valve.
 - g. Engine air cleaner: Dry type replaceable filter.
 - h. 12- or 24-VDC positive engagement solenoid shift-starting motor:
 - 1) The starting equipment must include the necessary devices to prevent an overcrank and lockout if the starter pinion fails to engage the flywheel ring gear on the initial crank attempt.
 - 2) This starter disconnect shall electronically sense the speed of the flywheel and when the flywheel setpoint speed has been reached, the electronic control signals the starter disconnect to disengage.
 - i. Oil level dip stick and oil drain pipe with valve and pipe plug:
 - 1) Oil drainpipe and valve are to extend 3 inches beyond edge of engine base.
 - j. Engines requiring glow plugs are not acceptable.
 - k. Crankcase breather filter for engines not equipped with EPA Tier certified engine's crankcase emissions control equipment:
 - 1) Provide crankcase ventilation system with coalescing filter/trap for blowby:
 - a) Coalescing filter to be replaceable.
 - 2) If engine manufacturer recommends an open crankcase breather system, route outlet of breather filter to outside at 3 inches above grade and away from engine components:
 - a) Provide on breather outlet Nelson "EcoVent" or equal, sized to match engine breather flow.
 - 3) If engine manufacturer recommends a closed crankcase breather system, provide integral crankcase pressure regulator with an automatic internal filter bypass and bypass indicator:
 - a) Racor Model CCV 4500 or equal.

C. Governor:

1. Isochronous type to maintain engine speed:
 - a. Within 0.5 percent for steady state conditions.
 - b. Within 5 percent for a no load to full load step with recovery to within 5 seconds of step load application.
 - c. Suitable for use on diesel engines.
 - d. Electronic governor control of fuel.
 - e. Suitable for automatic, unattended starts.
 - f. Speed sensing failure circuit to signal actuator to close if speed pick-up signal is lost.
 - g. With speed pick-up sensor.
 - h. With capabilities of local speed settings.
 - i. Adjustable acceleration rate control from 0 to 8 seconds.
 - j. Personnel guards over all exposed moving parts.
 - k. Equipped with a continuous duty shutdown system for normal remote stopping.

- D. Engine jacket water heater:
1. Provide an in-line thermostat that disconnects power when coolant temperature exceeds the manufacturer's suggested setpoint.
 2. Contacts from an oil pressure switch or control panel contacts disconnect the heater power when the engine is running.
 3. Provided with shutoff valves and unions to allow heater replacement without draining the cooling system.
 4. Make all water heater connections with high temperature silicon type hoses and constant torque hose clamps.
 5. Size heater such that the engine block temperature is maintained at 85 degrees Fahrenheit at the specified minimum ambient temperature.
 6. Connect water heater and thermostat to the engine to minimize heated water circulation through the radiator circuit.
 7. Power supply:
 - a. Water heaters smaller than 3,000 watts shall be 120 volts, 1-phase.
 - b. Heaters 3,000 watts and larger shall be 460 volts, 1-phase.
- E. Alternator (generator):
1. Brushless synchronous alternator.
 2. Re-connectable 12 lead if available.
 3. Self-ventilated.
 4. Full amortisseur windings.
 5. 2/3 pitch windings, skewed for smooth voltage waveform.
 6. With permanent magnet generator pilot exciter.
 7. Drip-proof enclosure.
 8. Protected against corrosion.
 9. Single bearing design.
 - a. Alternators over 2,000 kW may be 2 bearing design.
 10. Insulation:
 - a. Insulated for continuous operation at 40 degrees Celsius ambient temperature.
 - b. Class F (105 degrees Celsius rise by resistance) for medium voltage or Class H (125 degrees Celsius rise by resistance) for low voltage generators.
 - c. Vacuum impregnated with epoxy varnish to be fungus resistant per MIL I-24092.
 - d. Multiple dipped and baked with a non-hygroscopic varnish with a final dip of epoxy.
 11. Terminate alternator power leads using compression lugs on an insulator and bus bar system within the alternator junction box:
 - a. These terminations must not require any taping to complete the connection.
 - b. Utilize copper flexible, fine stranded type cables to connect from the alternator to the load bank:
 - 1) Sized for 125 percent of the alternator full load current.
 - 2) Neutral conductors shall be sized at 100 percent of the alternator full load rating.
 - c. Provide a ground terminal inside the junction box to terminate the ground cables between the alternator to the automatic transfer equipment ground bus:
 - 1) Minimum size of the equipment-grounding conductor: 12-1/2 percent of the size of the phase conductors.

12. Maximum balanced telephone interference factor not to exceed 50.
13. Designed to supply power to the non-linear loads as specified and as indicated on the Drawings:

F. Alternator digital voltage regulator:

1. Located in the engine control panel.
2. Performance requirements:
 - a. Maintain the steady state voltage within 1 percent:
 - 1) From 40 degrees Fahrenheit to 120 degrees Fahrenheit.
 - 2) From no load to full load conditions.
3. Constant volts per hertz characteristics with under frequency roll-off for better transient response.
4. Static type.
5. Sized to match the power requirements of the exciter circuit and power from the permanent magnet generator pilot exciter.
6. Include manual control to adjust voltage drop, voltage level, and voltage gain.
7. With 3-phase sensing.
8. Sealed from the environment and isolated from the load to prevent tracking when connected to SCR loads.
9. Include loss of sensing shutdown to protect the generator against uncontrolled voltage output when the sensing circuit to the regulator is opened.
10. Shut down regulator when the sensing circuit to the regulator does not have continuity.
11. Include over-excitation shutdown to protect the generator against thermal damage caused by prolonged field forcing.

G. Exhaust system:

1. General:
 - a. Provide a complete exhaust system following as specified.
 - b. Back pressure:
 - 1) Provide components such that the maximum back-pressure in the exhaust system including piping and silencer is less than the maximum allowable back-pressure published by the engine manufacturer, measured at the exhaust manifold header:
 - a) Reduce back-pressure when recommended by the engine manufacturer.
 - c. Provide each exhaust manifold header with a plugged, tapped connection for the attachment of a test manometer.
2. Exhaust silencer:
 - a. Heavy-duty industrial type fabricated of welded steel with ported tubes and snubbing chambers, and a rating meeting the specified sound attenuation.
 - b. End connections: Steel flanges with Class 150-pound drilling pattern.
 - c. Shell:
 - 1) Sufficiently heavy and reinforced to eliminate excessive vibration, stress, or deflection and to support all operating loads with the silencer at elevated temperatures and insulated as specified.
 - 2) Loads include insulation weight and connecting piping.
 - d. Drain: Provide threaded, plugged condensate drain.

- e. Sound attenuation: Attain the following minimum sound attenuation at the listed octave band center frequencies with the engine at full load:

Frequency (Hz)	63	125	250	500	1,000	2,000	4,000	8,000
Attenuation (dB)	39	42	42	40	38	38	38	38

- f. Supports: Provide shell lug supports suitable for supporting and mounting the silencer; support design to account for elevated temperatures under insulated shell.
- g. Pressure drop not to exceed manufacturer's recommendation at maximum engine rating.
3. Exhaust piping:
- Schedule 40 high temperature black steel pipe conforming to ASTM A106.
 - Slope piping to a drain point and provide drain plug.
 - Finish:
 - Sand blast and coat outside of exhaust piping with not less than 6 mils of inorganic zinc primer:
 - Finish coat in the field as specified in Section 09960 - High-Performance Coatings.
4. Exhaust expansion joints:
- Type:
 - Metal with convoluted portion of 0.038-inch thick Type 321 stainless steel.
 - Non-convoluted portions of expansion joint to be Type 304 stainless steel, Schedule 10S pipe.
 - Provide flanged ends with ASME B16.5, Class 150 bolt hole drilling.
 - Length: Minimum of 18 inches in length.
 - Movement:
 - Rated for a minimum of 1 inch lateral movement, and 1/2 inch axial movement.
 - Rated movement defined as plus or minus travel from neutral or free position.
 - Infinite cycle life with 1,200 degrees Fahrenheit exhaust, no insulation over the expansion joint, and continuous duty service.
 - Insulation:
 - Insulate expansion joints with custom fitted, removable with reusable fastening system, ceramic fiber insulation blankets enclosed between inner and outer high temperature fabric cover rated for 1,200 degrees Fahrenheit continuous duty.
 - Do not insulate expansion joints directly connected to turbocharger outlet.
- H. Radiator and cooling system:
- Unit mounted:
 - Furnish a skid mounted closed type radiator system for the engine driven generator:
 - Sized and selected by engine manufacturer to cool the engine and turbo charge aftercooler under ambient conditions.
 - Provide all necessary coolant specifically suitable for the location and conditions of service throughout the year:
 - Ship both the engine and the radiator with the coolant installed.

- I. Generator control panel:
 1. Microprocessor-based control system that is designed to provide automatic starting, monitoring, protection and control functions for the generator set.
 2. Mounted on the generator set:
 - a. Provide vibration isolation:
 - 1) Prototype tested to verify the durability of all components in the system under the vibration conditions encountered.
 3. Control system features and functions:
 - a. Control switches:
 - 1) Mode selector switch:
 - a) Provide a rotary switch or control panel keypads with status indicators.
 - b) The mode select switch initiates the following control modes:
 - (1) RUN or Manual position:
 - (a) Generator set starts, and accelerates to rated speed and voltage.
 - (2) OFF or STOP position:
 - (a) Generator set immediately stops, bypassing all time delays.
 - (3) AUTO position:
 - (a) Generator set accepts a signal from a remote device to start and accelerate to rated speed and voltage.
 - 2) EMERGENCY STOP switch:
 - a) Red "mushroom-head" pushbutton.
 - b) Activating the emergency stop switch causes the engine to immediately stop, and be locked out from automatic restarting.
 - 3) RESET switch:
 - a) Clears all faults and allow restarting the engine generator after it has shut down for any fault condition.
 - 4) PANEL LAMP switch or automatic display panel illumination.
 - b. AC output metering: Provide the control system with metering including the following features and functions:
 - 1) Provide digital metering:
 - a) 1.0 percent accuracy.
 - 2) Voltmeter:
 - a) RMS voltage.
 - b) Line-to-line.
 - c) Line-to-neutral.
 - 3) Ammeter:
 - a) RMS current.
 - 4) Frequency.
 - 5) Power Factor.
 - 6) Kilowatts (kW):
 - a) kW-hours.
 - b) Output kW.
 - 7) Kilovars (kVars):
 - a) kVar-hours.
 - b) Output kVar.
 - c. Generator alarm and status display:
 - 1) Provide high-intensity LED alarm and status indication lamps. Functions indicated include:
 - a) Red alarm-indicating lamps.

- b) Red common shutdown lamp.
 - c) Green lamp to indicate the engine generator is running at rated frequency and voltage based on actual sensed voltage and frequency on the output terminals of the generator set.
 - d) Flashing red lamp to indicate that the control is not in automatic state.
 - e) Amber common warning indication lamp.
- 2) Display the following alarm and shutdown conditions on an alphanumeric digital display panel:
- a) Low oil pressure (alarm).
 - b) Low oil pressure (shutdown).
 - c) Oil pressure sender failure (alarm or indication).
 - d) Low coolant temperature (alarm).
 - e) High coolant temperature (alarm).
 - f) High coolant temperature (shutdown).
 - g) Engine temperature sender failure (alarm or indication).
 - h) Low coolant level (alarm or shutdown - selectable).
 - i) Fail to crank (shutdown).
 - j) Fail to start/overcrank (shutdown).
 - k) Overspeed (shutdown).
 - l) Low DC battery voltage (alarm).
 - m) High DC battery voltage (alarm).
 - n) Low fuel-day tank (alarm).
 - o) High AC voltage (shutdown).
 - p) Low AC voltage (shutdown).
 - q) Under frequency (programmable for alarm or shutdown).
 - r) Overcurrent (programmed for warning or shutdown).
 - s) Short circuit - circuit breaker function (trip).
 - t) Emergency stop (shutdown).
- d. Engine status monitoring:
- 1) Display the following status conditions on an alphanumeric digital display panel:
 - a) Engine oil pressure (pounds per square inch or kilopascal).
 - b) Engine coolant temperature (degrees Fahrenheit or Celsius).
 - c) Engine speed (revolutions per minute).
 - d) Number of start attempts.
 - e) Battery voltage (DC volts).
- e. Data logging and display provision:
- 1) Log the last 10 warning or shutdown indications on the engine generator.
 - 2) Monitor the total load on the generator:
 - a) Maintain data logs of total operating hours at specific load levels ranging from 0 to 110 percent of rated load, in 10 percent increments.
 - b) Display total hours of operation at less than 30 percent load and total hours of operation at more than 90 percent of rated load.
 - 3) The control system to log:
 - a) Total number of operating hours.
 - b) Total kW hours.
 - c) Total control operational hours.

- f. Engine control functions:
 - 1) Provide a cycle cranking system, which allows for user selected crank time, rest time, and number of cycles:
 - a) Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
 - 2) Provide an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this Specification, including adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
 - 3) Provide time delay start (adjustable 0 to 300 seconds) and time delay stop (adjustable 0 to 600 seconds) functions.
 - g. Battery monitoring system:
 - 1) Initiate alarms when the DC control and starting voltage is outside the manufacturers tolerances.
 - 2) Disable the low voltage limit during engine cranking (starter engaged).
 - 3) Monitor DC voltage as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.
 - h. Remote control interface:
 - 1) Provide a minimum of 4 programmable output relays:
 - a) Configurable for any alarm, shutdown, or status condition.
 - 2) Provide a minimum of 4 programmable inputs:
 - a) Label as indicated on the Drawings.
 - b) Labels shall match other control labels.
4. Communications:
- a. MODBUS RS-485.

J. Battery system:

- 1. Installed on the engine-driven generator skid.
- 2. Provide extra flexible minimum 4/0 welding cable to make the connection between the battery and the engine:
 - a. Proper compression lugs and tooling must be used to terminate these cables.
- 3. Provide a 12- or 24-volt lead acid recombination no maintenance engine start battery system:
 - a. The battery shall have sufficient capacity, at the minimum and maximum temperature specified, to provide the specified cranking periods.
 - b. Provide battery capacity in order to supply power to the following:
- 4. Charger:
 - a. Sized to provide sufficient power to both fully charge a drained battery.
 - b. Location: On the engine skid.
 - c. DC ammeter and DC voltmeter.
 - d. On-Off switch.
 - e. Solid-state device with adjustable float voltage control.
 - f. Constant voltage design with current limit.
 - g. With an equalize switch which will allow the battery to be overcharged for maintenance purposes or an automatic charging cycle that has an equalize period.
 - h. Designed to meet the charge, float, and equalize requirement of the battery furnished.
 - i. Overload and short circuit protection.

2.07 ACCESSORIES

- A. Fuel system:
1. Engine fuel pump:
 - a. Positive displacement pump.
 - b. Capable of 5-foot lift minimum.
 2. Base mounted fuel tank:
 - a. Unit mounted base tank with the capacity to hold 24 hours of fuel with the engine generator set operating at full load.
 - b. UL 142 listed tank with secondary containment rupture basin.
 - c. Construction:
 - 1) Reinforced steel channel system.
 - 2) Minimum thickness of 7-gauge for channels.
 - 3) Minimum 12-gauge for tank construction.
 - d. Provide tank baffle to separate hot fuel return from cooler supply fuel.
 - e. Connections:
 - 1) 1.25-inch minimum vents:
 - a) Pipe vent outside any room or enclosure containing the generator set, using Schedule 40 black steel pipe.
 - 2) 2-inch minimum fill connection.
 - 3) 2-inch minimum main fuel storage level gauge.
 - 4) 1.25-inch minimum low fuel level alarm with level switch connected to control panel.
 - 5) 0.5-inch minimum fuel supply with dip tube.
 - 6) 0.5-inch minimum fuel return with dip tube.
 - f. Rupture basin level switch and alarm.
 - g. Finish:
 - 1) Interior: Treated to inhibit corrosion until fuel is added.
 - 2) Exterior: Epoxy coating with urethane top coat.
 - h. Ancillary equipment:
 - 1) Provide the following base tank accessories as required by NFPA 30 for project application:
 - a) Low fuel level float switch, set at 50 percent.
 - b) High fuel level / overfill prevention, audible alarm, set at 90 percent.
 - c) Overfill prevention valve on tank fill port, set at 95 percent.
 - d) Fill port drop tube to within 6 inches of the bottom of the tank.
 - e) Spill containment bucket or basin around fill port.
 - f) Interstitial monitoring float switch (leak detection).
 - g) Normal vents, extended 13 feet above grade, flame arrester caps.
 - h) Emergency vents, on tank and containment basin.
 - i) Provisions for connection of grounding conductor.
 - j) Tank calibration chart in inches to gallons.
 - i. Warning signage:
 - 1) No Smoking.
 - 2) Flammable Liquids.
 - 3) Diesel Fuel.
 - 4) NFPA 704 Placards.

- B. Weatherproof acoustical housing:
1. Provide engine enclosure to protect engine, generator, starting system, batteries, and other specified accessories from weather exposure.
 2. Meet seismic and wind requirements at the Project Site.
 3. Construction:
 - a. Minimum 14 gauge steel panel thickness.
 - b. All panels and members hot dip galvanized after fabrication.
 - c. Enclosure removable to allow for maintenance.
 - d. Fitted with lockable latches.
 - e. Stainless steel latches and hinges.
 4. Finishing: Factory or shop finished in epoxy and urethane coating system as specified in Section 09960 - High-Performance Coatings.
 5. Noise reduction:
 - a. Provide acoustical insulation and acoustical enclosure ventilation louvers and fan discharge silencers as necessary to achieve a measured sound pressure level of 80 dBA when measured at 23 feet from the enclosure.
 - b. Protect acoustical insulation with perforated metal covers and plastic bagging to prevent damage from abrasion or weather elements.
 - c. Provide an exhaust silencer matched to the enclosure to reduce the overall noise emissions level of the engine/generator assembly to the levels required above.
 6. Interior light:
 - a. Pre-wired battery operated light powered from the engine cranking batteries.
 - b. Located within the enclosure to illuminate the automatic transfer equipment as well as the engine generator control panel.
 - c. Controlled by a switch located by one of the entrance doors:
 - 1) Wind-up timer type switch that automatically shuts off after a preset interval not to exceed 1 hour.
 - d. Increase the size of the battery charger and battery to accommodate this additional load.
 7. Finish:
 - a. Upon final assembly, prime the enclosure with a minimum of 2 coats of a zinc rich primer.
 - b. Final finish: minimum of 2 coats of paint of a color selected by the Owner, and in conformance with the painting and finishes section of these Contract Documents.
 8. The engine generator manufacturer is solely responsible for all connections within the generator, the enclosure power system, and the enclosure so that the enclosure and engine generator are a single fully functional system.
- C. Wiring:
1. All external wiring connections to and from the engine and alternator shall be made via 2 engine mounted junction boxes:
 - a. One box shall be used for all control and DC power connections.
 - b. The other box shall be used for the alternator output connections:
 - 1) The alternator output breaker may be used for these connections.
 2. Enclose wiring in an NEC approved and recognized conduit system selected and sized by the engine generator manufacturer:
 - a. Suitable for the temperatures, vibrations, and conditions on the engine-driven generator skid.

3. Control wiring shall terminate on terminal blocks in the control junction box:
 - a. All connections shall be made to terminal blocks:
 - 1) 600 volt rated.
 - 2) Wires terminated on box with compression type ring type lugs, installed with proper tooling.
 - 3) Terminal blocks shall be numbered.
 - 4) All wiring in terminal box both internal and field connections shall be routed in plastic wire duct.
 4. Terminate alternator output connection wires using solderless compression type lugs when connecting to bus bar:
 - a. Lug manufacturer's termination methods and tools must be used.
 5. Splices are not allowed:
 - a. All connections are to be made at the terminal blocks in the control junction boxes.
- D. Miscellaneous engine generator skid items:
1. Provide the following items:
 - a. Sectionalized drip pans.
 - b. Rain shields for exhaust lines.
 - c. Roof jacks.
- E. Generator output circuit breaker:
1. Engine generator skid mounted and line side connected to alternator.
 2. Manually resettable.
 3. Line current sensing.
 4. Inverse time versus current response.
 5. Sized and coordinated to protect the generator from damage from overload and/or short circuit:
 - a. Coordinated with downstream devices:
 - 1) As specified in Section 16305 - Electrical System Studies.
 6. Breakers shall be as specified in Section 16412 - Low Voltage Molded Case Circuit Breakers.
 7. Provide breakers with proper number of lugs to match cables as indicated on the Drawings.
- F. Manual load bank and manual transfer breakers:
1. Furnish load bank integrally mounted on the engine-generator skid and fully connected:
 - a. Engine radiator airflow cooled, resistive load bank.
 - b. Load bank designed for local and manual control.
 - c. Install the load bank as follows:
 - 1) Bolted attachment to radiator with duct and flex coupling to air outlet in wall.
 - d. Electrical connection:
 - 1) Power source to load bank connection is 3-phase, 3-wire plus ground from engine-generator.
 - 2) 60 hertz.
 - e. Rating:
 - 1) Capacity minimum of 50 percent horsepower rating in kW of engine.
 - 2) 50 kW load step resolution.
 - 3) Air intake temperature coordinated with the maximum discharge temperature of the radiator.

- 4) Duty cycle: Continuous.
 - 5) Air temperature rise 100 degrees Fahrenheit nominal.
 - 6) Air back-pressure to be coordinated with the engine and radiator requirements.
- f. Design:
- 1) Completely self-contained unit that includes:
 - a) Resistive load elements.
 - b) Load control devices.
 - c) Load element branch circuit fuse protection.
 - d) Main load bus and terminals.
 - e) Control terminals.
 - f) System protection devices.
 - g) Enclosure.
 - 2) Enclosure:
 - a) NEMA Type 3R galvanized steel, unit construction.
 - b) Consisting of:
 - (1) Power section, for installation and wiring of the load elements.
 - (2) Control section for installation and wiring of control components. Physically and thermally isolated from both the hot load elements and the heated airflow.
 - c) Screen the exhaust of the load bank.
 - 3) Load elements:
 - a) UL listed, labeled, or recognized.
 - b) Totally enclosed, sealed, and weatherproofed.
 - c) Electrically grounded outer sheath such that the element cannot be electrically short circuited by external foreign objects, and personnel are protected against accidental electrical shock.
 - d) Replaceable individual elements.
 - e) Open wire type elements in which the electrically live conductors are exposed and which can be short circuited to each other or to ground by foreign objects or by the breakage of an element or an element support shall not be permitted.
 - f) Load element short circuit protection: branch circuit fuses, per each load step branch circuit:
 - (1) Fuses: 200,000 A.I.C. current limiting type.
 - 4) Load control: 1 magnetic contactor per each fused branch circuit.
 - 5) Load bank power wiring: 150 degrees Celsius insulated.
 - 6) Main terminals:
 - a) Barrier type power terminal block with compression type terminal to accept stranded building wire.
 - b) Provide chassis ground stud with compression type terminal.
 - 7) Control wiring: 105 degrees Celsius insulated.
 - 8) Control power: Derived internally from the main load bus, control and protective circuits operating at 120 VAC via control power transformer.
 - 9) System protection:
 - a) Protect against overheating.
 - b) Disconnect the load elements from the power source and activate an alarm upon sensing a loss of cooling airflow, or an exhaust air temperature greater than 300 degrees Fahrenheit.

- g. Local control panel:
 - 1) Provide a NEMA Type 3R control panel for manual operation that includes:
 - a) Control power On-Off pushbuttons.
 - b) Normal operation indicator lamp.
 - c) Master load control switch.
 - d) Load step control switches.
 - e) Cooling failure alarm indicator lamp.
 - f) Load dump circuit. Connected to engine/generator control panel to de-energize the load bank in the event of the generator receiving a start command from the automatic transfer switch.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. General:
 - 1. Install the equipment as indicated on the Drawings.
 - 2. Perform all Work in accordance with manufacturer's instructions and shop drawings.
 - 3. Before start-up, furnish written certification that the entire installation and all connections, both mechanical and electrical, have been inspected and are proper and consistent with the Drawings and Specifications.
- C. Installation shall be by personnel experienced and regularly engaged in field installation of power generation systems:
 - 1. Make all field mechanical and electrical connections.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

- A. Design prototype tests as follows:
 - 1. Use design prototypes similar to the equipment specified in this Section for testing, and not the actual equipment for the Project.
 - 2. Minimum testing requirements:
 - a. In accordance with NFPA.
 - b. Maximum power in kW.
 - c. Maximum starting kilovolt-ampere at 35 percent instantaneous voltage dip.
 - d. Alternator temperature rise:
 - 1) By embedded thermocouple.
 - 2) By resistance method.
 - 3) In accordance with NEMA MG1-22.40 and 16.40.
 - e. Governor speed regulation under steady state and transient conditions.
 - f. Fuel consumption at 25 percent, 50 percent, 75 percent, and 100 percent load.
 - g. Harmonic analysis, voltage wave form deviation, and telephone influence factor.
 - h. Cooling airflow.
 - i. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.
 - j. Endurance testing.
 - k. A certified copy of the test results will be furnished to the Owner.
- B. Test each engine generator under varying loads with all machine safety guards and exhaust system in place.
- C. Test the complete engine generator system at full load and rated power factor with a reactive load bank in the manufacturer's factory:
 - 1. Tests shall include:
 - a. Radiator.
 - b. Engine control panel.
 - c. Load bank.
 - d. Automatic transfer system.
 - e. Single-step load pickup.
 - f. Transient and steady-state governing.
 - g. Safety shutdown device testing.
 - h. Rated power.
 - i. Maximum power.
 - 2. During the tests, re-circulate the radiator cooling air through the radiator as necessary to test the system under the maximum ambient conditions specified in this Section.
 - 3. Run the unit for 2 hours with the following recordings made hourly:
 - a. Frequency.
 - b. Voltage.
 - c. Amperage.
 - d. Kilowatts.
 - e. Room temperature measured at the generator end of the unit.
 - f. Radiator air inlet temperature.
 - g. Coolant temperature.
 - h. Oil pressure.

4. Record the following items:
 - a. Time required for the engine/generator to start and reach rated voltage and frequency in seconds.
 - b. Maximum block load capabilities of the unit.
 - c. Point at which overtemperature shutdown occurs.
 - d. Point at which overspeed shutdown occurs.
 - e. Point at which low oil pressure shutdown occurs.
 - f. Point at which overcrank shutdown occurs.
 - g. Low water temperature alarm.
 - h. Low fuel level alarm.
 - i. Fuel leak alarm.
 - j. Overvoltage alarm and shutdown.
 - k. Undervoltage alarm and shutdown.
 - l. Under frequency alarm and shutdown.
 - m. Low battery voltage alarm.
5. Furnish a certified copy of the test results to the Owner:
 - a. Record any minor adjustments made during the test.
 - b. If major changes, as determined by the Engineer, are made, the 2-hour test must be repeated.

3.08 FIELD QUALITY CONTROL

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Provide the services of a manufacturer's representative for the following:
 1. Before start-up, furnish written certification that the entire installation and all connections, both mechanical and electrical, have been inspected and are proper and consistent with all Drawings and Specifications.
 2. Furnish the services of factory-certified technicians during the start-up and adjustment period to make sure all items furnished are in proper operating condition:
 - a. Engine technician must be completely knowledgeable in the operation, maintenance, and start-up of the mechanical system.
 - b. Electrical technician must be completely knowledgeable in the operation, maintenance, and start-up of the electrical system.
 - c. These technicians to instruct the Owner's personnel regarding the operation and maintenance of all items supplied:
 - 1) Supply written handouts during the training period, and these handouts should be suitable for future reference after the training period is completed.
 - d. Furnish a written report after the start-up:
 - 1) Report must state that the installation is complete and satisfactory.
 - 2) List the items requiring additional attention.
- C. Manufacturer to perform installation check, start-up, and load test.
- D. Certify that fuel, lubricating oil, and antifreeze conform to the manufacturer's recommendations under the environmental conditions present.

- E. Check accessories that normally function while the equipment is in standby mode for proper operation, before cranking the engine:
 - 1. These accessories include but are not limited to:
 - a. Jacket water heaters.
 - b. Fuel heaters, when used.
 - c. Battery charger.
 - d. Generator strip heaters, when used.

- F. Start-up under manual mode:
 - 1. Check for the following items:
 - a. Exhaust leaks.
 - b. External path for exhaust gases.
 - c. Cooling airflow.
 - d. Movement during starting and stopping.
 - e. Vibration during running.
 - f. Normal and emergency line-to-line voltage and phase rotation.

- G. Perform functional testing of load bank:
 - 1. Verify all load bank steps operate properly.
 - 2. Verify load dump circuitry is active.

- H. Perform field acceptance tests as specified in Section 16950 - Field Electrical Acceptance Tests.

3.09 ADJUSTING

- A. Make adjustments as necessary and recommended by the manufacturer, Engineer, or testing firm.

3.10 CLEANING (NOT USED)

3.11 PROTECTION

- A. As specified in Section 16050 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION

ATTACHMENT F

SECTION 16442

INDIVIDUALLY-MOUNTED CIRCUIT BREAKER SWITCHBOARDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Free standing, dead-front type metal-enclosed, low voltage switchboards with individually mounted circuit protective devices.

1.02 REFERENCES

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Institute of Electrical and Electronic Engineers (IEEE).
 - 1. C57.13 - IEEE Standard Requirements for Instrument Transformers.
- C. National Electrical Manufacturers' Association (NEMA):
 - 1. PB 2 - Deadfront Distribution Switchboards.
- D. Underwriters' Laboratories, Inc. (UL):
 - 1. 891 - Switchboards.

1.03 DEFINITIONS

- A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

- A. Factory assembled, wired, and tested switchboards, with major components being products of a single manufacturer, including circuit breakers, and other equipment specified in this Section and **indicated on the Drawings**.

1.05 SUBMITTALS

- A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.
- B. Product data:
 - 1. Manufacturer of switchboard.
 - 2. Manufacturer of all component parts of switchboard.
 - 3. Dimensions:
 - a. Width.
 - b. Length.
 - c. Height.
 - d. Weight.
 - 4. Nameplate schedule.
 - 5. Bill of material.
 - 6. Description of operation:

7. Ratings:
 - a. Voltage.
 - b. Phase.
 - c. Current.
 - d. Interrupting rating (circuit breakers and fuses).
 8. List of recommended spare parts.
 9. Certification that the utility metering compartment meets the requirements of the serving electrical utility.
 10. Name of dealer's repair facility and parts stocking agreement with the factory:
 - a. Agreement shall outline in detail the manufacturer's parts stocking requirements and the method by which the manufacturer's representative verifies that the stock is at an acceptable level.
 - b. Agreement should also outline the method by which the manufacturer's representative determines that the service personnel meet factory standards.
 - c. A toll-free or local phone number with 24/7 emergency monitoring/call back is required.
 11. Furnish circuit breaker submittals as specified in:
 - a. Section 16412 - Low Voltage Molded Case Circuit Breakers.
 - b. Section 16413 - Low Voltage Insulated Case Circuit Breakers.
 12. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in Section 16050 - Common Work Results for Electrical:
 - a. Manufacturer's statement of seismic qualification with substantiating test data.
 - b. Manufacturer's special seismic certification with substantiating test data.
- C. Shop drawings:
1. Complete, detailed, and scaled switchboard layout:
 - a. Front panel.
 - b. Sub-panels.
 - c. Interior panels.
 - d. Top and bottom conduit windows.
 2. Complete electrical wiring diagrams:
 - a. Point-to-point connections.
 - b. Internal compartment-to-compartment interconnection wiring diagrams.
 - c. Wiring identification and terminal numbers.
 3. Complete 3-line diagrams for each switchboard lineup. These drawings shall indicate devices comprising the switchboard assembly including, but not limited to, circuit breakers, control power and instrument transformers, meters, and control devices. Clearly, indicate electrical ratings of devices on Drawings.
 4. Complete interface and connection diagrams for metering system.
 5. Complete bill of material list and equipment data sheets identifying appropriate information specific to the switchboard being supplied.
 6. Nameplate schedule.
- D. Installation instructions:
1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
 2. For equipment installed in structures designated as seismic design category A or B:

- a. Provide manufacturer's installation instructions and anchoring details for connecting equipment to supports and structures.
 - 3. For equipment installed in structures designated as seismic design category C, D, E, or F:
 - a. Provide project-specific installation instructions and anchoring details based on support conditions and requirements to resist seismic and wind loads as specified in Section 16050 - Common Work Results for Electrical.
 - b. Submit anchoring drawings with supporting calculations.
 - c. Drawings and calculations shall be stamped by a professional engineer registered in the state where the Project is being constructed.
- E. Test forms and reports:
 - 1. Submit complete factory acceptance test procedures and all forms used during the test.
 - 2. Manufacturer to furnish a certified report after the shop tests.
 - 3. Manufacturer's start-up representative to furnish a written report after the start-up:
 - a. Report must state that the installation is complete and satisfactory, or list items requiring additional attention and a proposal for the actions.
 - b. If any items require attention after the initial start-up, a final report is required stating that the installation is complete and satisfactory.

1.06 QUALITY ASSURANCE

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. The switchboard and all components shall be UL listed and labeled.
- C. Where shown as service entrance equipment, the switchboard shall be UL labeled and listed Suitable for Service Entrance.
- D. Equipment shall be designed and constructed in accordance with the following standards and requirements:
 - 1. NEMA PB 2.
 - 2. UL 891.
- E. The manufacturer shall be ISO 9001 certified.

1.07 DELIVERY STORAGE AND HANDLING

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Ship switchboards to the site in dedicated air ride vans that will allow the Contractor to utilize on site off loading equipment.
- C. Furnish temporary equipment heaters within the switchboard to prevent condensation from forming.

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 16050 - Common Work Results for Electrical.

1.09 SEQUENCING

- A. Conduct the initial fault current study as specified in Section 16305 - Electrical System Studies and submit results for Engineer's review.
- B. After successful review of the initial fault current study, submit complete equipment submittal.
- C. Conduct factory acceptance test and submit certified test results for Engineer's review.
- D. Ship equipment to the Project Site after successful completion of factory acceptance test.
- E. Assemble equipment in the field.
- F. Conduct final fault current and coordination study.
- G. Conduct field acceptance test and submit results for Engineer's review.
- H. Submit manufacturer's certification that the equipment has been properly installed and is fully functional for Engineer's review.
- I. Conduct Owner's training sessions.
- J. Commissioning as specified in Section 01756 - Commissioning.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Extended warranty:
 - 1. Provide an additional 5 years manufacturer's warranty for all equipment provided under this Section.

1.12 SYSTEM START-UP

- A. As specified in Section 16050 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Switchboards:
 - 1. One of the following or equal:
 - a. Eaton.

- b. GE by ABB.
- c. Schneider Electric.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

- A. Switchboard:
 - 1. Provide complete and functional switchboards with required controls.
 - 2. Furnish and install devices or accessories not described in this Section but necessary for the proper installation and operation of the equipment.

- B. Voltage ratings:
 - 1. Voltage level and configuration: As **indicated on the Drawings**.
 - 2. Frequency: 60 hertz.
 - 3. Insulation level:
 - a. Twice the rated voltage plus 1,000 volts.

- C. Bus:
 - 1. General:
 - a. Tin-plated copper.
 - b. Bus cross-section in accordance with UL heat rise requirements.
 - c. Current density of 1,000 amperes per square inch.
 - d. Mounted on supports of high-impact, non-tracking insulators.
 - e. Phase A-B-C bus arrangement:
 - 1) Top-to-bottom, left-to-right, front-to-back throughout the switchboard.
 - f. Symmetrical short circuit current bracing of as **indicated on the Drawings**.
 - g. Continuous current rating as **indicated on the Drawings**.
 - 2. Horizontal bus:
 - a. Provisions for future connections to additional switchboard sections.
 - 3. Ground bus:
 - a. Sized per UL 891.
 - 4. Neutral bus:
 - a. Sized for 100 percent of power bus rating.

- D. Space for future devices:
 - 1. When specified or shown on the plans, space for future devices shall include:
 - a. All necessary bus.
 - b. Device supports.
 - c. Device mounting equipment.
 - d. Device connections to bus work.
 - e. Wire troughs or raceway space.
 - 2. Unused device space shall be covered with blank code gauge steel covers or doors.

- E. Utility metering compartment:
 - 1. When shown on the plans furnish an integral utility current and potential transformer cabinet for utility company metering.

2. Current transformer bus bars shall be mounted on high-impact fiberglass reinforced polyester insulation.
3. Door with concealed hinges, 3-point catch, and lockable handle.
4. Metering compartment barriers, rear, top, bottom, and sides.
5. Current transformer bus bars drilled in accordance with the requirements of the electric utility.
6. Potential transformer connections via drilled and tapped machine screw connections to service entrance bus bars as required by the electric utility.
7. All dimensions, ratings, spacings and standards shall be in accordance with the requirements of the electric utility.
8. Service Entrance cables to enter the utility metering compartment as **indicated on the Drawings.**

F. Enclosure:

1. General:
 - a. Self-supporting structures bolted together to form the required line-up.
 - b. All sections rear aligned.
 - c. Dead-front.
 - d. Conduit entry:
 - 1) Open-bottom.
 - 2) Removable top cover.
2. Frame:
 - a. Die-formed 12 gauge steel.
3. Covers:
 - a. Bolt-on.
 - b. Code gauge steel.
 - c. Removable front covers:
 - 1) Held in place by captive screws.
4. Rating:
 - a. NEMA Type 3R:
 - 1) Sloped roof.
 - 2) Filtered vents to provide ventilation to maintain the equipment within its operating temperature range.
 - 3) Space heaters to prevent condensation.
 - 4) Control power transformer:
 - a) Sized to power space heaters, lights, and receptacles.
 - b) Primary and secondary fusing.
 - 5) Doors:
 - a) Front and rear.
 - b) Wind stop on each door.
 - c) 3-point catch with provision for padlock.
 - d) Front to rear full depth lifting beams.
 - 6) Gasketed.
 - 7) Fluorescent light.
 - 8) 120-volt, 15-amp GFCI convenience outlet.
 - 9) Non walk-in construction.

2.06 COMPONENTS

A. Circuit breakers:

1. As specified in Sections 16412 - Low Voltage Molded Case Circuit Breakers and 16413 - Low Voltage Insulated Case Circuit Breakers.

2. All circuit breakers shall be individually mounted with line and load bus connections.
3. Main circuit breakers shall be fixed mounted molded case breaker with frame and trip ratings as **indicated on the Drawings**.
4. Circuit breakers shall have a minimum interrupting rating equal to the bus rating or as **indicated on the Drawings**.

B. Wiring:

1. Provide all necessary internal wiring, fuse blocks, and terminal blocks as required. Number all wires at each end and indicate wire numbers on shop drawings.
2. All control wiring within the equipment shall utilize type SIS switchboard wire with at least 26 strands. Minimum wire size shall be No. 14 for control circuits and No. 12 for potential and current transformer circuits.
3. All wires shall be numbered and labeled as specified in Section 16075 - Identification for Electrical Systems.

2.07 ACCESSORIES

A. Instrument transformers:

1. Current transformers:
 - a. Overload rating 1.0 at 55 degrees Celsius, breaker cubicle maximum allowable temperature.
 - b. Short time overload rating 10 times continuous rating for 1 second.
 - c. Connected directly to an accessible shorting type current transformer terminal block:
 - 1) As manufactured by GE by ABB.
 - d. Ratio as indicated.
2. Potential transformers:
 - a. Overload rating 1.10 times continuous rating.
 - b. Ratio as indicated.
 - c. Sized to that the thermal burden rating of the transformer is not exceeded.

B. Meter test blocks:

1. Allow independent metering of voltages on all phases:
 - a. Phase to Phase.
 - b. Phase to Neutral.
 - c. 6 pole test block.
2. Allow independent metering of all currents:
 - a. Phase currents.
 - b. Neutral current as indicated on the plans.
 - c. 4 pole test block.
3. Furnish 1 meter plug for each meter test block.
4. As manufactured by GE by ABB PK-2 or equal.

C. Surge protective devices:

1. As specified in Section 16285 - Surge Protective Devices.

D. Nameplates:

1. As specified in Section 16075 - Identification for Electrical Systems.
2. Furnish an individual nameplate for each breaker and/or switch identifying the load served.

3. Furnish an individual nameplate for each vertical section identifying the vertical section:
 - a. Nameplate mounted and centered on the top horizontal wireway for each vertical section.
 4. Furnish an individual nameplate for each cubicle:
 - a. One nameplate to identify cubicle designation.
 - b. One nameplate to identify load served.
 5. Manufacturers labels:
 - a. Each vertical section shall have a label identifying:
 - 1) Serial number.
 - 2) Shop order number.
 - 3) Bus rating.
 - 4) Vertical section reference number.
 - 5) Date of manufacture.
 6. Warning sign:
 - a. Provide a minimum of two warning signs on the front of the switchboard line-up and two on the back.
 - b. Red laminated plastic engraved with white letters approximately 1/2 inch high.
 - c. Signs shall read "DANGER HIGH VOLTAGE."
 7. Mimic bus:
 - a. Provide a laminated plastic mimic bus mounted on the front of the enclosure that represents all busing, protective devices, transformers, etc.
- E. Lugs:
1. For all external connections of No. 6 AWG or larger, plated or otherwise suitable for copper or aluminum and U/L listed for copper or aluminum.
 2. Lugs shall be of the compression type in design requiring a hydraulic press and die for installation as manufactured by:
 - a. Burndy.
 - b. T&B.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

- A. Chemically clean all steel surfaces before painting.
- B. Exterior color manufacturer's standard gray over phosphate-type rust inhibitor.

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.
- C. General:
 - 1. Furnish cables, conduit, lugs, bolts, expansion anchors, sealants, and other accessories needed to complete the installation of the switchboard.
 - 2. Physically assemble and install the switchboard in the location and layout **indicated on the Drawings**.
 - 3. Make bus splice connections.
 - 4. Perform work in accordance with manufacturer's instructions and shop drawings.
 - 5. Furnish components and equipment as required to complete the installation.
 - 6. Replace hardware lost or damaged during the installation or handling to provide a complete installation.
 - 7. Install the switchboard on a raised concrete housekeeping pad:
 - a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.
 - b. Weld and/or bolt the switchgear frame to the leveling channels.
 - 8. Provide openings in top or bottom of the enclosure for conduit only, no additional openings will be allowed:
 - a. Improperly cut holes will require that the entire panel be replaced:
 - 1) No hole closers or patches will be allowed.
- D. Provide the services of a qualified manufacturer's representative to:
 - 1. Inspect, verify, and certify that the mechanical installation meets the manufacturer's requirements.
 - 2. Make control connections across the shipping splits.
 - 3. Install and align all circuit breakers.
 - 4. Perform field tests.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

- A. As specified in Section 01756 - Commissioning.
- B. Factory tests:
 - 1. The Owner and Engineer will witness the factory acceptance test as specified in Section 16050 - Common Work Results for Electrical.
 - 2. Test the complete switchgear at the manufacturer's establishment.
 - a. Completely assemble, wire and test the switchboard:
 - 1) Detailed inspections before and after assembly to ensure correctness of design and workmanship.

- 2) Provide groups of wires leaving the shipping-assembled equipment with terminal blocks with suitable numbering strips.

C. Owner training:

1. As specified in Sections 01756 - Commissioning and 16050 - Common Work Results for Electrical.

3.08 FIELD QUALITY CONTROL

- A. As specified in Section 16050 - Common Work Results for Electrical.

B. Provide manufacturer's services for the following:

1. Make all bus splice connections.
2. Make all control connections across shipping splits.
3. Ensure that all items furnished are in proper operating condition:
 - a. Technician must be completely knowledgeable in the operation, maintenance, and start-up of the electrical system.
4. Furnish a written report after start-up signed by the manufacturer's authorized representative:
 - a. Report must state that the installation is complete and meets all of the manufacturer's requirements.
 - b. List any items requiring additional attention.

3.09 ADJUSTING

- A. Make all adjustments as necessary and recommended by the manufacturer, Engineer, or testing firm.

3.10 CLEANING

- A. As specified in Section 16050 - Common Work Results for Electrical.

3.11 PROTECTION

- A. As specified in Section 16050 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION

ATTACHMENT G

SECTION 16491
TRANSFER SWITCHES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Transfer switches.

1.02 REFERENCES

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Underwriters Laboratories (UL):
 - 1. UL 1008 Transfer Switch Equipment.

1.03 DEFINITIONS

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Specific definitions:
 - 1. ATS: Automatic transfer switch.
 - 2. MTS: Manually initiated, electrically operated transfer switch.
 - 3. SCCR: Short-Circuit Current Rating, the maximum short-circuit current a component and assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time.
 - 4. WCR: Withstand and Closing Rating, represents a transfer switch's capability to ride out a fault condition until the overcurrent protective device opens and clears the fault.

1.04 SYSTEM DESCRIPTION

- A. Provide transfer switches capable of transferring load circuits from utility power to standby power and back.
- B. ATS sequence of operation:
 - 1. When the voltage of any normal source phase drops below 80 percent and after an adjustable time delay (0 to 6 seconds minimum), the transfer switch shall start the standby generator.
 - 2. When standby voltage reaches 90 percent of nominal, and frequency is within 2 hertz of nominal, following an adjustable time delay (0 to 10 seconds), the switch shall transfer to standby power.
 - 3. When normal power has been restored to 90 percent of nominal on all phases, following an adjustable time delay (0 to 30 minutes), the switch shall retransfer to normal power.
 - a. If the standby source fails during this time delay, the switch shall automatically retransfer to normal power.
 - b. Retransfer to normal power shall be closed transfer.

- 1) An alarm shall be initiated if the switch fails to retransfer in a pre-set period of time.
4. Following an adjustable generator cool-down timer (0 to 60 minutes), the switch shall stop the generator.

1.05 SUBMITTALS

- A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.
- B. Product data:
 1. Manufacturer of transfer switch.
 2. Manufacturer of all component parts of the ATS.
 3. Dimensions:
 - a. Width.
 - b. Length.
 - c. Height.
 - d. Weight.
 4. Bill of material.
 5. Description of operation.
 6. Ratings:
 - a. Voltage.
 - b. Phase.
 - c. Current.
 - d. Number of poles.
 - e. Withstand and Closing Rating (WCR).
 7. List of recommended spare parts.
 8. For equipment installed in structures designated as Seismic Design Category C, D, E, or F, submit the following as specified in Section 16050 - Common Work Results for Electrical:
 - a. Manufacturer's statement of seismic qualification with substantiating test data.
 - b. Manufacturer's special seismic certification with substantiating test data.
- C. Shop drawings:
 1. Layout drawings:
 - a. Furnish full-dimension and to-scale equipment layout drawings which include:
 - 1) Plan, front, and side views.
 - 2) Sub-panels.
 - 3) Interior panels.
 - 4) Top and bottom conduit windows.
 2. Complete electrical wiring diagrams:
 - a. Point-to-point connections.
 - b. Indicate wire numbers.
 3. Complete interface and connection diagrams.
 4. Transfer Equipment Label indicating the short-circuit current rating (SCCR).
- D. Installation instructions:
 1. Detail the complete installation of the equipment including rigging, moving, and setting into place.

2. For equipment installed in structures designated as Seismic Design Category A or B:
 - a. Provide manufacturer's installation instructions and anchoring details for connecting equipment to supports and structures.
 3. For equipment installed in structures designated as Seismic Design Category C, D, E, or F:
 - a. Provide project-specific installation instructions and anchoring details based on support conditions and requirements to resist seismic and wind loads as specified in Section 16050 - Common Work Results for Electrical.
 - b. Submit anchoring drawings with supporting calculations.
 - c. Drawings and calculations shall be stamped by a professional engineer registered in the state where the Project is being constructed.
- E. Operation and maintenance manuals:
1. Operating instructions:
 - a. Printed and framed instruction chart suitable for wall hanging.
 - b. Detail the operational functions of all transfer switch controls.
 2. Maintenance manual:
 - a. Furnish maintenance manuals with instructions covering maintenance of all equipment and data identifying all parts.
 - b. Furnish all information needed to maintain the transfer switch including, but not limited to, the following:
 - 1) Instructions for testing, adjustment, and start-up.
 - 2) Detailed control instructions that outline the purpose and operation of every control device used in normal operation.
 - 3) Description of the sequence of operation that outlines the steps that follow normal power failure, transfer to standby power, return to normal power, and fault conditions.
 - 4) Schematics and wiring:
 - a) Furnished in a reduced 11-inch-by-17-inch fully legible format.
 - 5) Report listing the installed setting of all adjustable parameters for the automatic transfer system.
- F. Test forms and reports:
1. Submit complete factory acceptance test procedures and all forms used during the test.
 2. Manufacturer to furnish certified report after the factory tests.
 3. Manufacturer to furnish written report after start-up:
 - a. Report must state that the installation is complete and satisfactory, or list items requiring additional attention and a proposal for the corrective actions.
 - b. If the items require attention after the initial start-up, a final report is required stating that the installation is complete and satisfactory.
- G. Calculations:
1. Detailed calculations or details of the actual physical testing performed on the transfer switch to prove the transfer switch is suitable for the seismic requirements at the Project Site.
- H. Warranty.

1.06 QUALITY ASSURANCE

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Transfer switches shall be UL listed and labeled.
 - 1. Where **indicated on the Drawings** the transfer switch shall be UL labeled and listed "Suitable for Service Entrance."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Ship the transfer switch to the job site on a dedicated air-ride vehicle that will allow the Contractor to utilize on-site off-loading equipment.
- C. Furnish temporary equipment heaters within the transfer switch to prevent condensation from forming.

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 16050 - Common Work Results for Electrical.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

- A. As specified in Section 16050 - Common Work Results for Electrical.
- B. Extended warranty:
 - 1. Provide an additional 5 years manufacturer's warranty for all equipment provided under this Section.

1.12 SYSTEM START-UP

- A. As specified in Section 16050 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Transfer switch: One of the following or equal:
 - 1. GE Zenith Controls by ABB.
 - 2. Russelectric, Inc.
 - 3. Eaton.
 - 4. ASCO.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. General:

1. Capable of switching all classes of load.
2. Rated for continuous duty when installed in a non-ventilated enclosure.
3. Provide circuit breakers or contactors rated for continuous duty.
4. Minimum transfer time for delayed transition ATS: 1 second.
5. Capable of transferring successfully in either direction with 70 percent of rated voltage applied to the terminals.
6. Provide automatic transfer switches with provisions for manual operation under no load.
7. Transfer switch short circuit rating to be coordinated with the overcurrent protective devices at the fault current available on the line side of the transfer switch.

B. Electrical ratings:

1. Voltage, configuration, and amp ratings as **indicated on the Drawings**.
2. WCR in accordance with UL 1008.

C. Contacts:

1. Mechanically held.
2. Mechanically interlocked to prevent normal and standby sources from being closed at the same time.
3. Silver alloy construction.
4. Neutral contact, when **indicated on the Drawings**:
 - a. Same ratings as the phase contacts.
 - b. Break last and make first operation.

D. Controls:

1. ATS shall have 3-phase over-voltage, under-voltage, over-frequency, and under-frequency on both normal and standby sources.
2. ATS shall have a synch check relay for closed transfer:
 - a. Allows re-transfer when normal and standby sources are within 5 electrical degrees and within 5 percent of voltage.
3. Control panel:
 - a. Microprocessor based.
 - b. 4-line, 20-character LCD display. Displayed data shall include:
 - 1) Normal and standby source parameters.
 - 2) Diagnostic information.
 - 3) Switch and timer status.
 - c. Keypad for making all ATS settings and operating parameters.
 - 1) All settings shall be password protected.
 - d. LED display of the following:
 - 1) Normal source available.
 - 2) Connected to normal source.
 - 3) Standby source available.
 - 4) Connected to standby source.

- e. Communications: Modbus TCP.
- f. Provisions for testing ATS operation by simulating a normal source failure.
- g. Generator exerciser:
 - 1) Programmable to start the generator on a daily, weekly, monthly, or yearly basis for an adjustable period of time.
 - 2) Load or no load selectable.
 - a) When load is selected, ATS will transfer to the generator for the duration of the exercise period. Re-transfer back and cool down the generator.
 - b) When no load is selected, the ATS will run the generator for the duration of the exercise period and then stop the generator.
- 4. Status and control contacts:
 - a. Generator start/stop contact:
 - 1) Single-pole, double-throw.
 - 2) Rated for 5 amps at 30 VDC.
 - b. Status contacts:
 - 1) Single-pole, double-throw.
 - 2) Rated for 10 amps at 250 VAC.
 - 3) Provide contacts for the following:
 - a) Normal source available.
 - b) Normal source failure.
 - c) Connected to normal source.
 - d) Standby source available.
 - e) Standby source failure.
 - f) Connected to standby source.

E. Enclosure:

- 1. NEMA 3R type for mounting electrical equipment as indicated on the Drawings.

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. As specified in Section 16050 - Common Work Results for Electrical.

- B. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.
- C. General:
 - 1. Furnish cables, conduit, lugs, bolts, expansion anchors, sealants, and other accessories needed to complete the installation of the switchgear.
 - 2. Physically assemble and install the switchgear in the location and layout **indicated on the Drawings**.
 - 3. Make bus splice connections.
 - 4. Perform work in accordance with manufacturer's instructions and drawings.
 - 5. Furnish components and equipment as required to complete the installation.
 - 6. Replace hardware lost or damaged during the installation or handling to provide a complete installation.
 - 7. Install the transfer switch on a raised concrete housekeeping pad:
 - a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.
 - b. Weld and/or bolt the switchgear frame to the leveling channels.
 - 8. Provide openings in top or bottom of the enclosure for conduit only, no additional openings will be allowed:
 - a. Improperly cut holes will require that the entire panel be replaced:
 - 1) No hole closers or patches will be allowed.

3.04 ERECTION, INSTALLATION, APPLICATION, AND CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

- A. As specified in Section 01756 - Commissioning.
- B. Factory testing:
 - 1. Complete factory test to verify proper operation of all timers, settings, and operation.
 - 2. In accordance with UL-1008.

3.08 FIELD QUALITY CONTROL

- A. As specified in Section 16050 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

- A. As specified in Section 16050 - Common Work Results for Electrical.

3.11 PROTECTION

- A. As specified in Section 16050 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION