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02/24

PART 1 GENERAL

1.1 SUMMARY

This section lists the drawings for the project pursuant to contract clause "DFARS 252.236-7001, Contract Drawings and Specifications."

1.2 CONTRACT DRAWINGS

Contract drawings are as follows:

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17321761	G-003	1	LIST OF SHEETS
17321762	G-004		LIST OF SHEETS
17321763	G-005	1	BUILDING CODE SUMMARY
17321764	G-101	1	CODE COMPLIANCE SITE PLAN
17321765	G-102	1	1ST FLOOR PLAN - LIFE SAFETY
17321766	G-103	1	2ND FLOOR PLAN - LIFE SAFETY
17321767	G-104		UTILITY BUILDING AND PAVILION - LIFE SAFETY
17321772	V-101		TOPOGRAPHIC SURVEY
17321774	B-001		SOIL BORING LOCATION MAP AND BORING LOGS-1
17321775	B-002		BORING LOGS-2
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17321903	AS103		TRANSFORMER ENCLOSURE PLAN, EXTERIOR ELEVATIONS, AND SECTION
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17321965	A-701		CEILING DETAILS
17321966	A-710		CASEWORK DETAILS
17321967	A-720		RAILING DETAILS
17321968	A-730	1	MISCELLANEOUS INTERIOR DETAILS
17321969	A-731		MISCELLANEOUS INTERIOR DETAILS

17321970	A-740		ROOF DETAILS
17321971	A-750	1	MISCELLANEOUS EXTERIOR DETAILS
17321972	A-801	1	ENLARGED RAF FLOOR PLAN - 1A
17321973	A-802	1	ENLARGED RAF FLOOR PLAN - 1B
17321974	A-803		ENLARGED RAF FLOOR PLAN - 2A
17321975	A-804		ENLARGED RAF FLOOR PLAN - 2B
17321976	A-901	1	AIR BARRIER DIAGRAM - FLOOR PLANS
17321977	A-902	2	AIR BARRIER DIAGRAM
17321978	A-903		AIR BARRIER DETAILS
17321979	AI101	2	ENLARGED FLOOR FINISH PLAN - 1A
17321980	AI102	2	ENLARGED FLOOR FINISH PLAN - 1B
17321981	AI103	1	ENLARGED FLOOR FINISH PLAN - 2A
17321982	AI104	1	ENLARGED FLOOR FINISH PLAN - 2B
17321997	I-801	1	OVERALL FIRST FLOOR FF&E PLAN
17321998	I-802		OVERALL SECOND FLOOR FF&E PLAN
17321999	I-803		FF&E SCHEDULE
17322000	I-804	1	ENLARGED FF&E FLOOR PLAN - 1A
17322001	I-805	1	ENLARGED FF&E FLOOR PLAN - 1B
17322002	I-806		ENLARGED FF&E FLOOR PLAN - 1C
17322003	I-807		ENLARGED FF&E FLOOR PLAN - 1D
17322004	I-808		ENLARGED FF&E FLOOR PLAN - 1E
17322005	I-809		ENLARGED FF&E FLOOR PLAN - 1F
17322006	I-810		ENLARGED FF&E FLOOR PLAN - 2A
17322007	I-811		ENLARGED FF&E FLOOR PLAN - 2B
17322008	I-812		ENLARGED FF&E FLOOR PLAN - 2C
17322009	I-813		ENLARGED FF&E FLOOR PLAN - 2D
17322010	I-814		ENLARGED FF&E FLOOR PLAN - 2E

17322011	I-815		ENLARGED FF&E FLOOR PLAN - 2F
17322012	I-816		TYPICAL MOUNTING HEIGHTS - FF&E
17322023	F-001		FIRE PROTECTION NOTES, SYMBOLS AND ABBREVIATIONS
17322024	FX401		ENLARGED FLOOR PLAN 1A - FIRE SPRINKLER
17322025	FX402		ENLARGED FLOOR PLAN 1B - FIRE SPRINKLER
17322026	FX403		ENLARGED FLOOR PLAN 2A - FIRE SPRINKLER
17322027	FX404		ENLARGED FLOOR PLAN 2B - FIRE SPRINKLER
17322028	FX405		ENLARGED UTILITY BUILDING FLOOR PLAN - FIRE SPRINKLER
17322029	FX501		FIRE SPRINKLER DETAILS
17322030	FA401		ENLARGED FLOOR PLAN 1A - FIRE ALARM-MASS NOTIFICATION SYSTEM
17322031	FA402		ENLARGED FLOOR PLAN 1B - FIRE ALARM-MASS NOTIFICATION SYSTEM
17322032	FA403		ENLARGED FLOOR PLAN 2A - FIRE ALARM-MASS NOTIFICATION SYSTEM
17322033	FA404		ENLARGED FLOOR PLAN 2B - FIRE ALARM-MASS NOTIFICATION SYSTEM
17322034	FA405		ENLARGED UTILITY BUILDING FLOOR PLAN - FIRE ALARM-MASS NOTIFICATION SYSTEM
17322035	FA501		FIRE ALARM-MASS NOTIFICATION SYSTEM DETAILS
17322036	FA601		FIRE ALARM-MASS NOTIFICATION SYSTEM - SEQUENCE OF OPERATIONS
17322037	FA602		FIRE ALARM-MASS NOTIFICATION SYSTEM - RISER DIAGRAM
17322048	P-001		PLUMBING LEGEND, ABBREVIATIONS AND NOTES
17322049	PL100		COMPOSITE PLUMBING PLAN - BELOW FIRST FLOOR
17322050	PL101		PLUMBING PLAN - BELOW FIRST FLOOR - AREA 'A'
17322051	PL102		PLUMBING PLAN - BELOW FIRST FLOOR - AREA 'B'
17322052	PL103		PLUMBING PLAN - BELOW FIRST FLOOR - AREA 'C'
17322053	PL104		PLUMBING PLAN - BELOW FIRST FLOOR - AREA 'D'
17322054	PL105		PLUMBING PLAN - BELOW FIRST FLOOR - AREA 'E'
17322055	PL106		PLUMBING PLAN - BELOW FIRST FLOOR - AREA 'F'
17322056	PL110		COMPOSITE PLUMBING PLAN - FIRST FLOOR
17322057	PL111		PLUMBING PLAN - FIRST FLOOR - AREA 'A'

17322058	PL112		PLUMBING PLAN - FIRST FLOOR - AREA 'B'
17322059	PL113		PLUMBING PLAN - FIRST FLOOR - AREA 'C'
17322060	PL114	1	PLUMBING PLAN - FIRST FLOOR - AREA 'D'
17322061	PL115	2	PLUMBING PLAN - FIRST FLOOR - AREA 'E'
17322062	PL116		PLUMBING PLAN - FIRST FLOOR - AREA 'F'
17322063	PL120		COMPOSITE PLUMBING PLAN - SECOND FLOOR
17322064	PL121		PLUMBING PLAN - SECOND FLOOR - AREA 'A'
17322065	PL122		PLUMBING PLAN - SECOND FLOOR - AREA 'B'
17322066	PL123		PLUMBING PLAN - SECOND FLOOR - AREA 'C'
17322067	PL124	1	PLUMBING PLAN - SECOND FLOOR - AREA 'D'
17322068	PL125		PLUMBING PLAN - SECOND FLOOR - AREA 'E'
17322069	PL126		PLUMBING PLAN - SECOND FLOOR - AREA 'F'
17322070	PL140		COMPOSITE PLUMBING PLAN - ROOF
17322071	PL400	1	ENLARGED PLUMBING PLANS - SHEET 1
17322072	PL401	1	ENLARGED PLUMBING PLANS - SHEET 2
17322073	PL500		PLUMBING DETAILS - SHEET 1
17322074	PL501		PLUMBING DETAILS - SHEET 2
17322082	PL502	1	PLUMBING DETAILS - SHEET 3 - ADDED SHEET
17322075	PL600	1	PLUMBING SCHEDULES - SHEET 1
17322076	PL601	1	PLUMBING SCHEDULES - SHEET 2
17322077	PL901		PLUMBING ISOMETRICS - OVERALL
17322078	PL902		PLUMBING ISOMETRICS - FIRST FLOOR BATHROOM
17322079	PL903		PLUMBING ISOMETRICS - SECOND FLOOR BATHROOM
17322080	PL905		PLUMBING ISOMETRICS - ENLARGED VIEW
17322081	PL906		PLUMBING ISOMETRICS - SPECIAL SYSTEMS
17322092	M-001		MECHANICAL LEGEND, ABBREVIATIONS AND NOTES
17322093	MH100		COMPOSITE HVAC DUCT PLAN - FIRST FLOOR

17322094	MH101	1	HVAC DUCT PLAN - FIRST FLOOR - AREA 'A'
17322095	MH102	1	HVAC DUCT PLAN - FIRST FLOOR - AREA 'B'
17322096	MH103	2	HVAC DUCT PLAN - FIRST FLOOR - AREA 'C'
17322097	MH104	1	HVAC DUCT PLAN - FIRST FLOOR - AREA 'D'
17322098	MH105	1	HVAC DUCT PLAN - FIRST FLOOR - AREA 'E'
17322099	MH106	1	HVAC DUCT PLAN - FIRST FLOOR - AREA 'F'
17322100	MH110		COMPOSITE HVAC DUCT PLAN - SECOND FLOOR
17322101	MH111	1	HVAC DUCT PLAN - SECOND FLOOR - AREA 'A'
17322102	MH112	1	HVAC DUCT PLAN - SECOND FLOOR - AREA 'B'
17322103	MH113	1	HVAC DUCT PLAN - SECOND FLOOR - AREA 'C'
17322104	MH114	1	HVAC DUCT PLAN - SECOND FLOOR - AREA 'D'
17322105	MH115	1	HVAC DUCT PLAN - SECOND FLOOR - AREA 'E'
17322106	MH116	1	HVAC DUCT PLAN - SECOND FLOOR - AREA 'F'
17322107	MH127		GENERATOR/TANK MECHANICAL PLAN
17322108	MH300		MECHANICAL SECTIONS - SHEET 1
17322109	MH301		MECHANICAL SECTIONS - SHEET 2
17322110	MH400		ENLARGED FLOOR PLAN - SHEET 1
17322111	MH501		HVAC DETAILS - SHEET 1
17322112	MH502	1	HVAC DETAILS - SHEET 2
17322113	MH503		HVAC DETAILS - SHEET 3
17322114	MH504		HVAC DETAILS - SHEET 4
17322115	MH505		HVAC DETAILS - SHEET 5
17322116	MH506		HVAC DETAILS - SHEET 6
17322117	MH507		HVAC DETAILS - SHEET 7
17322118	MH508		HVAC DETAILS - SHEET 8
17322119	MH509		HVAC DETAILS - SHEET 9
17322120	MH510		HVAC DETAILS - SHEET 10

17322121	MH511		FUEL OIL SYSTEM DETAILS - SHEET 1
17322122	MH512		FUEL OIL SYSTEM DETAILS - SHEET 2
17322123	MH513		FUEL OIL SYSTEM DETAILS - SHEET 3
17322124	MH514		FUEL OIL SYSTEM DETAILS - SHEET 4
17322125	MH600	1	HVAC SCHEMATICS - SHEET 1
17322126	MH601	1	HVAC SCHEMATICS - SHEET 2
17322127	MH602		HVAC SCHEMATICS - SHEET 3
17322128	MH603	1	HVAC SCHEMATICS - SHEET 4
17322129	MH700	1	MECHANICAL SCHEDULES - SHEET 1
17322130	MH701	1	MECHANICAL SCHEDULES - SHEET 2
17322131	MH702		MECHANICAL SCHEDULES - SHEET 3
17322132	MH703		MECHANICAL SCHEDULES - SHEET 4
17322133	MH704	2	MECHANICAL SCHEDULES - SHEET 5
17322134	MH800	1	MECHANICAL CONTROLS
17322135	MH900		HVAC ISOMETRICS - SHEET 1
17322136	MH901		HVAC ISOMETRICS - SHEET 2
17322137	MP100		COMPOSITE HVAC PIPING PLAN - FIRST FLOOR
17322138	MP101		HVAC PIPING PLAN - FIRST FLOOR - AREA 'A'
17322139	MP102		HVAC PIPING PLAN - FIRST FLOOR - AREA 'B'
17322140	MP103		HVAC PIPING PLAN - FIRST FLOOR - AREA 'C'
17322141	MP104		HVAC PIPING PLAN - FIRST FLOOR - AREA 'D'
17322142	MP105	2	HVAC PIPING PLAN - FIRST FLOOR - AREA 'E'
17322143	MP106		HVAC PIPING PLAN - FIRST FLOOR - AREA 'F'
17322144	MP107	2	HVAC PIPING PLAN - FIRST FLOOR - MECHANICAL ENCLOSURE
17322145	MP110		COMPOSITE HVAC PIPING PLAN - SECOND FLOOR
17322146	MP111		HVAC PIPING PLAN - SECOND FLOOR - AREA 'A'
17322147	MP112		HVAC PIPING PLAN - SECOND FLOOR - AREA 'B'

17322148	MP113		HVAC PIPING PLAN - SECOND FLOOR - AREA 'C'
17322149	MP114		HVAC PIPING PLAN - SECOND FLOOR - AREA 'D'
17322150	MP115	2	HVAC PIPING PLAN - SECOND FLOOR - AREA 'E'
17322151	MP116		HVAC PIPING PLAN - SECOND FLOOR - AREA 'F'
17322152	MP400	1	ENLARGED FLOOR PLAN - SHEET 1
17322168	E-001	1	ELECTRICAL SYMBOLS, LEGEND, ABBREVIATIONS, AND NOTES
17322169	E-002		ONE-LINE AND THREE LINE DIAGRAM LEGEND
17322170	ES100	1	ELECTRICAL SITE PLAN
17322171	ES100B		ELECTRICAL SITE PLAN - BID OPTIONS 1 & 2
17322172	EG101	1	OVERALL GROUNDING PLAN
17322173	EG102		ENLARGED GROUNDING PLAN AREA A
17322174	EG103	1	ENLARGED GROUNDING PLAN AREA B
17322175	EG104		OVERALL LIGHTNING PROTECTION PLAN
17322176	EG105		ENLARGED LIGHTNING PROTECTION PLAN AREA A
17322177	EG106		ENLARGED LIGHTNING PROTECTION PLAN AREA B
17322178	EG107	1	GENERATOR & PAVILION BUILDINGS - GROUNDING AND LIGHTNING PROTECTION PLANS
17322179	EG401		ENLARGED GROUNDING PLAN - MECHANICAL ENCLOSURE
17322180	EL101	1	OVERALL LIGHTING PLAN - FIRST FLOOR
17322181	EL102		ENLARGED LIGHTING PLAN - FIRST FLOOR AREA 1A
17322182	EL103	1	ENLARGED LIGHTING PLAN - FIRST FLOOR AREA 1B
17322183	EL104		ENLARGED LIGHTING PLAN - FIRST FLOOR AREA 1C
17322184	EL105	1	ENLARGED LIGHTING PLAN - FIRST FLOOR AREA 1D
17322185	EL106		ENLARGED LIGHTING PLAN - FIRST FLOOR AREA 1E
17322186	EL107		ENLARGED LIGHTING PLAN - FIRST FLOOR AREA 1F
17322187	EL108		OVERALL LIGHTING PLAN - SECOND FLOOR
17322188	EL109		ENLARGED LIGHTING PLAN - SECOND FLOOR AREA 2A
17322189	EL110		ENLARGED LIGHTING PLAN - SECOND FLOOR AREA 2B

17322190	EL111		ENLARGED LIGHTING PLAN - SECOND FLOOR AREA 2C
17322191	EL112	1	ENLARGED LIGHTING PLAN - SECOND FLOOR AREA 2D
17322192	EL113	1	ENLARGED LIGHTING PLAN - SECOND FLOOR AREA 2E
17322193	EL114		ENLARGED LIGHTING PLAN - SECOND FLOOR AREA 2F
17322194	EL122		GENERATOR BUILDING - LIGHTING PLAN - BID OPTION #2
17322195	EL123		PAVILION - LIGHTING PLAN - BID OPTION #1
17322196	EL301		LIGHTING SECTIONS - SHEET 1
17322197	EL302		LIGHTING SECTIONS - SHEET 2
17322198	EL401		ENLARGED LIGHTING PLANS
17322199	EL501		LIGHTING DETAILS - SHEET 1
17322200	EL502	1	LIGHTING DETAILS - SHEET 2
17322201	EL503		LIGHTING DETAILS - SHEET 3
17322202	EL504		LIGHTING DETAILS - SHEET 4
17322203	EL505		LIGHTING DETAILS - SHEET 5
17322204	EL601		LIGHTING CONTROL SCHEDULE
17322205	EL602	1	SITE LIGHTING DIAGRAM
17322206	EL701		LIGHT FIXTURE SCHEDULE - SHEET 1
17322207	EL702	1	LIGHT FIXTURE SCHEDULE - SHEET 2
17322208	EP101	1	OVERALL POWER PLAN - FIRST FLOOR
17322209	EP102	1	ENLARGED POWER PLAN - FIRST FLOOR AREA 1A
17322210	EP103	1	ENLARGED POWER PLAN - FIRST FLOOR AREA 1B
17322211	EP104	1	ENLARGED POWER PLAN - FIRST FLOOR AREA 1C
17322212	EP105	1	ENLARGED POWER PLAN - FIRST FLOOR AREA 1D
17322213	EP106	1	ENLARGED POWER PLAN - FIRST FLOOR AREA 1E
17322214	EP107	1	ENLARGED POWER PLAN - FIRST FLOOR AREA 1F
17322215	EP108		OVERALL POWER PLAN - SECOND FLOOR
17322216	EP109		ENLARGED POWER PLAN - SECOND FLOOR AREA 2A

17322217	EP110		ENLARGED POWER PLAN - SECOND FLOOR AREA 2B
17322218	EP111		ENLARGED POWER PLAN - SECOND FLOOR AREA 2C
17322219	EP112		ENLARGED POWER PLAN - SECOND FLOOR AREA 2D
17322220	EP113	1	ENLARGED POWER PLAN - SECOND FLOOR AREA 2E
17322221	EP114	1	ENLARGED POWER PLAN - SECOND FLOOR AREA 2F
17322222	EP122	1	GENERATOR BUILDING - POWER PLAN
17322223	EP123		PAVILION - POWER PLAN - OPTION ITEM #1
17322224	EP401		ENLARGED POWER PLAN - MECHANICAL ENCLOSURE
17322225	EP402	1	ENLARGED POWER PLAN - BASE BID ELECTRICAL ROOMS
17322226	EP403	1	ENLARGED POWER PLAN - BID OPTION #2 ELECTRICAL ROOMS
17322227	EP404		ENLARGED POWER PLAN - MECHANICAL ROOM 119
17322228	EP405		ENLARGED POWER PLAN - MECHANICAL ROOM 217
17322229	EP501		ELECTRICAL DETAILS - SHEET 1
17322230	EP502		ELECTRICAL DETAILS - SHEET 2
17322231	EP503		ELECTRICAL DETAILS - SHEET 3
17322232	EP504	1	ELECTRICAL DETAILS - SHEET 4
17322233	EP505		ELECTRICAL DETAILS - SHEET 5
17322234	EP506		ELECTRICAL DETAILS - SHEET 6
17322235	EP601	1	ELECTRICAL ONELINE DIAGRAM - BASE BID SHEET 1
17322236	EP602		ELECTRICAL ONELINE DIAGRAM - BASE BID SHEET 2
17322237	EP603	1	ELECTRICAL ONELINE DIAGRAM - BID OPTION 2 SHEET 3
17322238	EP604		ELECTRICAL ONELINE DIAGRAM - BID OPTION 2 SHEET 4
17322239	EP701	1	PANELBOARD SCHEDULES - SHEET 1
17322240	EP702		PANELBOARD SCHEDULES - SHEET 2
17322241	EP703	1	PANELBOARD SCHEDULES - SHEET 3
17322242	EP704	1	PANELBOARD SCHEDULES - SHEET 4
17322243	EP705		PANELBOARD SCHEDULES - SHEET 5

17322244	EP706	1	PANELBOARD SCHEDULES - SHEET 6
17322245	EP707		PANELBOARD SCHEDULES - SHEET 7
17322246	EP708		PANELBOARD SCHEDULES - SHEET 8
17322247	EP709		PANELBOARD SCHEDULES - SHEET 9
17322248	EP710	1	PANELBOARD SCHEDULES - SHEET 10
17322249	EP720	1	CABLE SCHEDULE
17322265	T-001	1	TELECOMMUNICATIONS LEGEND
17322266	TS100		TELECOM OVERALL SITE PLAN
17322267	TS101	1	TELECOM SITE PLAN
17322268	TS501		TELECOM SITE DETAILS - SHEET 1
17322269	TS502		TELECOM SITE DETAILS - SHEET 2
17322270	TS503		TELECOM SITE DETAILS - SHEET 3
17322271	TN101		COMPOSITE PLAN - TELECOMMUNICATIONS - FIRST FLOOR
17322272	TN102	1	PARTIAL PLAN - TELECOMMUNICATIONS - FIRST FLOOR - AREA 'A'
17322273	TN103	1	PARTIAL PLAN - TELECOMMUNICATIONS - FIRST FLOOR - AREA 'B'
17322274	TN104		COMPOSITE PLAN - TELECOMMUNICATIONS - SECOND FLOOR
17322275	TN105		PARTIAL PLAN - TELECOMMUNICATIONS - SECOND FLOOR - AREA 'A'
17322276	TN106		PARTIAL PLAN - TELECOMMUNICATIONS - SECOND FLOOR - AREA 'B'
17322277	TN110		CABLE TRAY PLAN - FIRST FLOOR
17322278	TN111		CABLE TRAY PLAN - SECOND FLOOR
17322279	TN300		TELECOM CABINET ELEVATION GTR 1 RM 121A
17322280	TN301		TELECOM CABINET ELEVATION GTR 1T RM 121B
17322281	TN302		TELECOM CABINET ELEVATION GTR 2 RM 229A
17322282	TN303		TELECOM CABINET ELEVATION GTR 2T RM 229B
17322283	TN401		ENLARGED FIRST FLOOR GTR PLAN
17322284	TN402		ENLARGED SECOND FLOOR GTR PLAN
17322285	TN500		TELECOMMUNICATIONS DETAILS - SHEET 1

17322286	TN501		TELECOMMUNICATIONS DETAILS - SHEET 2
17322287	TN502	1	TELECOMMUNICATIONS DETAILS - SHEET 3
17322288	TN503		TELECOMMUNICATIONS DETAILS - SHEET 4
17322289	TN504		TELECOMMUNICATIONS DETAILS - SHEET 5
17322290	TN505		TELECOMMUNICATIONS DETAILS - SHEET 6
17322291	TN506		TELECOMMUNICATIONS DETAILS - SHEET 7
17322292	TN507		TELECOMMUNICATIONS DETAILS - SHEET 8
17322293	TN601		TELECOM BACKBONE RISER DIAGRAM
17322294	TN602		TELECOM RISER DIAGRAMS - SHEET 1
17322295	TN603		TELECOM RISER DIAGRAMS - SHEET 2
17322296	TN604	1	TELECOM RISER DIAGRAMS - SHEET 3
17322297	TY101	1	SPECIAL SYSTEMS - FIRST FLOOR - AREA 'A'
17322298	TY102	1	SPECIAL SYSTEM - FIRST FLOOR - AREA 'B'
17322299	TY103		SPECIAL SYSTEMS - SECOND FLOOR - AREA 'A'
17322300	TY104		SPECIAL SYSTEMS - SECOND FLOOR - AREA 'B'
17322301	TY501		SPECIAL SYSTEMS DETAILS - SHEET 1
17322302	TY502	1	SPECIAL SYSTEMS DETAILS - SHEET 2
17322318	TT-001		GENERAL NOTES, ABBREVIATIONS & SYMBOLS LEGEND
17322319	TT-101		1ST FLOOR TWO-WAY COMMUNICATION PLAN
17322320	TT-102		2ND FLOOR TWO-WAY COMMUNICATION PLAN
17322321	TT-501		TWO-WAY COMMUNICATIONS DETAILS & DIAGRAM
17322322	TT-502		TWO-WAY COMMUNICATIONS SEQUENCE OF OPERATIONS MATRIX
17322326	TA001		AV SYSTEMS GENERAL NOTES
17322327	TA002		AV SYSTEMS SYMBOLS, LEGEND, AND ABBREVIATIONS
17322328	TA101		OVERALL AV FIRST FLOOR PLAN
17322329	TA102	1	PARTIAL AV FIRST FLOOR PLAN - A
17322330	TA103		PARTIAL AV FIRST FLOOR PLAN - B

17322331	TA104		PARTIAL AV FIRST FLOOR CABLE TRAY PLAN - A
17322332	TA105		PARTIAL AV FIRST FLOOR CABLE TRAY PLAN - B
17322333	TA106		OVERALL AV SECOND FLOOR PLAN
17322334	TA107	1	PARTIAL AV SECOND FLOOR PLAN - A
17322335	TA108		PARTIAL AV SECOND FLOOR PLAN - B
17322336	TA109		PARTIAL AV SECOND FLOOR CABLE TRAY PLAN - A
17322337	TA110		PARTIAL AV SECOND FLOOR CABLE TRAY PLAN - B
17322338	TA401	1	AV INTERIOR ELEVATIONS
17322339	TA402		AV INTERIOR ELEVATIONS
17322340	TA403	1	AV INTERIOR ELEVATIONS
17322341	TA404		AV INTERIOR ELEVATIONS
17322342	TA405		ENLARGED AV PLANS & INTERIOR ELEVATIONS
17322343	TA406		ENLARGED AV PLANS & INTERIOR ELEVATIONS
17322344	TA407		ENLARGED AV PLANS & INTERIOR ELEVATIONS
17322345	TA408	1	ENLARGED AV PLANS
17322346	TA409		ENLARGED AV PLANS
17322347	TA410	1	AV INTERIOR ELEVATIONS & SECTIONS
17322348	TA501		AV INFRASTRUCTURE DETAILS
17322349	TA502		AV INFRASTRUCTURE DETAILS
17322350	TA503		AV INFRASTRUCTURE DETAILS
17322351	TA504		AV INFRASTRUCTURE DETAILS
17322352	TA601	1	AV SYSTEMS SCHEDULES
17322353	TA701	1	AV INFRASTRUCTURE RISER DIAGRAMS
17322354	TA702	1	AV INFRASTRUCTURE RISER DIAGRAMS
17322355	TA703	1	AV INFRASTRUCTURE RISER DIAGRAMS
17322356	TA704	1	AV INFRASTRUCTURE RISER DIAGRAMS

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SECTION 09 65 00

RESILIENT FLOORING
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4078	(2002; R 2015) Water Emulsion Floor Polish
ASTM E648	(2023) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F710	(2022) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
ASTM F1861	(2021; R 2025) Standard Specification for Resilient Wall Base
ASTM F1869	(2023) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F2170	(2019a) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 253	(2011) Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Guide 21	(2015) Guide to Evaluation of Slip and Fall Resistance of Flooring Surfaces

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2022) Adhesive and Sealant Applications

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCNA A326.3	(2022) American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials

UL SOLUTIONS (UL)

UL 2818	(2022) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Resilient Flooring and Accessories

Adhesives

Wall Base

Applied Moisture Barrier

Mouldings

SD-04 Samples

Resilient Flooring and Accessories; G

SD-06 Test Reports

Moisture, Alkalinity, and Bond Tests; G

SD-07 Certificates

Indoor Air Quality for Wall Base; S

Indoor Air Quality for Adhesives; S

SD-08 Manufacturer's Instructions

Surface Preparation; G

Installation; G

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories; G

1.3 CERTIFICATES

1.3.1 Indoor Air Quality

Submit required indoor air quality certifications and validations in one submittal package.

1.3.1.1 Floor Covering Materials

Provide wall base products certified to meet indoor air quality requirements by FLOORSCORE, UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification by other third-party programs. Provide current product certification documentation from certification body.

1.3.1.2 Adhesives, Caulking, and Sealants

Provide asbestos-free products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store exposed rubber surface materials in occupied spaces. Do not store near materials that may offgas or emit harmful fumes, such as fresh paint or adhesives.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 70 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.6 SCHEDULING

Schedule resilient flooring application after the completion of other work

which would damage the finished surface of the flooring.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

PART 2 PRODUCTS

2.1 WALL BASE

Conform to ASTM F1861, Type TP (thermoplastic rubber), Style B (coved). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide preformed corners in matching height, shape, and color.

Provide certification of indoor air quality for Wall Base.

2.2 MOULDINGS

Provide tapered mouldings of vinyl or rubber and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 1/4 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

2.3 ADHESIVES

Provide asbestos-free adhesives and applied moisture barrier for flooring, base and accessories as recommended by the manufacturer specifically designed for use on concrete up to 99 percent relative humidity and up to 11 pH and comply with local indoor air quality standards. Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.4 SURFACE PREPARATION MATERIALS

Provide asbestos-free surface preparation materials, such as leveling compounds, and floor crack fillers as recommended by the flooring manufacturer for the subfloor conditions.

2.5 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D4078 for polish. Confirm that polish finishes meet dry and wet coefficient of friction per TCNA A326.3,SSPC Guide 21, as applicable.

2.6 CAULKING AND SEALANTS

Provide asbestos-free caulking and sealants in accordance with Section

07 92 00 JOINT SEALANTS.

2.7 ACCESSORIES

Provide accessories necessary to complete transitions, coves, terminations, and trim as recommended by the resilient flooring and accessories manufacturers in writing.

2.8 MANUFACTURER'S COLOR, PATTERN, AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories as indicated on the drawings selected from manufacturer's standard colors. Color listed is not intended to limit the selection of equal colors from other manufacturers. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern. Submit manufacturer's descriptive data and three samples of each indicated color and type of flooring, base, mouldings, and accessories sized a minimum 6 by 9 inch. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

2.9 FIRE RESISTANCE TESTING REQUIREMENTS

Provide a minimum average critical radiant flux of 0.45 watts per square centimeter for flooring in corridors and exits when tested in accordance with ASTM E648 or NFPA 253.

2.10 APPLIED MOISTURE BARRIER

2-part epoxy-based applied moisture barrier recommended by carpet manufacturer specifically for high relative humidity (RH)/high pH concrete conditions. Barrier shall be recommended for 100% relative humidity, up to 25-pound calcium chloride MVER test results and up to 14 pH level. Applied to cured and preparated concrete.

PART 3 EXECUTION

3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, and recommended adhesives.

3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as including moisture barrier. Floor to be flat to within 3/16 inch in 10 feet. Prepare subfloor in accordance with flooring manufacturer's printed instructions. Comply with ASTM F710 for concrete subfloor preparation. Floor fills or toppings may be required as recommended by the flooring manufacturer. Install underlayments, when required by the flooring manufacturer, in accordance with manufacturer's printed installation instructions. Before any work under this section is begun, correct all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven

surfaces. Repair all damaged portions of concrete slabs as recommended by the flooring manufacturer. Remove concrete curing and sealer compounds from the slabs, other than the type that does not adversely affect adhesion. Remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions.

3.3 MOISTURE, ALKALINITY, AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F1869 or ASTM F2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's printed installation instructions. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

3.4 GENERAL INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

3.5 PLACING MOULDINGS

Provide mouldings where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate mouldings under door centerline. Mouldings are not required at doorways where thresholds are provided. Secure mouldings with adhesive as recommended by the manufacturer. Prepare and apply adhesives in accordance with manufacturer's printed installation instructions.

3.6 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed installation instructions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at concrete walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.7 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry and clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and finish in accordance with manufacturer's printed instructions.

3.8 PROTECTION

From the time of installation until acceptance, protect flooring from

damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

-- End of Section --

SECTION 09 67 23.13

STANDARD RESINOUS FLOORING
11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ESD STM 97.2	(2006) ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items: Floor Materials and Footwear – Voltage Measurement in Combination with a Person

ASTM INTERNATIONAL (ASTM)

ASTM C307	(2018) Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
ASTM C579	(2018) Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C580	(2018) Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM D257	(2014; R 2021) Standard Test Methods for DC Resistance or Conductance of Insulating Materials
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D570	(2022) Standard Test Method for Water Absorption of Plastics
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D695	(2015; R 2016) Standard Test Method for Compressive Properties of Rigid Plastics

ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D2240	(2015; R 2021) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D2370	(2016; R 2021) Standard Test Method for Tensile Properties of Organic Coatings
ASTM D2566	(1986) Test Method for Linear Shrinkage of Cured Thermosetting Casting Resins During Cure
ASTM D3363	(2022) Standard Test Method for Film Hardness by Pencil Test
ASTM D4541	(2022) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E84	(2024) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F2170	(2019a) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2024) Life Safety Code

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meetings

Pre-installation Conference: Conduct conference at Project site.

1.2.2 Product Data

Within 30 days of contract award, submit manufacturer's catalog data for the following items:

a. Epoxy Flooring

b. Epoxy/Urethane Static Disspative Floors

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality

Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Manufacturer's Catalog Data

SD-04 Samples

Hardboard Mounted Epoxy Flooring; G

SD-07 Certificates

Listing of Product Installations

Referenced Standards Certificates

SD-11 Closeout Submittals

Warranty

1.4 DELIVERY, STORAGE, AND HANDLING

Protect materials from weather, soil, and damage during delivery, storage, and construction. Deliver materials in original packages, containers, or bundles bearing brand name and name of material.

Maintain materials used in the installation of floor topping at a temperature between 65 and 85 degrees F.

1.5 QUALITY CONTROL

Prior to commencement of work, submit referenced standards certificates for the following, showing conformance with the referenced standards contained in this section:

a. Epoxy Flooring

b. Epoxy/Urethane Static Dissipative Flooring

1.5.1 Qualifications

Submit a listing of product installations for heavy duty epoxy flooring including identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. Identify purchaser, address of installation, service organization, and date of installation.

1.5.2 Sampling

Submit hardboard mounted epoxy flooring samples not less than 12 inch square for each required color.

Provide panels showing nominal thickness of finished toppings, color, and texture of finished surfaces. Finished floor toppings and the approved

samples are to match in color and texture.

1.5.3 Site Requirements

a. Application may proceed while air, material and substrate temperatures are between 60 F and 90 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.

b. The relative humidity in the specific location of the application shall be less than 85% and the surface temperature shall be at least 5 F above the dew point.

c. The Applicator shall ensure that adequate ventilation is available for the work area.

d. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.

1.6 WARRANTY

Submit a 1 year written warranty for all materials and installation work.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Submit installation drawings for epoxy flooring systems clearly designating the areas of application and the installation plan. Include in the installation plan, methods to control sand and dust if sand blasting is required.

2.2 MATERIALS

2.2.1 Epoxy/Urethane Static Dissipative Flooring (ESD-1)

a.	Primer:		
	1.	Percent Solids	100%
	2.	VOC	7.45 g/L
	3.	Surface Resistivity, ASTM D257	10^6-10^9 ohm/Square
	4.	Static Decay, MIL-STD-3010, Method 4046	0.01 seconds
	5.	Voltage generation, ANSI/ESD STM 97.2	14v
	6.	Compressive Strength, ASTM D695	16,000 psi
		ASTM C579	10,500 psi
	7.	Tensile Strength, ASTM D638	3,000 psi

a.	Primer:		
		ASTM C307	1,950 psi
	8.	Tensile Elongation, ASTM D638	7.5%
	9.	Flexural Strength, ASTM D790	4,000 psi
		ASTM C580	2,900 psi
	10.	Hardness (Shore D), ASTM D2240	70-80
	11.	Linear Shrinkage, ASTM D2566	0.02%
	12.	Linear Expansion, ASTM D696	$2x10^5$
	13.	Bond Strength to Concrete, ASTM D4541	400 psi, substrate fails
	14.	Indentation, MIL D-3134	0.025 Max
	15.	Impact Resistance, MIL D-3134	Pass
	16.	Water Absorption, ASTM D570	0.04%
	17.	Heat Resistance Limitation	140 F to 200 F
	18.	Flammability, ASTM D570	Self Extinguishing
	19.	Flame Spread/NFPA 101, ASTM E84	Class A
b.	Base Coat:		
	1.	Percent Solids	100%
	2.	VOC	7.45 g/L
	3.	Surface Resistivity, ASTM D257	10^6-10^9 ohm/Square
	4.	Static Decay, MIL-STD-3010, Method 4046	0.01 Seconds
	5.	Compressive Strength, ASTM D695	16,000 psi
		ASTM C579	10,500 psi
	6.	Tensile Strength, ASTM D638	3,000 psi
		ASTM C307	1,950 psi
	7.	Tensile Elongation, ASTM D638	7.5%
	8	Flexural Strength, ASTM D790	4,000 psi

a.	Primer:		
		ASTM C580	2,900 psi
	9.	Abrasion Resistance, ASTM D4060 C-10 Wheel, 1,000 gm load, 1,000 cycles	40 mg loss
	10.	Flame Spread, NFPA 101, ASTM E84	Class A
	11.	Flammability, ASTM D635	Self Extinguishing
	12.	Impact Resistance MIL D-3134	Pass
	13.	Water Absorption, MIL D-3134	0.04%
	14.	Heat Resistance Limitation	140 F to 200 F
c.	Topcoat:		
	1.	Percent Solids	69%
	2.	VOC	57 g/L
	3.	Tensile Strength, ASTM D2370	7,000 psi
	4.	Adhesion, ASTM D4541	Substrate Failure
	5.	Hardness, ASTM D3363	>4H
	6.	60^0 Gloss ASTM D523	30+/-10
	7.	Abrasion Resistance, ASTM D4060 CS 17 wheel (1,000 g load) 1,000 cycles	5 mg loss
	8.	Pot Life, 70 F, 50% RH	45 mins
	9.	Full Chemical Resistance	7 days
d.	Copper Foil Tape: Provide as recommended by the manufacturer.		

PART 3 EXECUTION

3.1 PREPARATION

Prior to applying resinous flooring material, inspect substrate and immediately report any unsatisfactory conditions that exist and repair.

Verify that the concrete substrates are dry and the moisture-vapor emissions are within acceptable levels according to the manufacturer's written instructions.

Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with

installation only after substrates have a maximum 75 percent relative humidity level measurement. Provide moisture mitigation system if required by the manufacturer.

3.1.1 Safety Precautions

Prior to application in confined spaces of toppings and coatings containing flammable or toxic properties, institute safety precautions recommended by the manufacturer of the product.

Erect "NO SMOKING" signs, and prohibit smoking or use of spark- or flame-producing devices within 50 feet of any mixing or placing operation involving flammable materials.

Provide the personnel required to handle, mix, or apply toppings containing toxic or flammable properties with such items of personal protective equipment and apparel for eye, skin, and respiratory protection as are recommended by the manufacturer of the product. Ensure all personnel are trained in the appropriate use and wearing of personal protection equipment.

3.1.2 Protection of Adjacent Surfaces

In addition to the protection of adjacent surfaces during installation, provide areas used to store and mix materials with a protective covering under the materials. After application of the epoxy flowing, protect finished flooring during the remainder of the construction period. In areas of expected minimum or moderate traffic, cover floors with 70 pound kraft paper, with strips taped together and edges secured to prevent roll-up. Place vegetable fiberboard, plywood, or other suitable material that does not mar the flooring over the paper to protect areas used as passages by workmen and areas subject to floor damage because of subsequent building operations. Upon completion of construction, remove the protection, clean flooring and, where necessary, repair, reseal, or both, at no additional cost to the Government.

3.1.3 Concrete Subfloor

3.1.3.1 New Concrete Floors

Do not commence installation of the floor topping until the concrete has cured a minimum of 28 calendar days. Verify that the concrete floor is straight, properly sloped, and has flat rubbed, float or light steel trowel type finish as recommended by the manufacturer. Ensure that the concrete is moist cured with burlap or polyethylene. Shot blast substract as recommended by the manufacturer. Before applying the prime coat, clean the concrete surface by an approved method.

3.1.4 Mixing Of Materials

Use mechanical equipment for mixing of materials in accordance with the manufacturer's instructions.

3.2 APPLICATION

3.2.1 Areas of Application

Anchor plates set with the top surface at or above the finished epoxy floor level do not require coverage with this flooring material. Extend

flooring under equipment, except when the equipment base is indicated to be flush against the structural floor. Cover and/or mask surfaces not to receive the epoxy floor topping, such as equipment or cabinets installed prior to surface-preparation efforts and adjacent to the flooring installation.

3.2.2 Epoxy/Urethane Static Dissipative Flooring (ESD-1)

a. General:

1. The system shall be applied in five distinct steps as listed below:

a. Substrate preparation
b. Priming
c. Install Copper foil tape
d. Base coat application
e. Topcoat application

2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using vacuum or clean, dry, oil-free compressed air.

3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.

4. The system shall follow the contour of the substrate.

5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

b. Primer:

1. The primer shall be mixed at the ratio of 2 parts resin to 1 part hardener per the manufacturer's instructions.

2. The primer shall be applied by notched squeegee and back rolled at the rate of 200 sf/gal, to yield a dry film thickness of 8 mils.

c. Copper Foil Tape:

1. Install copper foil tape with conductive adhesive into primer layer in close proximity to the grounding device (outlet, structural steel, conduit ordinance ground, etc.)

2. Use a minimum of 2-inch wide copper foil tape.

3. Copper foil tape is to be installed at one point per 1,000 SF with a minimum of two per room.

d. Base Coat:

1. The base coat shall be comprised of a liquid resin and hardener that is mixed at the ratio of 3 parts resin to 1 part hardener per the manufacturer's instructions.

2. The base coat shall be applied by notched squeegee and back rolled applied at the rate of 100 sf/gal to yield a dry film thickness of 16

mils.

e. Topcoat:

1. The topcoat shall be a kit comprised of a liquid resin, hardener and grit mixed per the manufacturer's instructions.

2. The topcoat shall be applied by notched squeegee and immediately back-rolled at the rate of 350 sf/kit to yield a dry film thickness of 3 to 4 mils.

3. The finished floor will have a nominal thickness of 28 mils.

3.3 FIELD QUALITY CONTROL

3.3.1 Repairing

Remove and replace damaged or unacceptable portions of completed work with new work to match adjacent surfaces at no additional cost to the Government.

3.3.2 Tests and Inspection

a. Temperature: Aire, substrate temperatures and, if applicable, dew point.

b. Coverage Rates: Rates for all layers shall be monitored by checking quantity of material used against the are covered.

c. Surface resistance readings of static dissipative flooring after 24 hour cure @70F: Floor readings should be tested using manufacturer's recommended Megohmeter @100V and read between 10^6-10^9 OHM/square.

3.4 ADJUSTING AND CLEANING

Clean surfaces of the new work, and adjacent surfaces soiled as a result of the work. Remove all equipment, surplus materials, and rubbish associated with the work from the site.

-- End of Section --

SECTION 10 26 00

WALL AND DOOR PROTECTION
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	(2025a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM D256	(2010; R 2018) Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D543	(2020) Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM E84	(2024) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F476	(2014) Standard Test Methods for Security of Swinging Door Assemblies
ASTM G21	(2015; R 2021; E 2021) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1545	(2005; R 2021) Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2022) Adhesive and Sealant Applications

UL SOLUTIONS (UL)

UL 2818	(2022) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Corner Guards

SD-03 Product Data

Corner Guards

Recycled content for aluminum component of corner guards; S

Recycled content for steel component of corner guards; S

SD-04 Samples

Corner Guards; G

SD-06 Test Reports

Fire Resistance Rating

SD-07 Certificates

Indoor air quality for adhesives; S

SD-10 Operation and Maintenance Data

Corner Guards, Data Package 1

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality

1.3.1.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or

provide certification or validation by other third-party program that products meet the requirements of this section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Keep materials dry, protected from weather and damage, and stored under cover. Store materials at approximately 70 degrees F for at least 48 hours prior to installation.

1.5 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a 1 year period of one year from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

To the maximum extent possible, provide wall protection items that are standard products of a single manufacturer and furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown are acceptable.

Submit detailed shop drawings of each wall protection item indicated. Include elevations, dimensions, clearances, details of construction and anchorage, and details of joints and connections.

Submit manufacturers' descriptive product data for each wall protection item indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each wall and door protection item indicated in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.1.1 Resilient Material

Provide resilient material consisting of high impact resistant extruded PVC free conforming to the following:

2.1.1.1 Minimum Impact Resistance

Minimum impact resistance must be 18 ft-lbs/sq. inch when tested in accordance with ASTM D256, (Izod impact, ft-lbs per sq inch notched). Minimum impact resistance must be 49.62 ft-lbs/sq. inch when tested in accordance with ASTM F476.

2.1.1.2 Fire Resistance Rating

Provide the following surface burning characteristics when tested and labeled in accordance with ASTM E84 by a qualified testing agency: maximum flame spread of 25 and a smoke developed rating of 450 or less. Provide material rated as self extinguishing when tested in accordance

with ASTM D635.

2.1.1.3 Integral Color

Provide colored components having integral color and matched in accordance with SAE J1545 to within plus or minus 1.0 on the CIE-LCH scales.

2.1.1.4 Chemical and Stain Resistance

Provide materials resistant to chemicals and stains reagents in accordance with ASTM D543.

2.1.1.5 Fungal and Bacterial Resistance

Provide materials resistant to fungi and bacteria in accordance with ASTM G21, as applicable.

2.2 CORNER GUARDS

2.2.1 Resilient Corner Guards (CG)

Provide surface mounted corner guards, radius formed to profile shown. Provide corner guards that extend as indicated. Furnish mounting hardware, cushions, and base plates. Provide assembly consisting of a snap-on corner guard formed from high impact resistant resilient material, mounted on a continuous PETG retainer. Provide with 1/4 inch radius and 2 inch legs. Provide data identifying percentage of recycled content for aluminum component of corner guards. Furnish factory fabricated end closure caps for top and bottom of surface mounted corner guards. Manufacturer to provide insulating materials that are an integral part of the corner guard system.

2.2.2 Stainless Steel Corner Guards (CG-1)

Provide stainless steel base material that contains a minimum of 60 percent recycled content. Provide data identifying percentage of recycled content for steel component of corner guards. Fabricate stainless steel base material of 16 gauge thick material conforming to ASTM A240/A240M, type 430 or 304. Provide corner guards that extend to height as indicated on drawings. Form corner guard to dimensions shown.

2.3 TRIM, FASTENERS AND ANCHORS

Provide PVC free trim, fasteners and anchors for each specific installation as indicated.

2.4 FINISH

Submit samples indicating color and texture of materials requiring color and finish.

2.4.1 Resilient Material Finish

Provide resilient material finish of texture with colors as indicated in accordance with SAE J1545.

2.4.2 Stainless Steel Finish

Provide stainless steel finish in accordance with ASTM A240/A240M, Type

302 or 304, finish number 4.

2.5 ADHESIVES

Provide adhesive for resilient material in accordance with manufacturers recommendations. Provide sealants and non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) the VOC content requirements of SCAQMD Rule 1168, or VOC content requirements of GS-36. Provide certification of indoor air quality for adhesives.

2.6 COLOR

Provide color as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install items that show visual evidence of biological growth. Install items on surfaces that are clean, smooth, and free of obstructions.

3.1.1 Corner Guards and Wall Guards

Mount guards as indicated on external corners of interior walls, partitions and columns and in accordance with manufacturer's written installation instructions.

3.1.1.1 Stainless Steel Guards

a. Where corner guards are installed on gypsum board, clean surfaces and anchor guards with a neoprene solvent-type contact adhesive specifically manufactured for use on gypsum board construction. Remove excess adhesive from the guard edges and allow to cure undisturbed for 24 hours.

b. Mount guards as indicated and in accordance with manufacturer's recommendations.

c. Where corner guards are installed on walls, partitions or columns finished with plaster or ceramic tile, anchor corner guards as indicated. Coat back surfaces of corner guards, where shown, with a non-flammable, sound deadening material. Overlap corner guards on finish plaster surfaces.

d. Where corner guards are installed on exposed structural glazed facing tile units or masonry wall, partitions or columns, anchor corner guards as indicated. Grout spaces solid between guards and backing with portland cement and sand mortar.

e. Where corner guards are installed on gypsum board, clean surfaces and anchor guards with a neoprene solvent-type contact adhesive specifically manufactured for use on gypsum board construction. Remove excess adhesive from the guard edges and allow to cure undisturbed for 24 hours.

-- End of Section --

SECTION 14 24 23

HYDRAULIC PASSENGER ELEVATORS
08/25

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1/CSA B44	(2022) Safety Code for Elevators and Escalators
ASME A17.2	(2023) Guide for Inspection of Elevators, Escalators, and Moving Walks
ASME B16.9	(2024) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2021) Forged Fittings, Socket-Welding and Threaded
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2024) International Building Code

NATIONAL ELEVATOR INDUSTRY, INC. (NEII)

NEII-1	(2000; R thru 2017) Building Transportation Standards and Guidelines, including the Performance Standards Matrix for New Elevator Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2026) National Electrical Code
NFPA 70E	(2024) Standard for Electrical Safety in the Workplace
NFPA 72	(2025) National Fire Alarm and Signaling Code
NFPA 101	(2024) Life Safety Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-490-06	(2018; with Change 1, 2021) Elevators
UFC 3-560-01	(2017; with Change 3, 2023) Operation and Maintenance: Electrical Safety
UFC 4-010-06	(2023) Cybersecurity of Facility-Related Control Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Elevator System; G

Elevator Components; G

Elevator Drive System; G

Wiring Diagrams; G

SD-03 Product Data

Elevator and Accessories; G

Elevator Components; G

Data Sheets; G

Elevator Microprocessor Controller; G

SD-05 Design Data

Emergency Power Systems

Heat Loads

Reaction Loads

SD-07 Certificates

Warranty

Welders' Qualifications

Elevator Mechanic State License, Certification, or Equivalent

SD-10 Operation and Maintenance Data

Elevator Controller Data Package, G

Maintenance Control Program (MCP); G

Software and Documentation; G

SD-11 Closeout Submittals

Elevator Certification Certificate, Assessment, or Validation and Compliance Report; G

1.2.1 Shop Drawing Requirements

Provide assembly and arrangement of elevators, accessories, and elevator components with clearances marked. Provide floor plan and elevations showing location of all elevator equipment and supporting components including but not limited to: machine, controller, transformers, power panels, motors, disconnects, governors, oil coolers, Heating and AC units, storage cabinets, and human interface systems in the elevator machine room (MR) or control room (CR) and machinery spaces. Floor plans and elevations must be fully dimensioned including size of equipment and code required clearances for servicing components. Provide details for materials and equipment, including but not limited to operating and signal fixtures, doors, door and car frames, car enclosure, controllers, motors, guide rails and brackets, layout of hoistway in plan and elevation, and other layout information and clearance dimensions.

1.2.2 Product Data Requirements

Provide manufacturers' product data for all elevator components, including but not limited to the following: elevator controller, hydraulic pump unit, hydraulic pump and motor, hydraulic cylinder, hydraulic piping and fittings, car and hall fixture buttons and switches, cab and machine room or control room communication devices, door operator, door protection system, car roller guides, and buffers. For data sheets, provide document identification number or bulletin number, published or copyrighted prior to the date of contract bid opening. Provide controller manufacturer's published procedures for performance of each and all testing required by ASME A17.1/CSA B44.

1.2.3 Design Data

1.2.3.1 Reaction Loads

Provide calculations by registered professional engineer for reaction loads imposed on building by elevator system. Demonstrate calculations complying with ASME A17.1/CSA B44

1.2.3.2 Heat Loads

Provide calculations from elevator manufacturer, or by registered professional engineer, for total anticipated heat loads generated by all of the elevator equipment.

1.2.3.3 Emergency Power Systems

Where the facility has an emergency power system, confirm the elevators are connected to the emergency power system. Confirm the complete emergency power system and sequence of operation for all elevators, including operation of the elevator lobby manual selection switch. Provide wiring diagrams for building emergency power interface with elevator controls. For elevators not supplied by an emergency power system, provide manufacturers' product data for auxiliary power systems.

1.2.4 Welders' Requirements

Comply with ASME BPVC SEC IX. Include certified copies of field welders' qualifications. Minimum qualifications are QW-122.4 Multiple Position 6G Pipe. List welders' names with corresponding code marks to identify each welder's welding work.

1.2.5 Maintenance Control Program (MCP)

For each elevator, prepare and provide a written Maintenance Control Program (MCP) that complies with ASME A17.1/CSA B44 Section 8.6 in its entirety. Include written documentation that details the test procedures for each and every test that is required to be performed by ASME A17.1/CSA B44. Assemble all MCP documentation, and supporting technical attachments, in a single MCP package and provide in both electronic and hard copy. Assemble entire hard copy MCP in 3-ring binders and install in each elevator machine room (MR), machinery space (MS), control room (CR), or control space (CS). For each elevator provided, the MCP must include only documentation and instruction that apply to the elevator specified.

For each elevator, provide an additional, separate binder that includes all maintenance, repair, replacement, call back, and other records required by ASME A17.1/CSA B44. Keep the records binder in the elevator MR, MS, or CR, maintained by elevator maintenance and service personnel, and available at all times to authorized personnel. Provide detailed information regarding emergency service procedures and elevator installation company personnel contact information. Provide a listing of all tools to be provided to the Contracting Officer as components of the elevator system.

1.3 QUALITY ASSURANCE

1.3.1 Qualification

Provide a designed and engineered elevator system by an elevator contractor regularly engaged in the installation of elevator systems. Provide elevator components manufactured by companies regularly engaged in the manufacture of elevator components. Utilize elevator personnel who are licensed, certified, or currently enrolled in an accredited elevator training program for adjusting, testing, and servicing of the elevators. Trainees, or helpers, are permitted to perform installation under the direct supervision of an elevator technician. Each elevator technician is permitted to supervise up to three trainees, or helpers.

1.3.1.1 Elevator Contractor's Elevator Technicians

For elevator installations in the United States, including United States territories, perform all elevator related work under the direct and continuous daily on-site supervision of an elevator technician with experience in the installation of elevator systems of the type and complexity specified in the contract documents within the preceeding three years. The elevator technician must provide a current elevator mechanic state license, certification, or equivalent, and have documented completion of training provided by one of the following organizations:

a. National Association of Elevator Contractors (NAEC)

b. National Elevator Industry Education Program (NEIEP)

c. National Association of Elevator Safety Authorities (NAESA)

Each elevator technician is permitted to supervise up to six trainees at any one time who are enrolled and actively participating in any of the above listed organization's training programs.

1.3.2 Manufacturers' Technical Support

Provide elevator components from manufacturers that provide factory training and online and live telephone elevator technical support to any elevator installation, service, and maintenance contractor. Provide elevator components from manufacturers that guarantee accessibility to all replacement and repair parts and components to any elevator installation, service, and maintenance contractor. Use only elevator component manufacturers that provide current published price lists for all elevator parts and components.

1.3.3 Operation and Maintenance Data

Assemble all shop drawing and product data material into O&M Data Packages in accordance with Article SUBMITTALS. Provide two complete O&M Data Packages in hard copy and two complete electronic O&M data packages on separate CDs, in PDF format. Provide all O&M Data Packages to Contracting Officer. Include controller diagnostic documentation and software as required under Article CONTROL EQUIPMENT.

1.3.4 Wiring Diagrams

Provide complete wiring diagrams and sequence of operations, which show electrical connections and functions of elevator systems. Provide one set

(11 inch by 17 inch minimum size) of wiring diagrams, with individual sheets laminated in plastic and assembled in binder, to be stored in the machine room or control room cabinet. Provide one additional hard copy set and one complete electronic set on separate CDs, in PDF format. Provide all wiring diagram sets to the Contracting Officer. Coded diagrams are not acceptable unless fully identified.

1.3.5 Machine Room/Control Room Cabinet

For storage of O&M Data Packages and Wiring Diagrams, provide metal cabinet capable of being locked with a standard padlock, with a minimum size of 20 inch W by 12 inch D by 30 inch H. Size cabinet large enough to accommodate all O&M Data, MCP, and hardware required in paragraphs OPERATION AND MAINTENANCE DATA and WIRING DIAGRAMS. Secure cabinet to machine room or control room wall.

1.4 NEW INSTALLATION SERVICE

Provide elevator warranty service in accordance with the manufacturer's maintenance plan, warranty requirements and applicable safety codes, for a period of 12 months after the date of acceptance by Contracting Officer. This work must be performed during regular working hours by a person meeting the requirements of paragraph ELEVATOR CONTRACTOR'S ELEVATOR TECHNICIANS. Provide supplies and parts to keep elevator system in operation. Perform service only by factory trained personnel. Provide Monthly services to include repairs, adjustments, greasing, oiling, and cleaning. Provide service log in elevator machine room or control room and update Monthly, throughout the one-year warranty period.

Provide 24-hour emergency service, with one hour on-site response time, during this period without additional cost to the Government.

1.4.1 Periodic Elevator Certification Inspection and Testing

Provide elevator mechanic to support NAVFAC QEI Certified Elevator Inspector in the periodic six-month and the annual Category 1 elevator certification inspection and testing. Perform Category 1 inspection and testing no greater than 30 days prior to the end of the warranty period. Perform all elevator certification testing in the presence of QEI Certified Elevator Inspector.

In conjunction with the testing noted above, test systems for Emergency Power Operation, Earthquake Emergency Operation, and Hospital Emergency Commandeering Service Operation, as applicable. Schedule so that testing does not interfere with building operations.

1.5 FIRE PROTECTION SYSTEM

Coordinate interface between building fire protection system and elevator controls.

Additional fire protection requirements are located in: Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE, Section 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION,

1.5.1 Fire Alarm Initiating Devices

Fire alarm initiating devices are specified in Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE, including conduit

and wiring from each detector to fire protection addressable modules in elevator machine room or control room.

1.5.2 Fire Sprinklers

Provide fire sprinklers in accordance with all applicable safety codes and with Section 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION . Provide shutoff valve, check valve, and non-adjustable, zero time-delay flow switch, in each sprinkler line immediately outside of each machine room, control room, and hoistway, as applicable. Provide inspectors' test valve for periodic testing of flow switch and shunt trip disconnect.

Pipe sprinkler piping serving these spaces in a series manner with no laterals. Locate inspectors' test connection at the end of pipe runs such that operation of the test connection will purge air from system piping.

1.5.3 Shunt Trip Disconnect

Provide flow switches specified in paragraph FIRE SPRINKLERS to comply with ASME A17.1/CSA B44 and NFPA 72 for shunt trip of the main line power supply. For each elevator, provide control wiring connecting the flow switch to a shunt trip equipped circuit breaker located in the elevator machine room or control room. Upon flow of water, flow switch will instantaneously cause opening of the shunt-trip circuit breaker and remove power from the elevator. Flow switch must also send a signal to fire alarm control panel to indicate water flow condition.

PART 2 PRODUCTS

2.1 ELEVATOR DESCRIPTION

Provide elevator system that complies with ASME A17.1/CSA B44 in its entirety, UFC 3-490-06 in its entirety, and additional requirements specified herein. Provide elevator system that meets or exceeds the NEII-1 Ride Quality Performance Standards Matrix (RQPSM). Comply with the RQPSM "Intermediate Performance" criteria.

Provide and install elevators in accordance with 36 CFR 1191 - ABAAS, ICC IBC, IEEE C62.41, NFPA 70 and NFPA 101 requirements.

2.1.1 Elevator Design Parameters

2.1.1.1 Elevator No.1 - Emergency Medical Service Accessibility (EMSA)

Provide elevator(s) with minimum size and arrangement to accommodate an ambulance stretcher 24-inch by 84-inch with not less than 5-inch radius corners, in the open, horizontal position.

a. Type: In-Ground Direct Plunger

b. Rated load: 4,000 lb.

c. Rated Speed: 125 fpm

d. Car Door Type: Single-speed center open.

e. Car Door Opening Width: 4 ft.-0 in. minimum.

2.1.2 Cab Enclosure and Hoistway Entrance Assemblies

Provide finishes as listed below:

a. Floor; vinyl composition tile.

b. Walls; stainless steel. Provide each cab wall with equally spaced and equally sized wall panels. All wall panel fasteners must be concealed.

(1) Wall trim; stainless steel.

(2) Accessories; Provide hand rails on full length of back wall and side walls of elevator cab.

c. Car doors, car door returns, and wall reveals; stainless steel.

d. Ceilings; supported stainless steel panels.

(1) Ceiling frame; stainless steel.

e. Hoistway Entrance Assembly Material and Finishes; stainless steel.

2.2 ELEVATOR OPERATION

ASME A17.1/CSA B44, Introduction, Section 3, Definitions.

2.2.1 Single, Two-Stop, Automatic Operation

Provide Single Two-Stop Automatic Operation.

2.2.2 Duplex Selective Collective Automatic Operation

Provide Duplex Selective Collective Automatic Operation. If a car is taken out of service or fails to respond to a landing call within a predetermined adjustable time limit of approximately 40 to 180 seconds, transfer calls to the other car functioning as a single car Selective Collective elevator until the out-of-service car is returned to the system.

2.3 SPECIAL OPERATION AND CONTROL

Provide the following special operations and control systems.

2.3.1 Keys for Elevator Key Switches

Provide a minimum of three industry standard barrel keys per unique cylinder used on all key switches for a single elevator. If there is more than one elevator, provide one additional key set for each unit. Provide keys with plastic, or better, tags marked "PROPERTY OF THE U.S. GOVERNMENT" on one side with function of key on the other side. Provide two elevator drop keys for each elevator with red plastic tag stating 'Emergency Elevator Key (DANGER)For Use By Authorized Persons Only'.

2.3.1.1 Elevator Key and Switch Scheme

Fan speed, cab, and work lighting must be non-key operated type switch located behind a locked service panel which is located on the COP. Follow the elevator key protocol as listed:

a. EX511 Key operates the audible alarm reset/Loss of communication and

must be located at the fire recall level.

b. EX512 Key opens the locked service panel door on the Car Operating Panel (COP) and operates the In-Car Stop switch located inside the locked service panel.

c. EX513 Key operates the independent service switch and is located on the COP accessible to the public (not behind the locked service panel door).

d. EX514 Key operates the Inspection enable switch, and the Access Enable switches located inside the locked service panel.

e. EX516 operates the Hospital Commandeering/Car switches, if applicable, and is located accessible to the public on the COP, and at every landing hall call station.

f. FEOK1 Key operates Fire Service phase 1 switch located at the fire recall level and must open the fire service panel and operate the phase 2 switch located inside firefighters service panel (FFS).

2.3.2 Firefighters' Emergency Operation (FEO)

Provide FEO equipment and signaling devices. The designated level for the FEO Phase I key operated switch is the ground floor. In the FEO Phase I fixture, provide FEO Operating Instructions.

2.3.2.1 Firefighters' Emergency Operation (FEO) Key Box

Provide locking, FEO Key Box of a minimum size inside dimensions of 5.375 inch W by 9 inch H by 1.375 inch D. Install at a height of 5 feet above floor level and directly above the FEO Phase I key switch. Provide box equipped with lock that uses the FEO K1 key and sized large enough to house a set of elevator keys for each unit in the bank, and a standard drop key.

2.3.3 Hoistway Access Operation

Provide hoistway access operation with switches at top and bottom terminal landings. Locate switch 6 feet above floor level, within 12 inches of elevator hoistway entrance frame or with the ferrule exposed when located in the elevator entrance frame.

2.3.4 In-Car Inspection Operation

Provide In-Car Inspection Operation.

2.3.5 Independent Service

Provide key-operated switch on the car operating panel to enable independent service and simultaneously disable in-car signals and landing-call responses. Provide indicator lights that automatically illuminate during independent service. For duplex or group operation, if one car is removed from group another car will respond to its hall calls.

2.3.6 Selective Door Operation

For elevator with one or more rear openings at same level as front opening, provide full-selective operation with car and door operating

buttons clearly marked for front and rear openings, front and rear car button for each such floor, and front and rear "DOOR OPEN" and "DOOR CLOSE" buttons. Only door for which the button was operated opens or closes.

2.3.7 Elevator Auxiliary Power Operating System

Provide elevator auxiliary power operating system for elevator 1.

2.4 ELEVATOR DRIVE SYSTEM

Provide hydraulic elevator drive system, including pump unit, piping, cylinder/plunger assembly, and associated equipment, which will operate at a maximum working pressure of 500 psi or less. Provide complete elevator system that meets or exceeds the NEII-1 Ride Quality Standard, including elevator ride quality and noise levels in car and in elevator machine room and machinery space.

2.4.1 Hydraulic Pump Unit

Provide self-contained pump unit, including oil-hydraulic elevator pump, electric motor, suction-line oil strainer, and structural steel outer base with tank supports and isolation pads. Provide oil tank capacity for full plunger displacement plus at least 10 gallons. Provide means to maintain oil temperature between 100 and 130 degrees F regardless of ambient temperature. Limit acoustic output in elevator machine room and machinery space to 80 dbA.

2.4.1.1 Pump Motor

Provide intermittent-duty pump motor rated at 80 starts/hour and class F insulation. Provide motor that is sized so that the motor amperage does not exceed the motor nameplate rating in any operating condition, exclusive of acceleration and deceleration. Provide minimum of one mega ohm insulation resistance between conductors and motor frame. Provide motor and pump nameplate and data tags permanently mounted on the outside of the pump unit frame, with all data viewable without the use of mirrors or other tools.

2.4.2 Hydraulic Controls and Equipment

Provide control valve, overspeed safety valve, blowout-proof muffler, and hydraulic pump discharge strainer in the hydraulic oil supply line. Provide two 1/4 turn, ball valve type manual shutoff valves. Provide one in the elevator hoistway pit and one in the elevator machine room or machinery space.

2.4.2.1 Hydraulic Control Valve

Provide constant-velocity, down-speed regulated, control valve. Down-speed regulated control valve allows the car to travel at the same speed in the down direction, regardless of the load on the elevator. In addition, the hydraulic control valve must have built-in adjustment capability to operate the elevator at 140 percent of rated speed to facilitate periodic testing of the overspeed safety valve.

2.4.2.2 Hydraulic Overspeed Safety Valve

Provide overspeed safety valve in hydraulic oil supply line, directly adjacent to the hydraulic cylinder. Provide threaded pipe connections

between the hydraulic cylinder and the overspeed valve. Provide valve equipped with manufacturer's manual shutoff feature. Overspeed valve must not be equipped with a manual lowering feature after activation. Provide adjustable valve with means to seal adjustment after inspection and testing by certified elevator inspector.

2.4.3 Hydraulic Piping and Accessories

Provide ASTM A53/A53M or ASTM A106/A106M, Schedule 80, carbon steel piping with ASME B16.9 or ASME B16.11 fittings for supply piping. Extend schedule 80 piping from the pump control valve body, inside the pump unit, to the hydraulic cylinder in the hoistway. Provide welded, threaded, forged, or grooved pipe fittings for all fittings and components of the hydraulic oil supply line. Welding of hydraulic piping and vessels require welders with minimum qualifications complying with ASME BPVC SEC IX. Provide Schedule 80 socket fittings, weld-o-let, and thread-o-let carbon steel fittings for all welded joints. Provide hangers or supports for all piping and components. Grooved couplings that are field modified (cut or rolled) are permitted when the installing technician presents proof of OEM training on the piping system being installed.

2.4.3.1 Containment of Hydraulic Oil Supply Line

Protect all portions of hydraulic oil supply line that are installed below ground, including portions encapsulated in concrete or covered by construction, with continuous, Schedule 80, PVC. Inside diameter of PVC must be 4 inches larger than the outside diameter of the hydraulic oil supply line pipe and couplings.

2.4.4 Hydraulic Elevator Type

Provide an in-ground direct plunger type hydraulic elevator. Elevators with telescopic or inverted cylinder-plungers are not acceptable and may not be used. Rope hydraulic elevator design is not acceptable and may not be used.

2.4.4.1 Cylinder-Plunger (Jack) Unit

Provide a single-stage plunger of seamless steel construction. Provide cylinder with self-stabilizing mount that supports and holds the cylinder plumb without the need for stabilization means at the bottom of the cylinder. Provide a threaded, 1/4 inch bleeder valve at the top of the cylinder, just below packing gland.

2.4.5 Cylinder Well System

For direct plunger, in-ground type hydraulic elevator, provide a dry, sealed cylinder well system.

2.4.5.1 Well Casing

Locate and drill well for the cylinder well system. Line well with steel casing, minimum 1/4 inch wall with welded 1/2 inch steel bottom. Set casing plumb.

2.4.5.2 PVC or HDPE Liner

Provide Schedule 80 PVC or HDPE liner with bottom cap and couplings; joints sealed watertight using pipe manufacturer's recommended adhesive or

heat welding methods. Provide liner inside diameter not less than 3 inches larger than elevator cylinder maximum outside diameter. Liner may be provided as a cylinder manufacture's applied liner or as a separate component. For separate liner, set liner plumb in well casing, located for cylinder installation. Provide dry, salt-free sand below and around the liner up to a minimum of 24 inches of the PVC liner.

2.4.5.3 Cylinder Installation

Remove all moisture from inside of liner. Install cylinder plumb, inside liner. Provide a 1/4 inch copper, or non-corrosive, evacuation tube inside the liner. The bottom of the evacuation tube must be within 6 inch of the bottom of the liner. Top of evacuation tube must extend at least 6 inch above pit floor. Provide top of test tube with removable cap to exclude foreign matter. Provide air inlet pressure fitting in top of liner and accessible in pit, for performance of air pressure test. Secure Liner/Cylinder Assembly as recommended by cylinder manufacturer.

2.4.5.4 Cylinder Liner Fluid Detection System

Provide fluid detection sensors inside the cylinder liner to detect the presence of oil or water at the bottom of the cylinder liner. Provide sensor monitoring system which actuate audible and visual alarms when water or oil is present, and discriminate between the two.

2.4.5.5 Seal Top of Well Casing

Upon successful test and certification of Liner/Cylinder assembly, seal gap between steel well casing and liner with foam insert strong enough to retain and support final grouting. Provide 3000 psi grout to a minimum of 4 inch thickness and level top of final grouting with pit floor.

2.5 ELEVATOR CONTROL EQUIPMENT

Enclose all elevator control equipment in factory-primed and baked-enamel coated sheet-metal cabinets with ventilation louvers and removable or hinged doors. Mount cabinets at eye level to the User Interface Tool, with the maximum height of the cabinet top no greater than of 78 inches above the machine room or control room finish floor. Controllers cannot be mounted on the hydraulic power unit. For floor mounted controllers, maintain a minimum clearance of 10 inches.

2.5.1 Motor Control Equipment

Provide elevator motor control with electronic, soft-start motor starter.

2.5.2 Elevator Controller

For each individual elevator controller, and for each group controller, provide a elevator microprocessor controller. Provide elevator controller data package that includes all hardware and software required for the installation, maintenance, testing, and service of the elevator, in its entirety. Provide an elevator controller designed to automatically reestablish normal elevator operation following any temporary loss of power, regardless of duration. Remote Interaction Operation (RIO)is not authorized for installation.

Provide EC Pixel Controller per J&A No. 21-0013.

2.5.2.1 Elevator Controller Availability

Identify the elevator controller as available for purchase and installation by any licensed elevator contractor. All components, parts, diagnostic tools, and software must be available for purchase and installation and use by any licensed elevator contractor; "exchange-only" provisions for the purchase of spare parts are not acceptable. The elevator controller manufacturer must publish an industry competitive price listing for all controller parts, diagnostic tools, and software.

Provide an elevator controller from a manufacturer that provides comprehensive factory training to include controller installation, adjustment, service, and maintenance. Identify the training as available to any licensed elevator contractor. Training schedule, with pricing, for factory training classes that manufacturer provides must made available upon request, and offered for a minimum period of one year prior to contract award date.

2.5.2.2 Elevator Controller Technical Support

Provide verification of telephone and internet based technical support service that the elevator controller manufacturer provides to any licensed elevator installation, service, and maintenance company at an industry competitive price. Include in the service live telephone based technical support for installation, adjustment, maintenance, and troubleshooting of the elevator controller and related elevator components. The service must be available during standard working hours.

2.5.2.3 Elevator Controller Interface

For each individual elevator microprocessor controller, provide a mounting in, or on, the elevator controller for the human interface system with it's own receptacle. For group elevator installations, a single cabinet and interface system with full access to each elevator controller may be utilized. The human controller interface software is supplied by the elevator controller manufacturer and includes a minimum 10 inch display. The elevator controller interface cabinet must comply with arc-flash protection requirements of NFPA 70E and UFC 3-560-01.

2.5.2.3.1 Elevator Microprocessor Human Interface

The interface system must provide complete elevator controller interface capability and must include the elevator controller manufacturer's comprehensive package of installation and diagnostic software. The interface cannot utilize wireless communication with the controller. The microprocessor interface system must provide unrestricted access to all parameters, all levels of adjustment, testing, and all flags necessary for installation, adjustment, maintenance, and troubleshooting of each elevator and for the elevator group. Store all software programming in non-volatile memory. The elevator controller fault log must provide non-volatile memory fault log storage of all faults, trouble calls, and fault history for a minimum of one hundred events, and have the ability to download or print the fault log. The controller interface must also provide the capability to display and diagnose trouble calls, faults, and shutdowns. Expiring software, degrading operation, and "key" access controls are not acceptable.

2.5.2.4 Software and Documentation

Provide two copies of the manufacturer's maintenance and service diagnostic software, with complete software documentation that enables unrestricted access to all parameters and functions of the controller. Manufacturer's maintenance and service diagnostic software that is available without charge for downloading via vendor portal meets this requirement. Revisions to software must be available at no additional charge for the life of the controller. Provide signed certification, from the manufacturer's corporate headquarters, that guarantees that the microprocessor software and access system will not terminate the unlimited and unrestricted access at any future date.

2.5.2.5 Elevator Controller Cybersecurity

Comply with UFC 4-010-06, Cybersecurity for Facility-Related Control Systems (FRCS), and Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS, to ensure the control system is isolated and not accessible remotely. Controllers that have remote capability are acceptable if proven that their remote capability is permanently disabled.

2.6 OPERATING PANELS, SIGNAL FIXTURES, AND COMMUNICATIONS CABINETS

For all panels and fixtures, provide identical and uniform panel and fixture design, material, finish, and components for all elevators. For all panels and fixtures, legibly and indelibly identify all buttons, devices, and all operating positions for each device. Use engraving and backfilling, or raised lettering, for button and device designations. Do not use attached signs. Provide industry standard grade barrel keys for all key switches unless otherwise specified. All illuminating panels and fixture components must utilize LED lighting for energy efficiency.

2.6.1 Car and Hall Buttons

For all cab and landing fixture buttons, provide industry-standard, vandal resistant push buttons with positive-stop assembly design. Buttons must be minimum 3/4 inch diameter, satin-finish stainless steel, with illuminating LED halo.

2.6.2 Passenger Car-Operating Panel

Provide each car with one car operating panel that contains operation controls and communication devices. Provide exposed, flush mounted buttons for the controls identified in subparagraph PASSENGER CONTROLS. Provide a lockable service cabinet for the controls listed in subparagraph SERVICE CONTROLS. Use engraving and backfilling or photo etching for button and switch designations. Do not use attached signs.

2.6.2.1 Passenger Controls

All passenger controls must be exposed and accessible to riders. In addition to ASME A17.1/CSA B44 requirements, provide the following operating controls, identified as indicated:

a. Illuminating car-call buttons identified to correspond to landings served by the elevator.

b. "DOOR OPEN" and "DOOR CLOSE" buttons. For front and rear openings at the same floor, include the identification "F" and "R" for each

opening.

c. Red, illuminating "ALARM" button.

d. Key-operated "Independent Service" switch.

e. "Help" communication device to include intercom function, which when activated communicates between elevator cab and elevator machine room or control room.

2.6.2.2 Service Controls

Locate all service controls behind a locked cover and not accessible to riders without a key. In addition to ASME A17.1/CSA B44 requirements, provide the following operating controls, identified as indicated:

a. Provide a key-operated, three-position switch for "In-car Inspection Operation" and "Hoistway Access". The center switch position provides normal, automatic operation.

b. "Car Light" must be a non-key operated switch.

c. "Car Fan" must be a non-key operated switch with two speed settings identified.

d. 120-volt ac 60 Hz single-phase duplex electrical outlet of ground-fault-circuit-interrupt (GFCI) design.

e. Provide an In-Car stop switch located in the service cabinet.

2.6.2.3 Certificate Window

Provide a minimum 4 inch wide by 6 inch high certificate window for elevator inspection certificate. Locate window in the Service Controls door of the Car Operating Panel.

2.6.2.4 Emergency Signaling Devices

Provide an audible signaling device, operable from the Car Operating Panel button marked "ALARM". The audible signaling device must have a sound pressure rating between 80 and 90 dBA at 10 ft. Provide battery backup power capable of operating the audible signaling device for at least one hour.

2.6.3 Elevator In-Car Position Indicators

For all elevators, provide illuminating position indicator in the Car Operating Panel.

2.6.4 Elevator In-Car Direction Indicators

For 2-stop elevator installations, provide visual direction indicators and audible car arrival signal in accordance with 36 CFR 1191. Visual indicators must be visible from the hall call fixture.

2.6.5 Hall Call Landing Fixtures

Provide a hall call fixture adjacent to each elevator. Provide a single push-button for terminal landings and dual push-buttons, up and down, at

intermediate landings.

2.6.5.1 Designated Landing Hall Call Fixture

2.6.5.1.1 Location of COMMUNICATION MEANS FAILURE (CMF) Visual Signal

As required by ASME A17.1/CSA B44, provide an elevator CMF audible and illuminating signal, and reset switch, in the FEO Designated Landing hall call fixture. Mount the signal and reset switch at a minimum of 7 inches above the "UP" hall call button.

2.6.5.1.2 COMMUNICATION MEANS FAILURE (CMF) Visual and Audible Signal Operation

Provide a CMF visual and audible signal system that conforms to ASME A17.1/CSA B44. Provide continuous verification of operability of the telephone line and activation of audible and visual signals within 60 seconds when verification means determines that the telephone line is not functioning. Provide illumination of visual signal at one second intervals. Provide a minimum of 65 dBA audible signal at 30 second intervals.

2.6.5.1.3 Firefighters' Emergency Operation Phase I Switch and Visual Signal

When required by ASME A17.1/CSA B44, provide an elevator Firefighters' Emergency Operation Phase I switch and illuminating visual signal in the FEO Designated Landing hall call fixture. Provide FEO Phase I visual signal that is designed with intermittent, flashing, illumination when actuated by the machine room, control room, or hoistway fire alarm initiating device. Locate FEO Phase I key switch above the CMF visual signal with a minimum of 6 inches vertical between the centerlines of the CMF signal and the FEO Phase I key switch. Locate FEO Phase I visual signal directly above the Phase I switch. In addition, locate Elevator Corridor Call Station Pictograph at top of hall call fixture.

2.6.6 Elevator Car Position and Direction Indicators and Car Arrival Signal

For elevator installations with three or more stops, provide a separate hall landing fixture that includes the visual elevator position indicator, visual direction indicators, and audible car arrival signal, in accordance with 36 CFR 1191.

2.6.7 Designated Landing Elevator Identification Fixture

For duplex and group elevator installations, provide and install a separate elevator identification fixture for each elevator on the top center of the hoistway door jamb, with identification engraved and backfilled with a contrasting color. Number elevators from left to right, as seen during primary approach from building main entrance to elevator lobby. Lettering must be minimum 3/4 inch height. For multiple elevator groups, begin numbering with group that is closest to the building main entrance.

2.6.8 Emergency or Standby Power

When emergency or standby power is provided for elevator operation, provide an elevator emergency power visual indicator that conforms to ASME A17.1/CSA B44. Locate the visual signal in the Firefighters

Emergency Operation fixture for each simplex elevator and for each elevator group. When an emergency power selector switch is required, provide switch in a separate, flush mounted fixture located at the designated level, in view of all elevator entrances.

2.7 CAR DOOR EQUIPMENT

2.7.1 Car Door Operator

Wireless communication systems are not to be utilized.

2.8 PASSENGER ELEVATOR GUIDES, PLATFORM, AND ENCLOSURE

2.8.1 Roller Guides

Provide coil-spring loaded roller guide assemblies in adjustable mountings on each side of car and counterweight frames in accurate alignment at top and bottom of frames.

2.8.2 Car Enclosure Wall Panels, Return Panels, Doors, Entrance Columns, and Transom

Provide 14 Gauge minimum stainless steel cab wall panels and entrance components. Use same material and finish for all hoistway and car entrance assemblies. Apply sound-deadening material on exterior of all cab wall panels.

2.8.3 Car Enclosure Top

Provide reinforced, 12 gauge minimum steel car enclosure top. Provide hinged emergency exit with lock that complies with the appropriate seismic risk design requirements of ASME A17.1/CSA B44. Locate emergency exit hinge towards the rear of the elevator cab. Design and configure the elevator cab interior ceiling to provide convenient and unobstructed access to, and use of, emergency exit from inside the elevator cab.

2.8.4 Car Door

Provide 16 gauge minimum stainless steel car doors of sandwich construction with flush surfaces on car and landing sides. Provide a minimum of two door guide assemblies per door panel, one guide at leading and one at trailing door edge with guides in the sill groove their entire length of travel.

2.8.5 Car Entrance Sill

Provide one piece cast nickel silver, entrance sill(s). Set sills level and flush with floor finish. Use same material for hoistway and car entrance sills.

2.8.6 Cab Finish Floor

Provide cab finish floor with top of finish floor flush with the cab sill.

2.8.7 Car Fan

Provide 2-speed fan for car enclosure forced ventilation. Mount fan in the car enclosure top.

2.8.8 Car Lighting

Utilize LED lighting for elevator car interior illumination. Provide a minimum of 10 foot-candles, measured at all areas of the car enclosure floor. Provide automatic car lighting operation that turns off car lights after 3 minutes of inactivity. Car lights must automatically turn on upon actuation of an elevator car or hall call.

2.8.9 Car Protection Pads and Hooks

Provide fire retardant, hanging car protection pads that provide protection for all car interior wall panels. Provide permanently installed studs in car that are designed for hanging the car protection pads in the car.

2.9 PASSENGER ELEVATOR HOISTWAY DOORS AND ENTRANCES

Provide fire rated hoistway entrance assemblies with rating as required per ICC IBC. Use same material and finish for all hoistway and car entrance assemblies.

2.9.1 Hoistway Entrance Frames

Provide 14 gage minimum stainless steel hoistway entrance frames. Solidly grout uprights of entrance ways to height of 5 feet.

2.9.2 Hoistway Entrance Sills

Provide one-piece cast nickel silver entrance sills. Set top of landing sill flush with top of finish floor. Solidly grout under full length of sill for grouted installations. All sills must support a minimum of Class A loading without deflection. Use same material for all hoistway and car entrance sills.

2.9.3 Hoistway Entrance Doors

Provide hollow metal stainless steel non-vision construction hoistway entrance doors with flush surfaces on car and landing sides. Provide a minimum of two door guide assemblies per door panel, one guide at leading edge and one at trailing edge with guides in the sill groove the entire length of door travel. Use same material and finish for all hoistway and car entrance assemblies. Provide an escutcheon tube that accommodates a standard drop key for each door.

2.9.4 Hoistway Entrance Door Track Dust Covers

Provide sheet metal hoistway door track dust covers at each landing. Dust covers must cover top and hoistway side of door locks and door roller tracks, and extend the full width of the door track and associated hardware. Dust cover sections will not exceed 3 feet in length.

2.10 HOISTWAY EQUIPMENT

2.10.1 Car Guide Rails and Fastenings

Provide T-section type guide rails for car. Paint rail shanks with one coat of black enamel.

2.10.2 Pit Equipment and Support Channels

Provide rail-to-rail pit channels to serve as mounting surface for main guide rails, hydraulic cylinder and car buffers. Method of installation of channels, brackets and buffer mounts cannot puncture the pit waterproofing. Paint all pit channels with rust resilient paint. Install one set of pipe supports (pokes), and store on brackets, in the pit for each car. Each car, or bank of cars, must have a set of portable barriers installed in the MR, or CR, for use in accessing any landing safely. Label barriers to indicate which car, or bank of cars, it is intended to be used for.

2.10.3 Pit "STOP" Switch

Provide push-to-stop/pull-to-run type pit "STOP" switch.

2.10.4 Traveling Cables

Suspend traveling cables by means of self-tightening webbed devices or internal suspension members.

2.10.5 Hoistway Pit Ladder

Provide continuous horizontal slip resistant rungs for the full height of the pit ladder. Center opening door systems usually require a retractable ladder to meet the required maximum distance from the hoistway door opening means. Ladder guarding is not permitted be installed.

2.10.6 Sump Pump Controls

Provide a sump pump oil sensing control system designed to allow water to be pumped out of the sump without pumping oil/hydraulic fluid from the elevator hoistway pit. The sump pump control system must include an audible alarm and visual indicators for water and oil. Install alarm indicators and controls in the elevator MR, CR, or in a convenient location at the designated landing. The system must alarm with high water level and the presence of oil in the sump.

2.10.7 Pit Flooring Preservation

Paint pit floor with minimum two coats of gray industrial grade, high traffic paint, or equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

Install in accordance with DOD design criteria, contract specifications, manufacturer's instructions, NEII-1 Building Transportation Standards and Guidelines, and all applicable building and safety code requirements.

3.1.1 Structural Members and Finish Materials

Do not cut or alter structural members. Do not alter finish materials from manufacturer's original design. Restore any damaged or defaced work to original condition.

3.1.2 Miscellaneous Requirements

Provide recesses, cutouts, slots, holes, patching, grouting, and refinishing to accommodate elevator installation. Use core drilling to drill all new holes in concrete. Finish work to be straight, level, and plumb. During installation, protect machinery and equipment from dirt, water, or mechanical damage. Paint all bare metal with rust resilient paint. At completion, clean all work and spot paint to match surrounding.

3.2 FIELD QUALITY CONTROL

The installing elevator Contractor must conduct elevator pre-acceptance inspection and testing utilizing a currently licensed Qualified Elevator Inspector (QEI) not employed by the installing elevator contractor. The inspections and testing ensures that the installation conforms to all applicable safety codes and contract requirements, meets all ASME testing requirements, and has passed all Field tests required by this specification. For modernization projects existing equipment must be adjusted to meet performance criteria.

Upon completion submit a written test data report certifying that the elevator is complete and ready for final Acceptance Inspection, Testing, and Commissioning. Include all findings, measurements, and test results in the report.

3.3 ACCEPTANCE INSPECTION, TESTING AND COMMISSIONING

When elevator system installation is complete and ready for final inspection, notify Contracting Officer that elevator system is ready for Acceptance Inspection, Testing, and Commissioning. Provide QEI certification specified in Article FIELD QUALITY CONTROL.

Contracting Officer is responsible to obtain the services of Naval Facilities Engineering Systems Command (NAVFAC) QEI Certified Elevator Inspector. NAVFAC QEI utilizes the applicable NAVFAC Elevator Acceptance Inspection Form to record the results of inspection and testing and to identify safety code and contract deficiencies. Provide specific values for all tests required by ASME A17.1/CSA B44, ASME A17.2, and contract documents. Upon completion of inspection and testing, the NAVFAC QEI will sign a copy of the completed forms and provide the signed copy to the Contracting Officer or representative. Within 2 weeks of the inspection, the QEI will also submit an Elevator Certification Certificate, Assessment, or Validation and Compliance Report, including all test results and deficiencies. Upon successful completion of inspection and testing, NAVFAC Certified Elevator Inspector will complete, sign and post form NAVFACENGCOM 9-11014/23(Rev.9-2009), Elevator Inspection Certificate.

3.3.1 Acceptance Inspection Support

Prime and Elevator Contractors must provide inspection support and perform all required tests, in order to demonstrate proper operation of each elevator system and to prove that each system complies with contract requirements and all applicable building and safety codes. Inspection procedures in ASME A17.2 form a part of this inspection and acceptance testing. All inspection and testing must be conducted in the presence of the Qualified Elevator Inspector (QEI).

If the elevator does not comply with all contract and safety code

requirements on the initial Acceptance Inspection and Test, the Contractor is responsible for all costs involved with re-inspection and re-testing required as a result of contractor delays and discrepancies discovered during inspection and testing.

3.3.2 Testing Materials and Instruments

Furnish all testing materials and instruments necessary for Acceptance Inspection, Testing and Commissioning. At a minimum, include calibrated test weights, tachometer, accelerometer, hydraulic pressure gauge, 600-volt mega ohm meter, volt meter and ammeter, infrared temperature gauge, door pressure gage, dynamometer, and 20 foot tape measure.

3.3.3 Field Tests

3.3.3.1 Endurance Tests

Test each elevator for a period of one hour continuous, automatic operation, with specified rated load in the elevator cab. During the one hour test, stop car at each floor, in both directions of travel, and allow automatic door open and close operation. The requirements for Automatic Operation, Rated Speed, Leveling, Temperature Rise and Motor Amperes must be met throughout the duration of the Endurance Test. Restart the one hour test period from the beginning, following any shutdown or failure.

3.3.3.2 Speed Tests

Determine actual speed of each elevator, in both directions of travel, with rated load and with no load in elevator car. Make Speed tests at the beginning and at the end of the Endurance test. Determine speed by tachometer reading or accelerometer, excluding accelerating and slow-down zones. Under all conditions, minimum acceptable elevator speed is the Rated speed specified. Maximum acceptable elevator speed is 110 percent of Rated speed.

3.3.3.3 Leveling Tests

Test elevator car leveling operation and provide a leveling accuracy equal to or less than 1/8 inch at each floor with no load in car, and with rated load in car, in both directions of travel. Determine leveling accuracy at the beginning and at the end of the endurance tests.

3.3.3.4 Temperature Rise Tests

Determine temperature rise of elevator pump motor and hydraulic fluid during one-hour full-load test run. Under these conditions, maximum temperature rise must not exceed acceptable temperature rise indicated on manufacturer's data plate. Start test only when equipment is within 5 degrees C of ambient temperature.

3.3.3.5 Motor Ampere Tests

At beginning and end of Endurance test, measure and record motor amperage in both directions of travel and in both no-load and rated load conditions.

3.3.3.6 Elevator Performance and Ride Quality Testing

Evaluate elevator performance to ensure compliance with specification requirements related to the NEII-1 Performance Standards Matrix for New

Elevator Installations.

3.3.3.7 Hydraulic Safety Valve (Automatic Shutoff Valve) Tests

In order to ensure consistent performance, regardless of hydraulic oil temperature, test the Hydraulic Safety Valve twice. Test once before the one-hour endurance test and once immediately after the one-hour test. For elevator certification, safety valve must perform to elevator safety code requirements in both tests.

3.3.3.8 Hydraulic Pressure Tests

Check the hydraulic static pressure and rated-speed operating pressure at the hydraulic control valve, under both no load and rated load conditions.

3.3.3.9 Pressure Test of Liner/Cylinder Assembly

Perform 20 psig pressure test of the completed and installed liner/cylinder assembly for a minimum of 15 minutes. Test liner/cylinder assembly as a sealed unit. Provide safety relief valve set to relieve at 20 psig; 4.5 inch diameter dial pressure gage scaled for 0 to 50 psig and calibrated to 0.5 percent accuracy; and an air pressure admission throttle and shutoff valve. For safety, perform pressure test only when liner and cylinder are fully inserted and assembled in the well casing. Perform the test from remote location outside of the elevator pit. Perform test in the presence of, and witnessed by, a Certified Elevator Inspector who must document all results. It is recommended that this testing be performed at the same time as the jack installation to prevent major re-work at the project completion.

3.3.3.10 Sump Pump Testing

Perform OEM required testing of the installed sump pump and control/alarm system in the presence of the QEI. Minimum testing must include motor amperage, actual flow rate, discharge verification, and alarm operation.

-- End of Section --

SECTION 26 32 15.01

ENGINE-GENERATOR SET STATIONARY 15-2500 KW, WITH AUXILIARIES-EMERGENCY
02/26

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.11	(2021) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B31.1	(2024) Power Piping
ASME B31.3	(2024) Process Piping
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2026) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A181/A181M	(2023) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A193/A193M	(2026) Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194/A194M	(2026) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both

ASTM A234/A234M	(2025) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM D975	(2020) Standard Specification for Diesel Fuel Oils

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

EGSA 101P	(1995) Performance Standard for Engine Driven Generator Sets

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1	(2000; R 2011) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation
IEEE 43	(2013) Recommended Practice for Testing Insulation Resistance of Rotating Machinery
IEEE 81	(2025) IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth
IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE 115	(2019) Guide for Test Procedures for Synchronous Machines: Part I Acceptance and Performance Testing; Part II Test Procedures and Parameter Determination for Dynamic Analysis
IEEE 120	(2023) Master Test Guide for Electrical Measurements in Power Circuits
IEEE 484	(2019) Recommended Practice for Installation Design and Implementation of Vented Lead-Acid Batteries for Stationary Applications
IEEE 485	(2020) Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
IEEE 519	(2022) Standard for Harmonic Control in Electrical Power Systems
IEEE C2	(2023; ERTA 1 2023; ERTA 2-3 2025) National Electrical Safety Code
IEEE C50.12	(2025) 50 Hz and 60 Hz Synchronous Generators and Generator/Motors Coupled to Hydraulic Turbines and Rated 5 MVA and Above

IEEE C57.13	(2016) Standard Requirements for Instrument Transformers
IEEE C57.13.1	(2006; R 2012) Guide for Field Testing of Relaying Current Transformers

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2024) International Building Code

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60034-2A	(1974; ED 1.0) Rotating Electrical Machines Part 2: Methods for Determining Losses and Efficiency of Rotating Electrical Machinery from Tests (Excluding Machines for Traction Vehicles) Measurement of Losses by the Calorimetric Method

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 3046	(2002, 2006, 2009, 2001) Reciprocating Internal Combustion Engines - Performance--Part 1, 3, 4, 5, 6
ISO 8528	(1993; R 2018) Reciprocating Internal Combustion Engine Driven Alternating Current Generator Sets--Part 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2025) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-80	(2019) Bronze Gate, Globe, Angle, and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA MG 00001	(2024) Motors and Generators
NEMA PB 1	(2011) Panelboards

NEMA PB 2	(2011) Deadfront Distribution Switchboards
NEMA/ANSI C12.11	(2024) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2024; ERTA 1 2025) Flammable and Combustible Liquids Code
NFPA 37	(2024; TIA 24-1) Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 54	(2024) National Fuel Gas Code
NFPA 58	(2024; TIA 24-2) Liquefied Petroleum Gas Code
NFPA 70	(2026; TIA 26-1; ERTA 26-1; TIA 26-2; TIA 26-3; TIA 26-4; TIA 26-5; TIA 26-6; TIA 26-7; ERTA 26-2; ERTA 26-3) National Electrical Code
NFPA 99	(2024, TIA 24-2) Health Care Facilities Code
NFPA 110	(2025) Standard for Emergency and Standby Power Systems

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE ARP892	(1965; R 1994) DC Starter-Generator, Engine
SAE J537	(2023) Storage Batteries

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-461	(2015; Rev G) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
UFC 3-301-01	(2023; with Change 6, 2026) Structural Engineering

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 60	Standards of Performance for New Stationary Sources

UL SOLUTIONS (UL)

UL 142	(2025) UL Standard for Safety Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 467	(2022) UL Standard for Safety Grounding

	and Bonding Equipment
UL 489	(2025) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 891	(2019; Reprint Mar 2025) UL Standard for Safety Switchboards
UL 1236	(2015; Reprint Feb 2021) UL Standard for Battery Chargers and Charging Engine-Starter Batteries

1.2 RELATED MATERIALS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, and Section 26 08 00 APPARATUS INSPECTION AND TESTING apply to this section, except as modified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Engine-Generator Set and Auxiliary Equipment; G

Auxiliary Systems; G

Detailed Drawings; G

Acceptance; G

SD-03 Product Data

Harmonic Requirements; G

Engine-Generator Set Efficiencies; G

Emissions; G

filters; G

special tools; G

Remote Alarm Annunciator; G

Engine-Generator Parameter Schedule

Heat Exchanger

Generator

Manufacturer's Catalog

Site Welding

Spare Parts

Onsite Training

Vibration-Isolation

Posted Data and Instructions; G

Instructions; G

Experience

Field Engineer

General Installation

Exciter

SD-05 Design Data

Performance Criteria

Sound Limitations; G

Integral Main Fuel Storage Tank

Power Factor

Heat Exchanger

Time-Delay on Alarms

Cooling System

Vibration Isolation

Battery Charger

Capacity Calculations for Engine-Generator Set; G

Brake Mean Effective Pressure (BMEP) Calculations; G

Torsional Vibration Stress Analysis Computations; G

Capacity Calculations for Batteries; G

Turbocharger Load Calculations; G

SD-06 Test Reports

Performance Tests

Factory Inspection and Tests

Factory Tests

Onsite Inspection and Tests; G

Acceptance Checks and Tests; G

Functional Acceptance Tests; G

Maintenance Procedures; G

Operation and Maintenance Manuals; G

Inspections; G

Functional Acceptance Test Procedure; G

SD-07 Certificates

Cooling System

Vibration Isolation

Prototype Test

Reliability and Durability

Fuel System Certification; G

Start-Up Engineer; G

Instructor's Qualification Resume; G

Engine Emission Limits; G

Sound Limitations

Site Visit

Current Balance

Materials and Equipment

Factory Inspection and Tests

SD-09 Manufacturer's Field Reports

Engine Tests; G

Generator Tests; G

Assembled Engine-Generator Set Tests; G

SD-10 Operation and Maintenance Data

Preliminary Assembled Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

Posted Data and Instructions; G

Training Plan; G

1.4 QUALITY ASSURANCE

1.4.1 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, NEMA, etc., the design, fabrication and installation must also conform to the code.

1.4.2 Site Welding

Weld structural members in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS. For all other welding, qualify procedures and welders in accordance with ASME BPVC SEC IX.

a. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1.

b. Submit a copy of qualifying procedures and a list of names and identification symbols of qualified welders and welding operators.

c. Submit a letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their identification symbols.

d. Perform welder qualification tests for each welder whose qualifications are not in compliance with the referenced standards. Notify the Contracting Officer 24 hours in advance of qualification tests which must be performed at the work site, if practical.

e. The welder or welding operator must apply the personally assigned symbol near each weld made as a permanent record.

1.4.3 Vibration Limitation

Limit the maximum engine-generator set vibration in the horizontal, vertical, and axial directions to 6 mils (peak-peak RMS), with an overall velocity limit of 0.95 inches/second RMS, at rated speed for all loads through 110 percent of rated speed. The engine-generator set must be provided with vibration isolation in accordance with the manufacturer's standard recommendation. Where the vibration isolation system does not secure the base to the structure floor or unit foundation, provide seismic restraints in accordance with the seismic parameters specified.

1.4.4 Torsional Analysis

Submit torsional analysis including prototype testing or calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus/minus 10 percent.

1.4.5 Performance Data

Submit vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Also submit a description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

1.4.6 Seismic Requirements

Seismic requirements must be in accordance with UFC 3-301-01 and Sections 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS, 23 05 48.19 SEISMIC BRACING FOR MECHANICAL SYSTEMS and 26 05 48 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

1.4.7 Experience

Each component manufacturer must have a minimum of 3 years' experience in the manufacture, assembly and sale of components used with stationary engine-generator sets for commercial and industrial use. The engine-generator set manufacturer/assembler must have a minimum of 3 years' experience in the manufacture, assembly and sale of stationary engine-generator sets for commercial and industrial use. Submit a statement showing and verifying these requirements.

1.4.8 Field Engineer

The engine-generator set manufacturer or assembler must furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer must have attended the engine generator manufacturer's training courses on installation and operation and maintenance of engine generator sets. Submit a letter listing the qualifications, schools, formal training, and experience of the field engineer.

1.4.9 Detailed Drawings

Submit detailed drawings showing the following:

a. Base-mounted equipment, complete with base and attachments, including anchor bolt template and recommended clearances for maintenance and operation.

b. Starting system.

c. Fuel system.

d. Cooling system.

e. Exhaust system.

f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.

g. Lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, electric heater, controls and wiring.

h. Location, type, and description of vibration isolation devices for all applications.

i. The safety system, including wiring schematics.

j. One-line schematic and wiring diagrams of the generator, exciter,

regulator, governor, and instrumentation.

k. Panel layouts.

l. Mounting and support for each panel and major piece of electrical equipment.

m. Engine-generator set rigging points and lifting instructions.

1.4.10 Auxiliary Systems Engine-Generator Set and Auxiliary Equipment Drawing Requirements

Submit drawings pertaining to the engine-generator set and auxiliary equipment, including but not limited to the following:

a. Certified outline, general arrangement (setting plan), and anchor bolt details. Show total weight and center of gravity of assembled equipment on the steel sub-base.

b. Detailed elementary, schematic wiring, and interconnection diagrams of the engine starting system, jacket coolant heating system, engine protective devices, engine alarm devices, engine speed governor system, generator and excitation system, and other integral devices.

c. Detailed elementary, schematic wiring; and interconnection diagrams of the fuel system, starting battery system, engine-generator control panel, generator circuit breaker.

d. Dimensional drawings or catalog cuts of exhaust silencers, radiator, fuel day tanks, fuel oil cooler, valves and pumps, intake filters, vibration isolators, and other auxiliary equipment not integral with the engine-generator set.

1.4.11 Auxiliary Systems Drawing Requirements

Submit drawings showing floor plan arrangement of exhaust, air intake, fuel oil cooler.

1.4.12 Vibration Isolation System Certification

Submit certification from the manufacturer that the vibration isolation system will reduce the vibration to the limits specified in the paragraph VIBRATION ISOLATION.

1.4.13 Fuel System Certification

When the fuel system requires a fuel oil cooler as described in the paragraph FUEL OIL COOLER, submit certification from the engine manufacturer that the fuel system design is satisfactory.

1.5 DELIVERY, STORAGE, AND HANDLING

Properly protect materials and equipment, in accordance with the manufacturers recommended storage procedures,before, during, and after installation. Protect stored items from the weather and contamination. During installation, cap piping and similar openings to keep out dirt and other foreign matter.

Deliver equipment on pallets or blocking wrapped in heavy-duty plastic,

sealed to protect parts and assemblies from moisture and dirt. Protect and prepare batteries for shipment as recommended by the battery manufacturer. Store auxiliary equipment at the site in covered enclosures, protected from atmospheric moisture, dirt, and ground water.

1.6 EXTRA MATERIALS

Provide two sets of special tools and two sets of filters required for maintenance. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. One handset must be provided for each electronic governor when required to indicate and/or change governor response settings. Furnish 4 liters one gallon of identical paint used on engine-generator set in manufacturer's sealed container with each engine-generator set.

Wrenches and tools specifically designed and required to work on the new equipment, which are not commercially available as standard mechanic's tools, must be furnished to the Contracting Officer.

Provide proposed operating instructions for the engine-generator set and auxiliary equipment laminated between matte-surface thermoplastic sheets and suitable for placement adjacent to corresponding equipment. After approval, install operating instructions where directed.

1.7 MAINTENANCE SERVICES

Submit the operation and maintenance manuals and have them approved prior to commencing onsite tests.

1.7.1 Operation Manual

Provide three copies of the operation manual in 8-1/2 by 11 inch three-ring binders. Sections must be separated by heavy plastic dividers with tabs which identify the material in the section. Fold drawings with the title block visible, and placed in 8-1/2 by 11 inch plastic pockets with reinforced holes. The manual must include:

a. Step-by-step procedures for system startup, operation, and shutdown;

b. Drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems with their controls, alarms, and safety systems;

c. Procedures for interface and interaction with related systems to include automatic transfer switches fire alarm/suppression systems.

1.7.2 Maintenance Manual

Provide three copies of the manufacturers standard maintenance manual containing the information described below in 8-1/2 x 11 inch three-ring binders. Separate each section by a heavy plastic divider with tabs. Fold drawings with the title block visible, and placed in plastic pockets with reinforced holes. The manual must include:

a. Procedures for each routine maintenance item. Procedures for troubleshooting. Factory-service, take-down overhaul, and repair service manuals, with parts lists.

b. The manufacturer's recommended maintenance schedule.

c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components.

d. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

1.7.3 Assembled Operation and Maintenance Manuals

The contents of the assembled operation and maintenance manuals must include the manufacturer's O&M information required by the paragraph SD-10, OPERATION AND MAINTENANCE DATA and the manufacturer's O&M information specified in Section 26 36 23 AUTOMATIC TRANSFER SWITCHES AND BY-PASS/ISOLATION SWITCH.

a. Manuals must be in separate books or volumes, assembled and bound securely in durable, hard covered, water resistant binder, and indexed by major assembly and components in sequential order.

b. A table of contents (index) must be made part of the assembled O&M. The manual must be assembled in the order noted in table of contents.

c. The cover sheet or binder on each volume of the manuals must be identified and marked with the words, "Operation and Maintenance Manual."

1.8 SITE CONDITIONS

Protect the components of the engine-generator set, including cooling system components, pumps, fans, and similar auxiliaries when not operating and provide components capable of the specified outputs in the following environment:

a. Site Location: Guam

b. Site Elevation: 500 feet above mean sea level.

c. Ambient Temperatures:

(1) Maximum 95 degrees F dry bulb, 79 degrees F wet bulb.

(2) Minimum 88 degrees F dry bulb.

d. Design Wind Velocity: 200 mph.

e. Prevailing Wind Direction: Northeast

f. Seismic Zone: Zone 4 as defined by ICC IBC.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

a. Provide and install each engine-generator set complete and totally functional, with all necessary ancillary equipment to include: air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system;

and engine exhaust system. Each engine-generator set must satisfy the requirements specified in the Engine-Generator Parameter Schedule. Submit certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

b. Provide each engine-generator set consisting of one engine, one generator, and one exciter mounted, assembled, and aligned on one base; and all other necessary ancillary equipment which may be mounted separately. Assemble sets having a capacity of 750 kW or smaller and attach to the base prior to shipping. Sets over 750 kW capacity may be shipped in sections. Provide set components that are environmentally suitable for the locations shown and that are the manufacturer's standard product offered in catalogs for commercial or industrial use. Provide a generator strip heater for moisture control when the generator is not operating. Identify any nonstandard products or components and the reason for their use.

2.1.1 Engine-Generator Parameter Schedule

Engine-Generator Set and Auxiliary Equipment
Capacity Calculations for Engine-Generator Set

ENGINE-GENERATOR PARAMETER SCHEDULE	
Identification	Make/Model
Electrical Characteristics	
Power Rating	Emergency Standby Gross bhp rating / Net brake power rating 100 kW at 0.8 power factor
Governor Type	Type Make / Model Isochronous
Overload Capacity (Prime applications only)	110 percent of Service Load for 1 hour in 12 consecutive hours
Service Load	125 kVA (continuous)
Motor Starting kVA (Max.)	25 kVA
Power Factor	0.8 lagging
Engine-Generator Applications	stand-alone
Voltage Regulation (No Load to Full Load)(Stand-alone applications)	plus or minus 2 percent (maximum)
Voltage Bandwidth (steady state)	plus or minus 0.5 percent
Frequency	60 Hz
Voltage	480 volts

ENGINE-GENERATOR PARAMETER SCHEDULE	
Phases	3 Phase, Wye
Minimum Generator Sub-transient Reactance	25 percent Sub-transient
Nonlinear Loads	30 kVA
Max Step Load Increase	100 percent of Service Load at 0.8 PF
Transient Recovery Time with Step Load Increase (Voltage)	3 seconds
Transient Recovery	3 seconds
Time with Step Load Increase (Frequency)	
Maximum Voltage Deviation with Step Load Increase	20 percent of rated voltage
Maximum Frequency Deviation with Step Load Increase	5 percent of rated frequency
Max Step Load Decrease (without shutdown)	100 percent of Service Load at 0.8 PF
Frequency Bandwidth (steady state)	plus or minus 0.25 percent
Frequency Regulation (droop) (No Load to Full Load)	3 percent (maximum)
Frequency Bandwidth (steady state)	plus or minus 0.25 percent
Reactances	Synchronous reactance, Xd Transient reactance, X'd Sub-transient reactance, X"d Negative sequence reactance, X2 Zero sequence reactance, Xo
Capacity Calculations	
Calculations must verify that the engine-generator set power rating is adequate for the following load conditions:	
Lighting	25 kW
Computer	_____ kW
Other Load	Elevator, 25 hp motor
Capacity Calculations for Batteries	

ENGINE-GENERATOR PARAMETER SCHEDULE	
Calculation must verify that the engine starting battery capacity exceeds dc power requirements.	
Mechanical Characteristics	
Engine Description	Strokes/cycle Number of cylinders Bore and Stroke, inches
Engine Speed	1800 rpm
Piston Speed	Per manufacturer fpm
Heat Exchanger Type	fin-tube (radiator)
Engine Cooling Type	water/ethylene glycol
Intercooler Type	Air-to-Air / Jacket Water
Induction Method	Naturally Aspirated / Turbocharged
Turbocharger	Make / Model
Max Time to Start and be Ready to Assume Load	10 seconds
Max Summer Indoor Temp (Prior to Engine-generator Operation)	115 degrees F
Min Winter Indoor Temp (Prior to Engine-generator Operation)	50 degrees F
Max Allowable Heat Transferred To Engine Generator Space at Rated Output Capacity	Per Mechanical Design MBTU/hr
Max Summer Outdoor Temp (Ambient)	115 degrees F
Min Winter Outdoor Temp (Ambient)	50 degrees F
Installation Elevation	500 above sea level
Engine-Generator Set Efficiencies	
Fuel Consumption	At 0.8 power factor, Gallons / hour for: 1 / 2 load 3 / 4 load Full Load
Generator Efficiency	At 0.8 power factor,(per cent) for: 1 / 2 load 3 / 4 load Full Load

ENGINE-GENERATOR PARAMETER SCHEDULE	
Radiator Capacity	Coolant Type gpm coolant cfm air through radiator Btu per hr of heat exchange based on optimum coolant temperature to and from engine
Engine-Generator Set Emissions Data	
Exhaust Temperature	Degrees F at full load
Weight of Exhaust Gas	lb per hr at full load
Weight of Intake Air	lb per hr at full load
Total Heat Rejected	Btu per hr, at full load to: Jacket Coolant System Fuel Oil Cooling System
Emissions	lb per hr, at full load Total Suspended Particulate Particulate Matter with an average aerodynamic diameter of 10 microns Sulfur Dioxides Nitrogen Oxides (as NO2) Carbon Monoxide Volatile Organic Compounds
Visible Emissions	Percent opacity at full load

Brake Mean Effective Pressure (BMEP) Calculations

Calculation must verify that the engine meets the specified maximum BMEP, as follows:

$$\text{BMEP psi} = \frac{(120{,}000 \times \text{bkW}) \times (792{,}000 \times \text{bhp})}{(\text{rpm} \times \text{cu. in.})}$$

Where:

bkW bhp = bkW' + bkW" bhp' + bhp"
bkW" bhp" is the Brake kW horsepower required by engine driven fan for cooling radiator or motor driven fan for cooling radiator.
bkW' bhp' = kW/GEN.EFF. kW/(GEN.EFF. times 0.746)
GEN.EFF. = Generator efficiency
cu. in. = Total engine piston displacement in cubic inches
rpm = Engine revolutions per minute
kW = Minimum power rating

Torsional Vibration Stress Analysis Computations

ENGINE-GENERATOR PARAMETER SCHEDULE
Torsional vibrational stresses in the crankshaft and generator shaft of assembled engine and driven generator must not exceed 5000 psi when engine is driving generator at rated speed while assembled unit is loaded to rated engine-generator set power. Computations must be based on a mathematical model of the assembled generator set provided or based on calculations using measured values from tests on a unit identical to the one provided. Calculations based on models of, or measured data from, the unassembled engine and generator will not be acceptable. Calculations must include: a. A description of the system relating information pertinent to analysis such as operating speed range and identification plate data. b. A mass elastic assembly drawing, showing the arrangement of the units in the generator set and dimensions of shafting, including minimum diameters (or section moduli) of shafting in the system. c. A labeled line diagram of the mass elastic system indicating values of masses, stiffness, equivalent lengths, and equivalent diameters including basic assumptions and definition of terms. d. Sample computations showing procedures used to obtain resulting stress values. e. Computations indicating assembled engine-generator speed of 1800 rpm with assembly loaded to rated generator power and the resulting computed critical torsional stress values in the assembled engine crankshaft and generator shaft.
Turbocharger Load Calculations

ENGINE-GENERATOR PARAMETER SCHEDULE
NOTE: When the engine-generator set installation includes field installed exhaust system (i.e., the engine-generator set is installed internal to a building in lieu of in a self-contained outdoor enclosure), include the following paragraph. When the proposed exhaust system layout is different from that shown on the contract drawings, submit calculations showing that the external loads from the exhaust system such as weight and thermal expansion do not exceed the engine manufacturer's maximum allowed forces and moments on the turbocharger.

2.1.2 Rated Output Capacity

Provide each engine-generator-set with power equal to the sum of service load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity must also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

The engine must meet the specified maximum BMEP requirements at rated speed as calculated in accordance with the calculations in the engine-generator parameter schedule. The engine capacity must be based on the following:

a. Engine burning diesel fuel conforming to ASTM D975, Grade JP-5 at an ambient temperature of 85 degrees F. For stationary engines operated in the United States, diesel fuel requirements are found in 40 CFR 60 Subpart IIII.

b. Engine cooled by a radiator fan mechanically driven by the engine or remote with a motor driven fan.

c. Engine cooled by coolant mixture of water and ethylene glycol, 50 percent by volume of each.

Maximum BMEP, psi			
	Naturally Aspirated	Turbocharged	Turbocharged and Intercooled
Four-cycle engines			

Maximum BMEP, psi			
Engine speed, rpm:	1800	1800	

2.1.2.1 Engine Emission Limits

Engine must be certified by the manufacturer to meet applicable EPA emission standards found in 40 CFR 60 Subpart IIII. In addition, engine must meet any applicable state or local emission requirements (ex: California SCAQMD).

2.1.2.2 Performance Class

The voltage and frequency behavior of the generator set must be in accordance with ISO 8528 operating limit values for performance Class as follows.

2.1.3 Power Ratings

Power ratings must be in accordance with EGSA 101P.

2.1.4 Transient Response

The engine-generator set governor and voltage regulator must cause the engine-generator set to respond to the maximum step load changes such that output voltage and frequency recover to and stabilize within the operational bandwidth within the transient recovery time. The engine-generator set must respond to maximum step load changes such that the maximum voltage and frequency deviations from bandwidth are not exceeded.

2.1.5 Reliability and Durability

Each standby engine-generator set must have both an engine and a generator capable of delivering the specified power on a standby basis with an anticipated mean time between overhauls of no less than 5,000 hours operating with a load factor of 70 percent. Cite two like engines and two like generators that have performed satisfactorily in a stationary power plant, independent and separate from the physical location of the manufacturer's and assembler's facilities, for standby without any failure to start, including all periodic exercise. Provide like engines and generators that have had no failures resulting in downtime for repairs in excess of 72 hours during two consecutive years of service. Provide engines that are the same model, speed, bore, stroke, number and configuration of cylinders, and rated output capacity. Provide generators that are the same model, speed, pitch, cooling, exciter, voltage regulator and rated output capacity.

Submit a reliability and durability certification letter from the manufacturer and assembler to prove that existing facilities are and have been successfully utilizing the same components proposed to meet this specification, in similar service. Certification may be based on components, i.e. engines used with different models of generators and generators used with different engines, and does not exclude annual technological improvements made by a manufacturer in the basic standard-model component on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets the performance requirements specified. Provide a

list with the name of the installations, completion dates, and name and telephone number of a point of contact.

2.1.6 Vibration Isolation

Provide an engine-generator set with a vibration isolation system in accordance with the manufacturer's standard recommendation. Submit vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor plus description of seismic qualification of the engine-generator mounting, base, and vibration isolation. Submit torsional analysis including prototype testing or and calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus 10 percent. Design and qualify vibration isolation systems as an integral part of the base and mounting system in accordance with the seismic parameters specified. Where the vibration isolation system does not secure the base to the structure floor or unit foundation, provide seismic restraints in accordance with the seismic parameters specified.

2.1.7 Harmonic Requirements

Non-linear loads to be served by each engine-generator set are as indicated. The maximum linear load demand (kVA at PF) when non-linear loads will also be in use is as indicated.

2.1.8 Starting Time Requirements

Upon receipt of a signal to start, each engine generator set will start, reach rated frequency and voltage and be ready to assume load within the time specified. For standby sets used in emergency power applications, each engine generator set will start, reach rated frequency and voltage, and power will be supplied to the load terminals of the automatic transfer switch within the starting time specified.

2.2 NAMEPLATES

Provide the manufacturer's name, type or style, model or serial number and rating on a plate secured to the equipment for each major component of this specification. Provide plates and tags sized so that inscription is readily legible to operating or maintenance personnel and securely mounted to or attached in proximity of their identified controls or equipment. Lettering must be normal block lettering, a minimum of 0.25 inch high. As a minimum, provide nameplates for:

Engines	Relays
Generators	Transformers (CT & PT)
Regulators	Day tanks
Pumps and pump motors	Governors
Generator Breaker	Air Starting System

Economizers	Heat exchangers (other than base mounted)

Where the following equipment is not provided as a standard component by the engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger	Heaters
Switchboards	Exhaust mufflers
Switchgear	Silencers
Battery	Exciters

2.2.1 Materials

Construct ID plates and tags of 16 gage minimum thickness bronze or stainless steel sheet metal engraved or stamped with inscription. Construct plates and tags not exposed to the weather or high operational temperature of the engine of laminated plastic, 0.125 inch thick, matte white finish with black center core, with lettering accurately aligned and engraved into the core.

2.2.2 Control Devices and Operation Indicators

Provide ID plates or tags for control devices and operation indicators, including valves, off-on switches, visual alarm annunciators, gages and thermometers, that are required for operation and maintenance of provided mechanical systems. Plates or tags must be minimum of 0.5 inch high and 2 inches long and must indicate component system and component function.

2.2.3 Equipment

Provide ID plates of a minimum size of high and 5 inches long on provided equipment indicating the following information:

a. Manufacturer's name, address, type and model number, serial number, and certificate of compliance with applicable EPA mission standards;

b. Contract number and accepted date;

c. Capacity or size;

d. System in which installed; and

e. System which it controls.

2.3 SAFETY DEVICES

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices such that proper operation of the equipment is not impaired.

2.4 MATERIALS AND EQUIPMENT

Submit certification stating that where materials or equipment are specified to comply with requirements of UL, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

2.4.1 Circuit Breakers, Low Voltage

UL 489.

2.4.2 Filter Elements

Provide the manufacturer's standard fuel-oil, lubricating-oil, and combustion-air filter elements.

2.4.3 Instrument Transformers

NEMA/ANSI C12.11.

2.4.4 Revenue Metering

IEEE C57.13.

2.4.5 Pipe (Fuel/Lube-Oil, Compressed Air, Coolant, and Exhaust)

ASTM A53/A53M, or ASTM A106/A106M steel pipe. Pipe smaller than 2 inches must be Schedule 80. Pipe 2 inches and larger must be Schedule 40.

2.4.5.1 Flanges and Flanged Fittings

ASTM A181/A181M, Class 60, or ASME B16.5, Grade 1, Class 150.

2.4.5.2 Pipe Welding Fittings

ASTM A234/A234M, Grade WPB or WPC, Class 150 or ASME B16.11, 3000 lb.

2.4.5.3 Threaded Fittings

ASME B16.3, Class 150.

2.4.5.4 Valves

MSS SP-80, Class 150.

2.4.5.5 Gaskets

Manufacturer's standard.

2.4.6 Pipe Hangers

MSS SP-58.

2.4.7 Electrical Enclosures

NEMA ICS 6.

2.4.7.1 Switchboards

NEMA PB 2.

2.4.7.2 Panelboards

NEMA PB 1.

2.4.8 Electric Motors

Provide electric motors that conform to the requirements of NEMA MG 00001. Motors must have sealed ball bearings and a maximum speed of 1800 rpm. Motors used indoors must have drip-proof frames; enclose those that are used outside. Alternating current motors larger than 1/2 Hp must be of the squirrel-cage induction type for operation on 208 volts or higher, 60 Hz, and three-phase power. Alternating current motors 1/2 Hp or smaller, must be suitable for operation on 120 volts, 60 Hz, and single-phase power. Direct current motors must be suitable for operation on 125 volts.

2.4.9 Motor Controllers

Provide motor controllers and starters that conform to the requirements of NFPA 70 and NEMA ICS 2.

2.5 ENGINE

Each engine must operate on No. 2-D diesel fuel conforming to ASTM D975, must be designed for stationary applications and must be complete with ancillaries. The engine must be a standard production model shown in the manufacturer's catalog describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate complete specification compliance. The engine must be naturally aspirated, supercharged, or turbocharged. The engine must be 2- or 4-stroke-cycle and compression-ignition type. The engine must be vertical in-line, V- or opposed-piston type, with a solid cast block or individually cast cylinders. The engine must have a minimum of two cylinders. Opposed-piston type engines must have more than four cylinders. Each block must have a coolant drain port. Equip each engine with an over-speed sensor.

ISO 3046. Diesel engines must be four-cycle naturally aspirated, or turbocharged, or turbocharged and intercooled; vertical in-line or vertical Vee type; designed for stationary service. Engines must be capable of immediate acceleration from rest to normal speed without intermediate idle/warm up period or pre-lubrication to provide essential electrical power. Two-cycle engines are not acceptable.

2.5.1 Sub-base Mounting

Mount each engine-generator set on a structural steel sub-base sized to support the engine, generator, and necessary accessories, auxiliaries and control equipment to produce a complete self-contained unit as standard with the manufacturer. Design the structural sub-base to properly support the equipment and maintain proper alignment of the engine-generator set in the specified seismic zone. In addition, provide sub-base with both lifting rings and jacking pads properly located to facilitate shipping and installation of the unit. Factory align engine and generator on the sub-base and securely bolt into place in accordance with the

manufacturer's standard practice. Crankshaft must have rigid coupling for connection to the generator.

2.5.2 Assembly

Completely shop assemble each engine-generator set on its structural steel sub-base. Paint entire unit with manufacturer's standard paints and colors. After factory tests and before shipping, thoroughly clean and retouch painting as necessary to provide complete protection.

2.5.3 Turbocharger

If required by the manufacturer to meet the engine-generator set rating, provide turbine type driven by exhaust gas from engine cylinders, and direct connected to the blower supplying air to the engine intake manifold.

2.5.4 Intercooler

Provide manufacturer's standard intercooler for engine size specified.

2.5.5 Crankcase Protection

2.5.6 Miscellaneous Engine Accessories

Provide the following engine accessories where the manufacturer's standard design permits:

a. Piping on engine to inlet and outlet connections, including nonstandard companion flanges.

b. Structural steel sub-base and vibration isolators, foundation bolts, nuts, and pipe sleeves.

c. Level jack screws or shims, as required.

d. Rails, chocks, and shims for installation of sub-base on the foundation.

e. Removable guard, around fan. Support guard, on engine sub-base, to suit manufacturer's standard.

2.5.7 Intercooler

Provide manufacturer's standard intercooler for engine size specified.

2.6 FUEL SYSTEM

Provide fuel system conforming to the requirements of NFPA 30 and NFPA 37 and containing the following elements.

2.6.1 Fuel Filter

Provide a minimum of one full-flow fuel filter for each engine. The filter must be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. Mark the inlet and outlet connections of the filter.

Provide intake filter assemblies for each engine of the oil bath or dry type, as standard with the manufacturer. Filters must be capable of

removing a minimum of 92 percent of dirt and abrasive 3 microns and larger from intake air. Size filters to suit engine requirements at 100 percent of rated full load. Design unit for field access for maintenance purposes.

2.6.2 Relief/Bypass Valve

Provide a relief/bypass valve to regulate pressure in the fuel supply line, return excess fuel to a return line and prevent the build-up of excessive pressure in the fuel system.

2.6.3 Integral Main Fuel Storage Tank

Provide each engine with an integral main fuel tank. Each tank must be factory installed and provided as an integral part of the generator manufacturer's product. Provide each tank with connections for fuel supply line, fuel return line, local fuel fill port, gauge, vent line, and float switch assembly. Provide a fuel return line cooler as recommended by the manufacturer and assembler. The temperature of the fuel returning to the tank must be below the flash point of the fuel. Mount the tank within the enclosure for each engine-generator set provided with weatherproof enclosures. The fuel fill line must be accessible without opening the enclosure.

a. All Tanks: UL 142. Provide integral in skid double wall (110 percent containment) fuel tanks with a minimum capacity of 24 hours of engine-generator set operation at full-rated load. Epoxy coat day tanks inside and prime and paint outside. Construct tanks of not less than 3/16 inch steel plate with welded joints and necessary stiffeners on exterior of tank. Provide a braced structural steel framework support. Weld tank top tight. Provide 4 1/2 inch square inspection port with a 2 inch NPT fill connection and spill box. Provide proper normal and emergency venting for the primary tank and emergency venting only for the secondary tank / containment basin in accordance with UL 142 requirements.

b. Leak Detector Switch for All Tanks: Actuates when fuel is detected in containment basin, stops fuel transfer pump, and closes the fuel oil solenoid valve.

c. Control Panel for All Tanks: Provide NEMA ICS 6, Type 1, enclosed control panel for each day tank. Control panel must include the following accessories.

(1) Power available LED (green).

(2) Critical low fuel alarm contacts for shut down of engine.

(3) Low-low level fuel alarm LED.

(4) Low-low level fuel alarm contracts for remote annunciator.

(5) Critical high level fuel alarm LED.

(6) Leak detecting alarm LED.

(7) Alarm horn.

d. Tank Gages for All Tanks: Provide buoyant force type gages for fuel tanks with dial indicator not less than 4 inches in size and arranged

for top mounting. Calibrate each reading dial or scale for its specific tank to read from empty to full, with intermediate points of 1/4, 1/2, and 3/4.

e. Integral Base Tanks Used as Primary Tank: Provide a 2 inch opening at the tank fill port, fitted an overfill prevention valve (OPV). Additionally, the fill opening must be perpendicular to the tank in order to allow operation of the OPV. Integral base tank must be sized and configured such that the filling and venting nozzles are outside the generator cabinet for ease of accessibility, inspection, and maintenance. Level gage must be in the line of sight from the fill port.

f. Integral Base Tanks Located Inside Buildings. The tank vents must discharge outside the building in accordance with NFPA 30 and NFPA 37. The fill pipe must terminate outside the building. The fill pipe connection point must be housed in a sealed spill box. High level alarms or level gauges used as overfill protection mechanisms must annunciate at the fill connection point. Provide an overfill prevention valve (OPV) at the tank with a check valve mounted on the fill line in the spill box. The fill connection point must be labeled with tank contents and capacity.

2.6.4 Strainer

Simplex strainers must comply with Section 33 52 40 FUEL SYSTEMS PIPING (NON-HYDRANT).

2.6.5 Fuel Oil Meters

Fuel oil meter must comply with Section 33 52 40 FUEL SYSTEMS PIPING (NON-HYDRANT).

2.6.6 Fuel Oil Cooler

Provide an air cooled fuel oil cooler if the temperature of the fuel returned to the tank from the engine will cause overheating of the tank fuel above the maximum fuel temperature allowed by the engine manufacturer when operating at maximum rated generator power output and low fuel level in the tank. The fuel oil cooler must be furnished by the engine manufacturer for the application and the installation must be complete including piping and power requirements.

2.7 LUBRICATION

Provide engine with a separate lube-oil system conforming to NFPA 30 and NFPA 37. Pressurize each system by engine-driven pumps. Regulate system pressure as recommended by the engine manufacturer. Provide a pressure relief valve on the crankcase for closed systems. Vent the crankcase in accordance with the manufacturer's recommendation. Do not vent the crankcase to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, must be piped to vent to the outside. The system must be readily accessible for service such as draining, refilling, etc. Each system must permit addition of oil and have oil-level indication with the set operating. The system must utilize an oil cooler as recommended by the engine manufacturer.

2.7.1 Lube-Oil Filter

Provide one full-flow filter for each pump. The filter must be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. Mark inlet and outlet connections.

2.7.2 Lube-Oil Sensors

Equip each engine with lube-oil pressure sensors located downstream of the filters and provide signals for required indication and alarms. Submit two complete sets of filters, required for maintenance, supplied in a suitable storage box. Provide these filters in addition to filters replaced after testing.

2.7.3 Precirculation Pump

Provide a motor-driven precirculation pump powered by the station battery, complete with motor starter, if recommended by the engine manufacturer.

2.8 COOLING SYSTEM

Provide each engine with its own cooling system to operate automatically while its engine is running. The cooling system coolant must use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across each engine must not exceed that recommended below. Submit a letter which certifies that the engine-generator set and cooling system function properly in the ambient temperature specified, stating the following values:

a. The maximum allowable inlet temperature of the cooling air.

b. The minimum allowable inlet temperature of the cooling air across the engine.

c. The maximum allowable temperature rise in the cooling air across the engine.

d. The minimum allowable inlet fuel temperature.

2.8.1 Coolant Pumps

Provide centrifugal coolant pumps. Each engine must have an engine-driven primary pump. Provide secondary pumps that are electric motor driven and have automatic controllers. Control raw-water circulating pump by manual-off-automatic controllers and must be electric motor driven.

2.8.2 Heat Exchanger

Provide heat exchanger with the size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted for the maximum summer outdoor design temperature and site elevation. Submit manufacturer's data to quantify heat rejected to the space with the engine generator set at rated capacity. Provide heat exchangers that are corrosion resistant, suitable for service in ambient conditions of application.

2.8.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosion resistant film, provided that corrective measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via over sizing, or other compensating methods. Provide internal surfaces that are compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Provide heat exchangers that are pressure type incorporating a pressure valve, vacuum valve and a cap. Design caps for pressure relief prior to removal. Provide heat exchanger and cooling system that is capable of withstanding a minimum pressure of 7 psi and protect with a strong grille or screen guard. Provide heat exchanger with at least two tapped holes; equip one tapped hole with a drain cock, and plug the rest.

Provide for each engine-generator set, as standard with the manufacturer.

a. Design Conditions: Each radiator unit must have ample capacity to remove not less than the total Btu per hour of heat rejected by its respective engine at 100 percent full-rated load to the jacket water, fuel oil, and lubricating oil system, and intercooler. Radiator capacity must be rated at optimum temperature of coolant leaving the engine and intercooler as recommended by the engine manufacturer with an ambient dry bulb air temperature outside the enclosure of 104 degrees F maximum, and 30 degrees F minimum at the site elevation specified in the paragraph SITE CONDITIONS, and with the coolant mixture specified in the paragraph RATED OUTPUT CAPACITY. Pressure drop through the radiator must not exceed 6 psi when circulating the maximum required coolant flow. Radiator air velocity must be a maximum of 1500 feet per minute.

b. Engine Mounted Radiator Construction: Radiator fan must direct airflow from the engine outward through the radiator. Fan must be V-belt driven directly from the engine crankshaft. Radiator fan must have sufficient capacity to meet design conditions against a static restriction of 1/2 inch of water. Fan static capacity must be adjusted to suit the ductwork furnished. Cooling section must have a tube and fin-type core consisting of copper or copper base alloy tubes with nonferrous fins. Select engine-driven fans for quiet vibration-free operation. Make provision for coolant expansion either by self-contained expansion tanks or separately mounted expansion tanks, as standard with the manufacturer. Provide suitable guards for each fan and drive.

c. Coolant solution must be a mixture of clean water and ethylene glycol, 50 percent by volume each. Provide an anti-freeze solution tester suitable for the mixture.

2.8.3 Thermostatic Control Valve

Provide a modulating type, thermostatic control valve in the coolant system to maintain the coolant temperature range submitted in paragraph SUBMITTALS.

2.8.4 Ductwork

Provide ductwork in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION, except use a flexible connection to connect the duct to the engine radiator. Material for the connection must be wire-reinforced

glass. Provide airtight connection.

2.8.5 Temperature Sensors

Equip each engine with coolant temperature sensors. Provide temperature sensors with signals for pre-high and high indication and alarms.

2.9 SOUND LIMITATIONS

Submit sound power level data for the packaged unit operating at 100 percent load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification. Submit certification from the manufacturer stating that the sound emissions meet the specification. Do not exceed the following sound pressure levels in any of the indicated frequencies when measured in a free field at a radial distance of 22.9 feet 7 meters at 45 degrees apart in all directions when operating at 100 percent load.

Frequency Band (Hz)	Maximum Acceptable Sound Level (Decibels)
31	87
63	87
125	77
250	70
500	64
1,000	61
2,000	60
4,000	60
8,000	60

2.10 AIR INTAKE EQUIPMENT

Locate filters and silencers in locations that are convenient for servicing. Provide high-frequency filter type silencers and locate in the air intake system as recommended by the engine manufacturer. Provide silencer to reduce the noise level at the air intake so that the indicated pressure levels specified in paragraph SOUND LIMITATIONS will not be exceeded. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Provide rubber expansion elements in air-intake lines.

Provide intake filter assemblies for each engine of the oil bath or dry type, as standard with the manufacturer. Filters must be capable of removing a minimum of 92 percent of dirt and abrasive 3 microns and larger from intake air. Size filters to suit engine requirements at 100 percent of rated full load. Design unit for field access for maintenance purposes.

2.11 EXHAUST SYSTEM

Provide a separate and complete system for each engine. Support piping to minimize vibration. Where a V-type engine is provided, use a V-type connector, with necessary flexible sections and hardware, to connect the engine exhaust outlets.

2.11.1 Flexible Sections and Expansion Joints

Provide a flexible section at each engine and an expansion joint at each muffler. Provide flexible sections and expansion joints that have flanged connections. Provide flexible sections made of convoluted seamless tube without joints or packing. Provide bellows type expansion joints. Provide stainless steel expansion and flexible elements suitable for engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Provide expansion and flexible elements that are capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.11.2 Exhaust Muffler

Provide a chamber type exhaust muffler. Provide welded steel muffler designed for outside mounting. Provide eyebolts, lugs, flanges, or other items as necessary for support in the location and position indicated. Do not exceed the engine manufacturer's recommended pressure drop. Outside mufflers must be zinc coated or painted with high temperature 400 degrees F resisting paint. The muffler and exhaust piping together must reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS. Provide muffler with a drain valve, nipple, and cap at the low-point of the muffler.

A silencer must be provided for each engine which will reduce the exhaust sound spectrum by the following listed values at a 75 foot radius from the outlet, with generator set loaded to rated capacity and clear weather. Inlet and outlet connections must be flanged.

Octave Band Center Frequency (Hertz)								
Minimum Silencer Attenuation Decibels	63	125	250	500	1000	2000	4000	8000

2.11.3 Exhaust Piping

Slope horizontal sections of exhaust piping downward away from the engine to a drip leg for collection of condensate with drain valve and cap. Changes in direction must be long radius. Insulate exhaust piping, mufflers and silencers installed inside any building in accordance with paragraph THERMAL INSULATION and covered to protect personnel. Provide vertical exhaust piping with a hinged, gravity-operated, self-closing, rain cover.

Field installed exhaust piping must conform to the following:

a. Exhaust Piping: Provide flanges for connections to engines, exhaust mufflers, and flexible connections. Provide steel pipe conforming to ASTM A53/A53M for each engine complete with necessary fittings, flanges, gaskets, bolts, and nuts. Exhaust piping must be Schedule 40 pipe for 12 inches and smaller, standard weight for sizes 14 inches

through 24 inches, and 0.25 inch wall thickness for sizes larger than 24 inches. Flanges must be Class 150 slip-on forged steel welding flanges in accordance with ASME B16.5, with material in accordance with ASTM A181/A181M, Grade I. Fittings must be butt welding conforming to ASTM A234/A234M, with wall thickness same as adjoining piping. Fittings must be of same material and wall thickness as pipe. Built-up miter welded fittings may be used. Miter angles of each individual section must not exceed 22.5 degrees total and not more than 11.25 degrees relative to the axis of the pipe at any one cut. Gaskets for exhaust piping must be of high temperature asbestos-free material suitable for the service and must be ASME B16.21, composition ring, 0.0625 inch thick. Bolting material for exhaust flanges must be alloy-steel bolt-studs conforming to ASTM A193/A193M, Grade B7 bolts and alloy-steel nuts conforming to ASTM A194/A194M, Grade 7. Bolts must be of sufficient length to obtain full bearing on the nuts and must project not more than two full threads beyond the nut. Provide stainless steel counterbalance type rain caps at termination of each exhaust pipe.

b. Expansion (Flexible) Joints: Provide sections of multiple corrugated stainless steel expansion joints with liners in the engine exhaust piping for each engine to absorb expansion strains and vibration transmitted to the piping. Flexible joints must be suitable for operation at 200 degrees F above normal exhaust gas temperature at 100 percent load, 10,000 cycles, minimum. Joints must be flanged and located between engine exhaust manifold and exhaust piping, must be the same size as exhaust piping size, and must be designed and constructed for engine exhaust service.

c. Hangers and Supports: MSS SP-58.

d. Piping Sleeves: Provide where piping passes through masonry or concrete walls, floors, roofs, and partitions. Sleeves must be placed during construction. Unless indicated otherwise, pipe sleeves must comply with following requirements: sleeves in outside walls below and above grade, in floor, or in roof slabs, must be standard weight zinc coated steel pipe. Sleeves in partitions must be zinc coated sheet steel having a nominal weight of not less than 0.90 pound per square foot. Space between piping insulation and the sleeve must not be less than 0.25 inch. Sleeves must be held securely in proper position and location during construction. Sleeves must be sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs must extend 2 inches above the finished floor. Space between the pipe and the sleeve must be firmly packed with insulation and caulked at both ends of the sleeve with plastic waterproof cement.

e. Piping Insulation: Provide exhaust piping insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.12 EMISSIONS

The finished installation must comply with Federal, state, and local regulations and restrictions regarding the limits of emissions, as listed here: EPA Stationary Emergency Standby. Submit certification from the engine manufacturer stating that the engine exhaust emissions meet the federal, state, and local regulations and restrictions specified. At a minimum this certification must include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter,

sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HAPs).

2.13 STARTING SYSTEM

Provide starting system for standby engine generator sets used in emergency applications in accordance with NFPA 99 and NFPA 110and as follows.

2.13.1 Controls

Provide an engine control switch with functions including: run/start (manual), off/reset, and, automatic mode. Provide start-stop logic for adjustable cycle cranking and cool-down operation. Arrange the logic for fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION. Provide electrical starting systems with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

2.13.2 Capacity

Provide starting system with sufficient capacity, at the maximum indoor summer temperature specified to crank the engine without damage or overheating. The system must provide a minimum of three cranking periods with 15 second intervals between cranks. Each cranking period must have a maximum duration of 15 seconds. Starting must be accomplished using an adequately sized dc starter system with a positive shift solenoid to engage the starter motor and to crank the engine continuously for 60 seconds without overheating.

2.13.3 Electrical Starting

Manufacturers recommended dc system, utilizing a negative circuit ground. Starting motors must be in accordance with SAE ARP892.

2.13.3.1 Battery

Provide a starting battery system including the battery, battery rack, intercell connectors, spacers, automatic battery charger with overcurrent protection, metering and relaying. Provide battery in accordance with SAE J537. Size critical system components (rack, protection, etc.) to withstand the seismic acceleration forces specified. Provide lead-acid battery with sufficient capacity, at the minimum indoor and maximum indoor temperature specified, to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable.

Provide maintenance free, sealed, lead-acid, SAE Type D engine starting batteries. Batteries must have sufficient capacity to provide 60 seconds of continuous cranking of the engine in an ambient temperature of 65 degrees F.

2.13.3.2 Battery Charger

Provide a current-limiting battery charger, conforming to UL 1236, that automatically recharges the batteries. Submit battery charger sizing calculations. The charger must be capable of an equalize charging rate for recharging fully depleted batteries within 24 hours and a floating charge rate for maintaining the batteries at fully charged condition. Provide an ammeter to indicate charging rate. Provide a voltmeter to

indicate charging voltage. Provide a timer for the equalize charging-rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

Provide 120 volt ac, enclosed, automatic equalizing, dual-rate, solid-state, constant voltage type battery charger with automatic ac line compensation. DC output must be voltage regulated and current limited. Charger must have two ranges, float and equalize, and must provide continuous taper charging. The charger must have a continuous output rating of not less than 10 amperes and must be sized to recharge the engine starting batteries in a minimum of 8 hours while providing the control power needs of the engine-generator set. Enclosure must be NEMA ICS 6, Type 1. The following accessories must be included:

a. DC ammeter

b. DC voltmeter

c. Equalize light

d. AC on light

e. Low voltage light

f. High voltage light

g. Equalize test button/switch

h. AC circuit breaker

i. Low dc voltage alarm relay

j. High dc voltage alarm relay

k. Current failure relay

l. AC power failure relay

2.13.4 Storage Batteries

Provide storage batteries of suitable rating and capacity to supply and maintain power for the remote alarm annunciator for a period of 90 minutes minimum without the voltage applied falling below 87.5 percent of normal. Provide a 120 volt ac automatic battery charger.

2.13.5 Starting Aids

Provide one or more of other following methods to assist engine starting.

2.13.5.1 Glow Plugs

Design glow plugs to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of -25 degrees F.

2.13.5.2 Jacket-Coolant Heaters

Mount a thermostatically controlled electric heater in the engine coolant

jacketing to automatically maintain the coolant within plus or minus 3 degrees F of the control temperature. The heater must operate independently of engine operation so that starting times are minimized. Power for the heaters must be 120 volts ac. Include necessary equipment, piping, controls, wiring, and accessories.

2.13.5.2.1 Prime Rated Sets

The control temperature must be the higher of the manufacturer's recommended temperature or the minimum coolant inlet temperature of the engine recommended in paragraph SUBMITTALS.

2.13.5.2.2 Standby Rated Sets

The control temperature must be the temperature recommended by the engine manufacturer to meet the starting time specified at the minimum winter outdoor temperature.

2.13.5.3 Lubricating-Oil Heaters

Mount a thermostatically controlled electric heater in the engine lubricating-oil system to automatically maintain the oil temperature within plus or minus 3 degrees F of the control temperature. The heater must operate independently of engine operation so that starting times are minimized. Power for the heaters must be 120 volts ac.

2.13.6 Exerciser

Provide exerciser in accordance with Section 26 36 23 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.14 GOVERNOR

Provide a forward acting type engine speed governor system. Steady-state frequency band and frequency regulation (droop) must be in accordance with the operating limit values of the performance class specified in the paragraph PERFORMANCE CLASS.

Provide engine with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100 percent of rated output capacity. Configure the governor for safe manual adjustment of the speed/frequency during operation of the engine-generator set, without special tools, from 90 to 110 percent of the rated speed/frequency, over a steady state load range of 0 to 100 percent or rated capacity. Submit two complete sets of special tools required for maintenance (except for electronic governor handset). Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. Provide a suitable tool box for tools. Provide one handset for each electronic governor when required to indicate and/or change governor response settings. Maintain the midpoint of the frequency bandwidth at the same value for steady-state loads over the range of zero to 100 percent of rated output capacity for isochronous governors.

2.15 GENERATOR

Provide synchronous type, one or two bearing, generator conforming to the performance criteria in NEMA MG 00001, equipped with winding terminal housings in accordance with NEMA MG 00001, equipped with an amortisseur

winding, and directly connected to the engine. Submit calculations of the engine and generator output power capability, including efficiency and parasitic load data. Provide Class H insulation.

a. Select NEMA MG 00001, Part 16, standby duty, and temperature rise of 130 degrees C for engine-generator sets which are expected to operate for less than 300 hours per year. Select NEMA MG 00001, Part 22, continuous duty, and temperature rise of 105 degrees C for engine-generator sets expected to operate 300 hours or greater per year or rated 300 kW and above.

b. Select 2/3 pitch design option for engine-generator sets rated 300 kW and above.

c. Select 10-12 lead re-connectable for engine-generator sets rated 300 kW to 800 kW.

d. For applications requiring high SCR loading or in harsh environments laden with salts and chemicals, select vacuum pressure impregnation (VPI) insulated coils. When engine-generator sets are rated 800 kW and larger, also select form wound coils.

e. Provide salient-pole type, ac, brushless-excited, revolving field, air-cooled, self-ventilated, drip-proof guarded, coupled type, synchronous generator conforming to NEMA MG 00001, Part 16, and IEEE C50.12. Generator must be rated for standby duty at 100 percent of the power rating of the engine-generator set as specified in the table shown in paragraph ENGINE GENERATOR PARAMETER SCHEDULE. Temperature rise of each of the various parts of the generator must not exceed 130 degrees C as measured by resistance, based on a maximum ambient temperature of 40 degrees C. Winding insulation must be Class H.

f. Stator: Stator windings must be 2/3 pitch design with VPI insulated and form wound coils.

g. Rotor: The rotor must have connected amortisseur windings.

h. Generator Space Heater: Provide 120 volt ac heaters. Heater capacity must be as recommended by the generator manufacturer to aid in keeping the generator insulation dry.

i. Grounding: Provide non-corrosive steel grounding pads located at two opposite mounting legs.

j. Filters: Provide manufacturer's standard generator cooling air filter assembly.

k. Design generator to protect against mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 110 percent for prime applications and 100 percent for standby applications.

l. Provide generator ancillary equipment meeting the short circuit requirements of NEMA MG 00001. Select drip-proof guarded option for generators without weatherproof enclosures.

m. Submit manufacturer's standard data for each generator (prototype data at the specified rating or above is acceptable), listing the following

information:

(1) Direct-Axis sub-transient reactance (per unit).

(2) The generator kW rating and short circuit current capacity (both symmetric and asymmetric).

2.15.1 Current Balance

At 100 percent rated output capacity, and load impedance equal for each of the 3 phases, the permissible current difference between any 2 phases must not exceed 2 percent of the largest current on either of the 2 phases. Submit certification stating that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125 percent of rated speed without vibration or damage.

2.15.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated output capacity, the difference in line-to-neutral voltage among the 3 phases must not exceed 1 percent of the average line-to-neutral voltage. For a single phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other 2 phases, the maximum simultaneous difference in line-to-neutral voltage between the phases must not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement must be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

2.15.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced rated output capacity must not exceed 10 percent. The RMS of all harmonics must be less than 5.0 percent and that of any one harmonic less than 3.0 percent of the fundamental at rated output capacity. Design and configure engine-generator to meet the total harmonic distortion limits of IEEE 519.

2.16 EXCITER

Provide brushless generator exciter. Provide semiconductor rectifiers that have a minimum safety factor of 300 percent for peak inverse voltage and forward current ratings for all operating conditions, including 110 percent generator output at 104 degrees F ambient. The exciter and regulator in combination must maintain generator-output voltage within the limits specified.

Provide a brushless excitation system consisting of an exciter and rotating rectifier assembly, and permanent magnet generator integral with the generator and a voltage regulator. Insulation class for parts integral with the generator must be as specified in paragraph GENERATOR. System must provide a minimum short circuit of 300 percent rated engine-generator set current for at least 10 seconds. Steady state voltage regulation must be in accordance with the operating limit values of the performance class specified in the paragraph PERFORMANCE CLASS.

a. Exciter and Rotating Rectifier Assembly: Rectifiers must be provided with surge voltage protection.

b. Permanent Magnet Generator: Provide a voltage spike suppression device for permanent magnet generator (PMG) excitation systems.

c. Voltage Regulator: Voltage regulator must be solid state or digital, automatic, three-phase sensing, volts per hertz type regulator. Regulator must receive its input power from a PMG. Voltage variation for any 40 degree C change over the operating temperature range must be less than plus or minus 1.0 percent. Operating temperature must be minus 40 degree C to plus 70 degree C. Voltage adjust range must be plus to minus 5.0 percent of nominal. Inherent regulator features must include over excitation shutdown.

2.16.1 Electromagnetic Interference (EMI) Suppression

Provide as an integral part of the generator and excitation system, EMI suppression complying with MIL-STD-461.

2.17 VOLTAGE REGULATOR

Provide a solid-state voltage regulator, separate from the exciter, for each generator. Maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100 percent of rated output capacity. Configure regulator for safe manual adjustment of the engine-generator voltage output without special tools, during operation, from 90 to 110 percent of the rated voltage over the steady state load range of 0 to 100 percent of rated output capacity. Regulation drift exceeding plus or minus 0.5 percent for an ambient temperature change of 68 degrees F is not acceptable. Reactive droop compensation or reactive differential compensation must load share the reactive load proportionally between sets during parallel operation. Provide voltage regulator with a maximum droop of 2 percent of rated voltage over a load range from 0 to 100 percent of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.18 GENERATOR ISOLATION AND PROTECTION

Provide necessary devices for electrical protection and isolation of each engine-generator set and its ancillary equipment. The generator circuit breaker (IEEE Device 52) ratings must be consistent with the generator rated voltage and frequency, with continuous, short circuit withstand, and interrupting current ratings to match the generator capacity. Provide electrically operated generator circuit breaker. Mount a set of surge capacitors at the generator terminals. Provide monitoring and control devices as specified in paragraph PANELS.

The generator circuit breaker must comply with UL 489 requirements for molded case, adjustable thermal magnetic trip type circuit breaker. The circuit breaker continuous current rating must be adequate for the power rating of the engine-generator set and the circuit breaker must be rated to withstand the short circuit current provided by the generator set. Provide circuit breaker in a NEMA ICS 6, Type 1 enclosure mounted on the engine-generator set.

2.18.1 Switchboards

Provide free-standing, metal-enclosed, general purpose, 3-phase, 4-wire, 600 volt rated, with neutral bus and continuous ground bus, switchboards conforming to NEMA PB 2 and UL 891. Neutral bus and ground bus capacity

must be full capacity. Provide panelboards conforming to NEMA PB 1. Provide enclosure designs, construction, materials and coatings suitable for the application and environment. Bus continuous current rating must be at least equal to the generator rating and correspond to the UL listed current ratings specified for panelboards and switchboards. Current withstand (short circuit rating) must be equal to the breaker interrupting rating. Provide copper buses.

2.18.2 Devices

Provide switches, circuit breakers, switchgear, fuses, relays, and other protective devices as specified in Section 26 05 73 POWER SYSTEM STUDIES.

Furnish with respective pieces of equipment. Motors, controllers, contactors, and disconnects must conform to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical connections under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide controllers and contactors with maximum of 120-volt control circuits, and auxiliary contacts for use with controls furnished. When motors and equipment furnished are larger than size indicated, the cost of providing additional electrical service and related work must be included under this section.

2.19 SAFETY SYSTEM

Provide and install devices, wiring, remote panels, and local panels, etc., as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. Provide a safety system with a self-test method to verify its operability. Provide alarm signals that have manual acknowledgment and reset devices. The alarm signal systems must reactivate for new signals after acknowledgment is given to any signal. Configure the systems so that loss of any monitoring device will be dealt with as an alarm on that system element.

2.19.1 Audible Signal

Provide audible alarm signal sound at a frequency of 70 Hz at a volume of 100 dB at 10 feet. The sound must be continuously activated upon alarm and silenced upon acknowledgment. Locate signal devices as shown.

2.19.2 Visual Signal

The visual alarm signal must be a panel light. The light must be normally off, activated to be blinking upon alarm. The light must change to continuously lit upon acknowledgement. If automatic shutdown occurs, the display must maintain activated status to indicate the cause of failure and must not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms must be red; all other alarms must be amber.

2.19.3 Alarms and Action Logic

2.19.3.1 Shutdown

Accomplish simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers.

2.19.3.2 Problem

Accomplish activation of the visual signal.

2.19.4 Safety Indications and Shutdowns
Provide a local alarm panel with the following shutdown and alarm functions as indicated in accordance with NFPA 110 level 1 mounted either on or adjacent to the engine generator set.

A remote alarm panel is required for audible alarms, e.g., in the control room.

Indicator Function (at battery voltage)	NFPA 110 Level 1 CV S RA
Overcrank	X X X
Low water temperature	X NA X
High engine temperature pre-alarm	X NA X
High engine temperature	X X X
Low lube oil pressure pre-alarm	NA NA NA
Low lube oil pressure	X X X
Overspeed	X X X
Low fuel main tank	X NA X
Low coolant level	X O X
EPS supplying load	X NA NA
Control switch not in automatic position	X NA X
High battery voltage	X NA NA
Low cranking voltage	X NA X
Low voltage in battery	X NA NA
Battery charger ac failure	X NA NA
Lamp test	X NA NA
Contacts for local and remote common alarm	X NA X

Indicator Function (at battery voltage)	NFPA 110 Level 1 CV S RA
Audible alarm silencing switch	NA NA X
Low starting air pressure	X NA NA
Low starting hydraulic pressure	X NA NA
Air shutdown damper when used	X X X
Remote emergency stop	NA X NA
Symbology: CV: Control panel-mounted visual. S: Shutdown of EPS indication. RA: Remote audible. Symbology: CV: Control panel-mounted visual. S: Shutdown of EPS indication. RA: Remote audible. X: Required. O: Optional. NA: Not applicable.	

2.19.5 Time-Delay on Alarms

For startup of the engine-generator set, install time-delay devices bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. Submit the magnitude of monitored values which define alarm or action set points, and the tolerance (plus and/or minus) at which the devices activate the alarm or action for items contained within the alarm panels. The lube-oil time-delay device must return its alarm to normal status after the engine starts. The coolant time-delay device must return its alarm to normal status 5 minutes after the engine starts.

2.20 PANELS

Each panel must be of the type and kind necessary to provide specified functions. Mount panels on the engine-generator set base by vibration/shock absorbing type mountings. Mount instruments flush or semiflush. Provide convenient access to the back of panels to facilitate maintenance. Calibrate instruments using recognized industry calibration standards. Provide a panel identification plate identifying the panel function. Provide a plate identifying the device and its function for each instrument and device on the panel. Provide switch plates identifying the switch-position function.

2.20.1 Enclosures

Design enclosures for the application and environment, conforming to NEMA ICS 6. Locking mechanisms must be keyed alike.

Provide for each engine-generator set and fabricate from zinc coated or phosphatized and shop primed 16 gage minimum sheet steel in accordance with the manufacturer's standard design. Provide a complete, weatherproof enclosure for the engine, generator, and auxiliary systems and equipment. Support exhaust piping and silencer so that the turbocharger is not subjected to exhaust system weight or lateral forces generated in connecting piping that exceed the engine manufacturer's maximum allowed forces and moments. The housing must have sufficient louvered openings to allow entrance of outside air for engine and generator cooling at full load. Design louvered openings to exclude driving rain and snow. Provide properly arranged and sized, hinged panels in the enclosure to allow convenient access to the engine, generator, and control equipment for maintenance and operational procedures. Provide hinged panels with spring type latches which must hold the panels closed securely and will not allow them to vibrate. Brace the housing internally to prevent excessive vibration when the set is in operation

2.20.2 Electronic

Electronic indicating instruments must be true RMS indicating instruments, 100 percent solid state, state-of-the-art, microprocessor controlled to provide specified functions. Provide control, logic, and function devices that are compatible as a system, sealed, dust and water tight, and that utilize modular components with metal housings and digital instrumentation. Provide an interface module to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy less than 98 percent for unit mounted devices and 99 percent for control room, panel mounted devices, throughout a temperature range of minus 4 to 158 degrees F is not acceptable. Provide LED or back lit LCD data display. Additionally, the display must provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height must be 0.5 inch.

2.20.3 Parameter Display

Provide indication or readouts of the tachometer, lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and safety system parameters. Specify a momentary switch for other panels.

2.21 SURGE PROTECTION

Electrical and electronic components must be protected from, or designed to withstand the effects of surges from switching and lightning.

2.22 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Provide fully automatic operation for the following operations: engine-generator set starting and load transfer upon loss of normal source. Devices must automatically reset after termination of their function.

2.22.1 Automatic Transfer Switch

Provide automatic transfer switches in accordance with Section 26 36 23 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.22.2 Monitoring and Transfer

Provide devices to monitor voltage and frequency for the normal power source and each engine-generator set, and control transfer from the normal source and retransfer upon restoration of the normal source. Describe functions, actuation, and time delays as described in Section 26 36 23 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.23 MANUAL ENGINE-GENERATOR-SET SYSTEM OPERATION

Provide complete facilities for manual starting and testing of each set without load, loading and unloading of each set, and synchronization of each set with an energized bus.

2.24 STATION BATTERY SYSTEM

Provide a station battery system including the battery, battery rack, spacers, automatic battery charger and distribution panelboard with overcurrent protection, metering and relaying. Size components to withstand the seismic acceleration forces specified. Provide batteries that have a rated life of 20 years and a manufacturer's 5-year, no cost replacement guarantee.

2.24.1 Battery

Provide lead-acid battery sized in accordance with IEEE 485 and conforming to the requirements of IEEE 484. Valve-regulated lead-acid batteries are not acceptable. Provide battery environment temperature range between 65 and 95 degrees. The battery must be rated for at least 210 ampere hours at the 8-hour rate.

2.24.2 Battery Capacity

The battery must be rated for at least 210 ampere hours at the 8-hour rate, and must have sufficient capacity to serve the following loads without recharging for a period of 20 hours. At the end of the discharge period, the battery must have the capacity to simultaneously close and trip all the circuit breakers provided, based on a 1-minute load to final voltage of 12 volts per cell.

a. Diesel-generator safety circuits.

b. Switchgear indicating lights, control relays, protective relays, and other switchgear dc components as required for 24 hours.

c. Voltage regulator (dc power supplies).

2.24.3 Battery Charger

Furnish a current-limiting, 120-volt battery charger to automatically recharge the batteries. Provide a charger that is capable of an equalize charging rate for recharging fully depleted batteries within 24 hours and a floating-charge rate for maintaining the batteries in a fully charged condition. Equip the charger with a low-voltage alarm relay, 0- to 24-hour equalizing timer, an ammeter to indicate charging rate, and necessary circuit breakers. The charger must conform to the requirements of UL 1236. A battery is considered to be fully depleted when the voltage falls to a level incapable of operating the equipment loads served by the

battery.

2.25 BASE

Provide a steel base. Design the base to rigidly support the engine-generator set, ensure permanent alignment of rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment is maintained during shipping and normal operation. The base must permit skidding in any direction during installation and must withstand and mitigate the affects of synchronous vibration of the engine and generator. Provide base with suitable holes for anchor bolts and jacking screws for leveling.

2.26 THERMAL INSULATION

Provide thermal insulation as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.27 PAINTING AND FINISHING

Clean, prime and paintthe engine-generator set in accordance with the manufacturer's standard color and practice.

2.28 FACTORY INSPECTION AND TESTS

Submit six complete reproducible copies of the factory inspection result on the checklist format specified below. Perform the factory tests on each engine-generator set. The component manufacturer's production line test is acceptable as noted. Run each engine-generator set for at least 1 hour at rated output capacity prior to inspections. Complete inspections and make all necessary repairs prior to testing. Use engine generator controls and protective devices that are provided by the generator set manufacturer as part of the standard package for factory tests. When controls and switchgear are not provided as part of the generator set manufacturer's standard package, the actual controls and protective devices provided for the project are not required to be used during the factory test. The Contracting Officer may provide one or more representatives to witness inspections and tests.

2.28.1 Factory Inspection

Perform inspections prior to beginning and after completion of testing of the assembled engine-generator set. Look for leaks, looseness, defects in components, proper assembly, etc. and note any item found to be in need of correction as a necessary repair. Use the following checklist for the inspection:

INSPECTION ITEM	GOOD	BAD	NOTES
Drive belts			
Governor and adjustments			
Engine timing mark			

INSPECTION ITEM	GOOD	BAD	NOTES
Starting motor			
Starting aids			
Coolant type and concentration			
Radiator drains			
Block coolant drains			
Coolant fill level			
All coolant line connections			
All coolant hoses			
Combustion air filter			
Combustion air silencer			
Lube oil type			
Lube oil sump drain			
Lube-oil filter			
Lube-oil-level indicator			
Lube-oil-fill level			
All lube-oil line connections			
All lube-oil lines			
Fuel type and amount			
All fuel-line connections			
All fuel lines			
Fuel filter			
Coupling and shaft alignment			
Voltage regulators			
Battery-charger connections			
All wiring connections			
Instrumentation			

INSPECTION ITEM	GOOD	BAD	NOTES
Hazards to personnel			
Base			
Nameplates			
Paint			
Exhaust-heat recovery unit			
Switchboard			
Switchgear			

2.28.2 Factory Tests

Submit a letter giving notice of the proposed dates of factory inspections and tests at least 14 days prior to beginning tests, including:

a. A detailed description of the manufacturer's procedures for factory tests at least 14 days prior to beginning tests.

b. Six copies of the Factory Test data described below in 8-1/2 by 11 inch binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Separate sections by heavy plastic dividers with tabs. Provide full size (8-1/2 by 11 inch minimum) data plots showing grid lines, with full resolution.

(1) A detailed description of the procedures for factory tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) A list of the parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of adjustments made.

On engine-generator set tests where the engine and generator are required to be connected and operated together, the load power factor must be the power factor specified in the engine generator set parameter schedule. For engine-generator set with dual-fuel operating capability, perform the following tests using the primary fuel type. Perform electrical measurements in accordance with IEEE 120. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation must be in accordance with IEEE 1. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature,

etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Tests specifically for the generator may be performed utilizing any prime mover.

a. Insulation Resistance for Stator and Exciter Test, IEEE 115 and IEEE 43, to the performance criteria in NEMA MG 00001, Part 22. Generator manufacturer's production line test is acceptable.

b. High Potential Test, in accordance with IEEE 115 and NEMA MG 00001, test voltage in accordance with NEMA MG 00001. Generator manufacturer's production line test is acceptable.

c. Winding Resistance Test, Stator and Exciter, in accordance with IEEE 115. Generator manufacturer's production line test is acceptable.

d. Phase Balance Voltage Test, to the performance criteria specified in paragraph GENERATOR. This test can be performed with any prime mover. Generator manufacturer's production line test results are acceptable.

(1) Start and operate the generator at no load.

(2) Adjust a regulated phase voltage (line-to-neutral) to rated voltage.

(3) Read and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(4) Apply 75 percent rated load and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(5) Apply rated load and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(6) Calculate average line-neutral voltage and percent deviation of individual line-neutral voltages from average for each load condition.

e. Current Balance on Stator Winding Test, by measuring the current on each phase of the winding with the generator operating at 100 percent of Rated Output Capacity, with the load impedance equal for each of the three phases: to the performance criteria specified in paragraph GENERATOR.

f. Voltage Waveform Deviation and Distortion Test in accordance with IEEE 115 to the performance criteria specified in paragraph GENERATOR. Use high-speed recording instruments capable of recording voltage waveform deviation and all distortion, including harmonic distortion. Include appropriate scales to provide a means to measure and interpret results.

g. Voltage and Frequency Droop Test. Verify that the output voltage and frequency are within the specified parameters as follows:

(1) With the generator operating at no load, adjust voltage and frequency to rated voltage and frequency. Record the generator output frequency and line-line and line-neutral voltages.

(2) Increase load to Rated Output Capacity. Record the generator output frequency and line-line and line-neutral voltages.

(3) Calculate the percent droop for voltage and frequency with the following equations:

$$\text{Voltage droop percent} = \frac{\text{(No-Load Volts) - (Rated Capacity Volts)}}{\text{(Service-Load Volts)}} \times 100$$

$$\text{Frequency droop percent} = \frac{\text{(No-Load Hertz) - (Rated Capacity Hertz)}}{\text{(Service-Load Hertz)}} \times 100$$

(4) Repeat steps 1 through 3 two additional times without making any adjustments.

h. Frequency and Voltage Stability and Transient Response. Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer. Include the following tabular data:

(1) Ambient temperature (at 15 minute intervals).

(2) Generator output current (before and after load changes).

(3) Generator output voltage (before and after load changes).

(4) Frequency (before and after load changes).

(5) Generator output power (before and after load changes).

(6) Graphic representations must include the actual instrument trace of voltage and frequency showing: charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

(a) Perform and record engine manufacturer's recommended pre-starting checks and inspections.

(b) Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

(c) With the unit at no load, apply the Maximum Step Load Increase.

(d) Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.

(e) Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100 percent of Service Load.

(f) Apply the Maximum Step Load Increase.

(g) Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.

(h) Repeat steps (c) through (g).

i. Test Voltage Unbalance with Unbalanced Load (Line-to-Neutral) to the performance criteria specified in paragraph GENERATOR. Prototype test data is acceptable in lieu of the actual test. Submit manufacturer's standard certification that prototype tests were performed for the generator model proposed. This test may be performed using any prime mover.

(1) Start and operate the generator set at rate voltage, no load, rated frequency, and under control of the voltage regulator. Read and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(2) Apply the specified load between terminals L_1-L_2, L_2-L_0, and L_3-L_0 in turn. Record all instrument readings at each line-neutral condition.

(3) Express the greatest difference between any two of the line-to-line voltages and any two of the line-to-neutral voltages as a percent of rated voltage.

(4) Compare the largest differences expressed in percent with the maximum allowable difference specified.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the job, perform a Site Visit to verify the information shown on the drawings, before performing any work. Submit a letter stating the date the site was visited and listing discrepancies found. Notify the Contracting Officer in writing of any discrepancies.

3.2 GENERAL INSTALLATION

Provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Submit a copy of the manufacturer's installation procedures and a detailed description of the manufacturer's recommended break-in procedure. Install pipe, duct, conduit, and ancillary equipment to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.3 PIPING INSTALLATION

Weld piping. Provide flanged valve connections. Provide flanged connections at equipment. Provide threaded connections to the engine if the manufacturers standard connection is threaded. Except where otherwise specified, use welded flanged fittings to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Make connections to equipment with vibration isolation-type flexible connectors. Support and align piping and tubing to prevent stressing of flexible hoses and connectors. Flash pipes extending through the roof. Install piping clear of windows, doors and openings, to permit thermal expansion and contraction without damage to joints or hangers, and install a 1/2 inch drain valve with cap at each low point.

The installation of gas engines must conform to the requirements of NFPA 37 and its references therein, including NFPA 54, NFPA 58, and ASME B31.3.

3.3.1 Support

Provide hangers, inserts, and supports to accommodate any insulation and conforming to MSS SP-58. Space supports no more than 7 feet on center for pipes 2 inches in diameter or less, no more than 12 feet on center for pipes larger than 2 inches but smaller than 4 inches in diameter, and not more than 17 feet on center for pipes larger than 4 inches in diameter. Provide supports at pipe bends or change of direction.

3.3.1.1 Ceiling and Roof

Support exhaust piping with appropriately sized Type 41 single pipe roll and threaded rods; support all other piping with appropriately sized Type 1 clevis and threaded rods.

3.3.1.2 Wall

Make wall supports for pipe by suspending the pipe from appropriately sized Type 33 brackets with the appropriate ceiling and roof pipe supports.

3.3.2 Flanged Joints

Provide flanges that are Class 125 type, drilled, and of the proper size and configuration to match the equipment and engine connections. Provide gasketed flanged joints that are square and tight.

3.3.3 Cleaning

After fabrication and before assembly, piping interiors must be manually wiped clean of debris.

3.3.4 Pipe Sleeves

Fit pipes passing through construction such as ceilings, floors, or walls with sleeves. Extend each sleeve through and fasten in its respective structure and cut flush with each surface. Build the structure tightly to the sleeve. The inside diameter of each sleeve must be minimum 1/2 inch, and where pipes pass through combustible materials 1 inch larger than the outside diameter of the passing pipe or pipe insulation/covering.

3.4 ELECTRICAL INSTALLATION

Perform electrical installation in compliance with NFPA 70, IEEE C2, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. For vibration isolation, provide flexible fittings for conduit, cable trays, and raceways attached to engine-generator sets; provide flexible stranded conductor for metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set; and provide crimp-type terminals or lugs for terminations of conductors on the engine generator set.

3.5 FIELD PAINTING

Perform field painting as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6 ONSITE INSPECTION AND TESTS

Perform and report on factory tests and inspections prior to shipment. Provide certified copies of manufacturer's test data and results. Test procedures must conform to ASME, IEEE, and ANSI standards, and to ISO requirements on testing, as appropriate and applicable. The manufacturer performing the tests must provide equipment, labor, and consumables necessary for tests and measuring and indicating devices must be certified to be within calibration. Tests must indicate satisfactory operation and attainment of specified performance. If satisfactory, equipment tested will be given a tentative approval. Equipment must not be shipped before approval of the factory test reports for the following tests.

Submit a letter giving notice of the proposed dates of onsite inspections and tests at least 14 days prior to beginning tests.

a. Submit a detailed description of the Contractor's procedures for onsite tests including the test plan and a listing of equipment necessary to perform the tests at least 30 days prior to beginning tests.

b. Submit six copies of the onsite test data described below in 8-1/2 by 11 inch binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Separate sections by heavy plastic dividers with tabs. Provide full size (8-1/2 by 11 inch minimum) data plots showing grid lines, with full resolution.

    (1) A detailed description of the procedures for onsite tests.

    (2) A list of equipment used, with calibration certifications.

    (3) A copy of measurements taken, with required plots and graphs.

    (4) The date of testing.

    (5) A list of the parameters verified.

    (6) The condition specified for the parameter.

    (7) The test results, signed and dated.

    (8) A description of adjustments made.

3.6.1 Test Conditions

3.6.1.1 Data

Make and record measurements of all parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, make adjustments, replacements, or repairs and repeat the step until satisfactory results are obtained. Unless otherwise indicated, record data in 15 minute intervals during engine-generator set operation and include: readings of all engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set. Perform electrical measurements in accordance with IEEE 120. Definitions of terms are in accordance with IEEE 100. Provide temperature limits in the rating of electrical equipment and for the evaluation of electrical insulations in accordance with IEEE 1.

3.6.1.2 Power Factor

Submit the generator capability curve showing generator kVA output capability (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0. For all engine-generator set operating tests the load power factor must be the power factor specified in the engine-generator set parameter schedule.

3.6.1.3 Contractor Supplied Items

Provide equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.6.1.4 Instruments

Verify readings of panel gauges, meters, displays, and instruments provided as permanent equipment during test runs, using test instruments of greater precision and accuracy. Test instrument accuracy must be within the following: current plus or minus 1.5 percent, voltage plus or minus 1.5 percent, real power plus or minus 1.5 percent, reactive power plus or minus 1.5 percent, power factor plus or minus 3 percent, frequency plus or minus 0.5 percent. Calibrate test instruments by a recognized standards laboratory within 30 days prior to testing.

3.6.1.5 Sequence

Provide the sequence of testing as specified in the approved testing plan unless variance is authorized by the Contracting Officer. Perform field testing in the presence of the Contracting Officer. Schedule and sequence tests in order to optimize run-time periods; however, follow the general order of testing: Construction Tests; Inspections; Pre-operational Tests; Safety Run Tests; Performance Tests; and Final Inspection.

3.6.2 Construction Tests

Perform individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer prior to

connection to the engine-generator set.

3.6.2.1 Piping Test

a. Flush lube-oil and fuel-oil piping with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.

b. Test fuel piping which is external to the engine-generator set in accordance with NFPA 30. Pressure all remaining piping which is external to the engine-generator set with air pressure at 150 percent of the maximum anticipated working pressure, but not less than 150 psi, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, perform the test before the insulation is applied.

3.6.2.2 Electrical Equipment Tests

a. Perform low-voltage cable insulation integrity tests for cables connecting the generator breaker to the automatic transfer switch. Test low-voltage cable, complete with splices, for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. Apply a test voltage of 500 volts dc for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. Provide the minimum value of insulation as follows:

(1) R in meg-ohms = (rated voltage in kV plus 1) x 304.8/(length of cable in meters)

(2) R in meg-ohms = (rated voltage in kV plus 1) x 1000/(length of cable in feet)

(3) Each cable failing this test must be repaired or replaced. The repair cable must be retested until failures have been eliminated.

b. Ground-Resistance Tests. Measure the resistance of the ground ring using the fall-of-potential method defined in IEEE 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. Take measurements in normally dry weather, not less than 48 hours after rainfall. Provide site diagram indicating location of test probes with associated distances, and provide a plot of resistance vs. distance. The combined resistance of separate systems may be used to meet the requirements resistance, but the specified number of electrodes must still be provided as follows:

(1) Single rod electrode - 25 ohms.

c. Examine and test circuit breakers and switchgear in accordance with the manufacturer's published instructions for functional testing.

3.6.3 Inspections

Perform the following inspections jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Submit a letter certifying that all facilities are complete and functional; that each system is fully functional; and that each item of

equipment is complete, free from damage, adjusted, and ready for beneficial use. Perform checks applicable to the installation. Document and submit the results of those which are physical inspections (I) in accordance with paragraph SUBMITTALS. Present manufacturer's data for the inspections designated (D) at the time of inspection. Verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Provide manufacturer's statements to certify provision of features which cannot be verified visually.

Drive belts	I
Governor type and features	I
Engine timing mark	I
Starting motor	I
Starting aids	I
Coolant type and concentration	D
Radiator drains	I
Block coolant drains	I
Coolant fill level	I
Coolant line connections	I
Coolant hoses	I
Combustion air filter	I
Intake air silencer	I
Lube oil type	D
Lube oil sump drain	I
Lube-oil filter	I
Lube-oil level indicator	I
Lube-oil fill level	I
Lube-oil line connections	I
Lube-oil lines	I
Fuel type	D

Fuel level	I
Fuel-line connections	I
Fuel lines	I
Fuel filter	I
Access for maintenance	I
Voltage regulator	I
Battery-charger connections	I
Wiring and terminations	I
Instrumentation	I
Hazards to personnel	I
Base	I
Nameplates	I
Paint	I
Exhaust-heat system	I
Exhaust muffler	I
Switchboard	I
Switchgear	I
Access provided to controls	I
Enclosure is weather resistant	I
Engine and generator mounting bolts (application)	I

3.6.4 Engine Tests

Perform customary commercial factory tests in accordance with ISO 3046 on each engine and associated engine protective device, including, but not limited to the following:

a. Perform dynamometer test at rated power. Record horsepower at rated speed and nominal characteristics such as lubricating oil pressure, jacket water temperature, and ambient temperature.

b. Test and record the values that the low oil pressure alarm and protective shutdown devices actuate prior to assembly on the engine.

c. Test and record values that the high jacket water temperature alarm and protective shutdown devices actuate prior to assembly on the

engine.

3.6.5 Generator Tests

Tests must be performed on the complete factory assembled generator prior to shipment. Conduct tests in accordance with IEEE 115, IEC 60034-2A, and NEMA MG 00001.

3.6.5.1 Routine Tests

Perform the following routine tests on the generators and their exciters:

a. Resistance of armature and field windings.

b. Mechanical balance.

c. Phases sequence.

d. Open circuit saturation curve and phase (voltage) balance test.

e. Insulation resistance of armature and field windings.

f. High potential tes.t

3.6.5.2 Design Tests

Submit the following design tests made on prototype machines that are physically and electrically identical to the generators specified.

a. Temperature rise test

b. Short circuit saturation curve and current balance test

3.6.6 Assembled Engine-Generator Set Tests

Submit the following tests made on prototype machines that are physically and electrically identical to the engine-generator set specified.

3.6.6.1 Initial Stabilization Readings

Operate the engine-generator set and allow the set to stabilize at rated kW at rated power factor, rated voltage, and rated frequency. During this period record instrument readings for output power (kW), terminal voltage, line current, power factor, frequency (rpm) generator (exciter) field voltage and current, lubricating oil pressure, jacket water temperature, and ambient temperature at minimum intervals of 15 minutes. Adjust the load, voltage, and frequency to maintain rated load at rated voltage and frequency. Adjustments to load, voltage, or frequency controls must be recorded on the data sheet at the time of adjustment. Stabilization must be considered to have occurred when four consecutive voltage and current recorded readings of the generator (or exciter) field either remain unchanged or have only minor variations about an equilibrium condition with no evident continued increase or decrease in value after the last adjustment to the load, voltage, or frequency has been made.

3.6.6.2 Regulator Range Test

Remove load and record instrument readings (after transients have subsided). Adjust voltage to the maximum attainable value or to a value

just prior to actuation of the overvoltage protection device. Apply rated load and adjust voltage to the minimum attainable value or a value just prior to activation of the under-voltage protection device. The data sheets must indicate the voltage regulation as a percent of rated voltage and the maximum and minimum voltages attainable. Voltage regulation must be defined as follows:

$$\text{Percent Regulation} = \frac{((\text{No-Load Voltage}) - (\text{Rated-Load Voltage})) \times 100}{(\text{Rated-Load Voltage})}$$

3.6.6.3 Frequency Range Test

Adjust the engine-generator set frequency for the maximum attainable frequency at rated load. Record instrument readings. Adjust the engine-generator set frequency for the specified minimum attainable frequency at rated load. Record instrument readings. Reduce the load to zero and adjust the engine-generator set frequency for the maximum attainable frequency. Record instrument readings. Adjust the engine-generator set frequency for the minimum attainable frequency. Record instrument readings. The data sheet must show the maximum and minimum frequencies attained at rated load, and at no load.

3.6.6.4 Transient Response Test

Drop the load to no load and re-apply rated load three times to ensure that the no load and rated load voltage and frequency values are repeatable and that the frequency and voltage regulation is within the limits specified. Record generator terminal voltage and frequency using a high speed strip chart recorder. The data sheet must show the following results:

a. Frequency

(1) Stability bandwidth or deviation in percent of rated frequency.

(2) Recovery time.

(3) Overshoot and undershoot.

b. Voltage

(1) Stability bandwidth or deviation in percent of rated voltage.

(2) Recovery time.

(3) Overshoot and undershoot.

3.6.7 Pre-operational Tests

3.6.7.1 Protective Relays

Visually and mechanically inspect, adjust, test, and calibrate protective relays in accordance with the manufacturer's published instructions. Include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Implement relay settings in accordance with the installation coordination study. Manually or electrically operate relay contacts to verify that the proper breakers and alarms initiate. Field test relaying current transformers in

accordance with IEEE C57.13.1.

3.6.7.2 Insulation Test

Test generator and exciter circuits insulation resistance in accordance with IEEE 43. Take stator readings including generator leads to switchboard at the circuit breaker. Record results of insulation resistance tests. Readings must be within limits specified by the manufacturer. Verify mechanical operation, insulation resistance, protective relay calibration and operation, and wiring continuity of switchboard assembly. Do not damage generator components during test.

3.6.7.3 Engine-Generator Connection Coupling Test

When the generator provided is a two-bearing machine, inspect and check the engine-generator connection coupling by dial indicator to prove that no misalignment has occurred. Use the dial indicator to measure variation in radial positioning and axial clearance between the coupling halves. Take readings at four points, spaced 90 degrees apart. Align solid couplings and pin-type flexible couplings within a total indicator reading of 0.0005 to 0.001 inch for both parallel and angular misalignment. For gear-type or grid-type couplings, 0.002 inch will be acceptable.

3.6.8 Safety Run Test

For the following tests, repeat the associated safety tests if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

c. Activate the manual emergency stop switch and verify that the engine stops.

d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install a temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine-generator set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If either temperature reading exceeds the value required for an alarm condition, activate the manual emergency stop switch.

f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily install a temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine generator-set at no load until the output voltage and frequency stabilize.

i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 2 hours at 75 percent of Service Load.

l. Verify proper operation and set-points of gauges and instruments.

m. Verify proper operation of ancillary equipment.

n. Manually adjust the governor to increase engine speed past the over-speed limit. Record the RPM at which the engine shuts down.

o. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of Service Load.

p. Manually adjust the governor to increase engine speed to within 2 percent of the over-speed trip speed previously determined and operate at that point for 5 minutes. Manually adjust the governor to the rated frequency.

q. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.

r. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine.

s. Attach a manifold to the engine oil system (at the oil pressure sensor port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. Move the engine's oil pressure sensor from the engine to the manifold. Open the manifold shutoff valve and close the bleed valve.

t. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of Service Load.

u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.

v. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100 percent of Service Load. Record the maximum sound level in each frequency band at a distance of 75 feet from the end of the exhaust and air intake piping directly along the path of intake and discharge for horizontal piping; or at a radius of 75 feet from the engine at 45 degrees apart in all directions for vertical piping. If a sound limiting enclosure is provided, modify or replace the enclosure, the muffler, and intake silencer must be modified or replaced as required to meet the sound requirements contained within this specification. If the sound limitations can not be obtained by modifying or replacing the muffler and air intake silencer, notify the Contracting Officers Representative and provide a recommendation for meeting the sound limitations.

w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low level alarm limits.

3.6.9 Performance Tests

In the following tests, where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. For the following tests, repeat the associated tests if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries.

3.6.9.1 Continuous Engine Load Run Test

Test the engine-generator set and ancillary systems at service load to demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, repeat the entire test. Accomplish the engine load run test during daylight hours, with an average ambient temperature of 105 degrees F, during the month of August. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Take data taken at 15 minute intervals and include the following:

Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

Pressure: Lube-oil.

Temperature: Coolant, Lube-oil, Exhaust, Ambient.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warmup period.

c. Operate the engine generator-set for 2 hours at 75 percent of Service Load.

d. Increase load to 100 percent of Service Load and operate the engine generator-set for 4 hours.

e. For prime rated units, increase load to 110 percent of Service Load and operate the engine generator-set for 2 hours.

f. Decrease load to 100 percent of Service Load and operate the engine generator-set for 2 hours or until all temperatures have stabilized.

g. Remove load from the engine-generator set.

3.6.9.2 Voltage and Frequency Droop Test

For the following steps, verify that the output voltage and frequency return to and stabilize within the specified bandwidth values following each load change. Record the generator output frequency and line-line and line-neutral voltages following each load change.

a. With the generator operating at no load, adjust voltage and frequency to rated voltage and frequency.

b. Increase load to 100 percent of Rated Output Capacity. Record the generator output frequency and line-line and line-neutral voltages.

c. Calculate the percent droop for voltage and frequency with the following equations.

$$\text{Voltage droop percent} = \frac{\text{No-load volts - rated output capacity volts}}{\text{Rated output capacity volts}} \times 100$$

$$\text{Frequency droop percent} = \frac{\text{No load hertz - rated output capacity hertz}}{\text{Rated output capacity volts}} \times 100$$

d. Repeat steps a. through c. two additional times without making any adjustments.

3.6.9.3 Voltage Regulator Range Test

a. While operating at no load, verify that the voltage regulator adjusts from 90 to 110 percent of rated voltage.

b. Increase load to 100 percent of Rated Output Capacity. Verify that the voltage regulator adjusts from 90 to 110 percent of rated voltage.

3.6.9.4 Governor Adjustment Range Test

a. While operating at no load, verify that the governor adjusts from 90 to 110 percent of rated frequency.

b. Increase load to 100 percent of Rated Output Capacity. Verify that the governor adjusts from 90 to 110 percent of rated frequency.

3.6.9.5 Frequency and Voltage Stability and Transient Response

Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer. Include the following tabular data:

(1) Ambient temperature (at 15 minute intervals).

(2) Generator output current (before and after load changes).

(3) Generator output voltage (before and after load changes).

(4) Frequency (before and after load changes).

(5) Generator output power (before and after load changes.

(6) Include the actual instrument trace of voltage and frequency in graphic representations showing:

Charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

c. With the unit at no load, apply the Maximum Step Load Increase.

d. Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.

e. Repeat steps c. through g.

3.6.10 Automatic Operation Tests

Test the automatic operating system to demonstrate automatic starting, loading and unloading, the response to loss of operating engine-generator

sets, and paralleling of each engine-generator set. Utilize load banks at the indicated power factor and actual loads to be served for this test, and the loading sequence is the indicated sequence. Record load-sharing characteristics during all operations. Perform this test for a minimum of two successive, successful tests. Include the following data:

(1) Ambient temperature (at 15 minute intervals).

(2) Generator output current (before and after load changes).

(3) Generator output voltage (before and after load changes).

(4) Generator output frequency (before and after load changes).

(5) Power division and exchange between generator sets.

(6) Real and reactive power on each set.

a. Initiate loss of the preferred power source and verify the specified sequence of operation.

b. Verify resetting of automatic starting and transfer logic.

3.6.11 Automatic Operation Tests for Stand-Alone Operation

Test the automatic loading system to demonstrate automatic starting, and loading and unloadingof each engine-generator set. Utilize the actual loads to be served for this test, and the loading sequence is the indicated sequence. Perform this test for a minimum of two successive, successful tests. Include the following data:

(1) Ambient temperature (at 15 minute intervals).

(2) Generator output current (before and after load changes).

(3) Generator output voltage (before and after load changes).

(4) Generator output frequency (before and after load changes).

a. Initiate loss of the primary power source and verify automatic sequence of operation.

b. Restore the primary power source and verify sequence of operation.

c. Verify resetting of controls to normal.

3.7 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems must have a resistance to solid earth ground not exceeding 5 ohms.

3.7.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.7.2 Engine-Generator Set Grounding

Provide separate copper grounding conductors and connect them to the ground system as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" must apply.

3.7.3 Connections

Make joints in grounding conductors by exothermic weld or compression connector. Exothermic welds and compression connectors must be installed as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION paragraph regarding GROUNDING.

3.7.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.8 START-UP ENGINEER

Provide the services of a qualified factory trained start-up engineer, regularly employed by the engine-generator set manufacturer. The start-up services must include conducting preliminary operations and functional acceptance tests. The start-up engineer must be present at the engine generator set installation-site, full-time, while preliminary operations and functional acceptance tests are being conducted.

3.9 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the engine-generator set and auxiliary equipment.

3.9.1 Piping Tests

Complete as specified in Section 33 52 40 FUEL SYSTEMS PIPING (NON-HYDRANT).

3.9.2 Performance of Acceptance Checks and Tests

The acceptance checks and tests must be accomplished by the testing organization as described in Section 26 08 00 APPARATUS INSPECTION AND TESTING.

3.9.3 Generator Sets

Complete as specified in the paragraph ACCEPTANCE CHECKS AND TESTS.

3.9.3.1 Automatic Transfer Switches

Complete acceptance checks and tests as specified in Section 26 36 23 AUTOMATIC TRANSFER SWITCHES AND BY-PASS/ISOLATION SWITCH.

3.9.4 Preliminary Operations

The start-up engineer must conduct manufacturer recommended start-up procedures and tests to verify that the engine-generator set and auxiliary equipment are ready for functional acceptance tests. Give the Contracting Officer 15 days' advance notice that preliminary operations will be conducted. After preliminary operation has been successfully conducted,

the start-up engineer will notify the Contracting Officer in writing stating the engine-generator set and auxiliary equipment are ready for functional acceptance tests.

3.9.5 Preliminary Assembled Operation and Maintenance Manuals

Preliminary assembled operation and maintenance manuals must have been submitted to and approved by the Contracting Officer. Manuals must be prepared as specified in the paragraph ASSEMBLED OPERATION AND MAINTENANCE MANUALS.

3.9.6 Functional Acceptance Test Procedure

Test procedure must be prepared by the start-up engineer specifically for the engine-generator set and auxiliary equipment. The test agenda must cover the requirements specified in the paragraph FUNCTIONAL ACCEPTANCE TESTS. The test procedure must indicate in detail how tests are to be conducted. A statement of the tests that are to be performed without indicating how the tests are to be performed is not acceptable. Indicate what work is planned on each workday and identify the calendar dates of the planned workdays. Specify what additional technical support personnel is needed such as factory representatives for major equipment. Specify on which testing workday each technical support personnel is needed. Data recording forms to be used to document test results are to be submitted with the proposed test procedure. A list of test equipment and instruments must also be included in the test procedure.

3.9.7 Test Equipment

Test equipment and instruments must be on hand prior to scheduling field tests or, subject to Contracting Officer approval, evidence must be provided to show that arrangements have been made to have the necessary equipment and instruments on-site prior to field testing.

3.10 FIELD QUALITY CONTROL

Give Contracting Officer NAVFAC PAC, Code C144 30 days' notice of dates and times scheduled for tests which require the presence of the Contracting Officer. The Contracting Officer will coordinate with the using activity and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The Contractor must be responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The Contractor must provide labor, equipment, fuel, test load, and consumables required for the specified tests. The test load must be a cataloged product. Calibration of measuring devices and indicating devices must be certified. Refer to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, for requirements for a cataloged product. Perform the following field tests.

3.10.1 Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.10.1.1 Circuit Breakers - Low Voltage Insulated Case/Molded Case

a. Visual and Mechanical Inspection

(1) Compare nameplate data with specifications and approved shop drawings.

(2) Inspect circuit breaker for correct mounting.

(3) Operate circuit breaker to ensure smooth operation.

(4) Inspect case for cracks or other defects.

(5) Verify tightness of accessible bolted connections and cable connections by calibrated torque-wrench method. Thermo-graphic survey is not required.

(6) Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

(1) Perform contact-resistance tests.

(2) Perform insulation-resistance tests.

(3) Adjust breaker(s) for final settings in accordance with engine-generator set manufacturer's requirements.

3.10.1.2 Current Transformers

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary and secondary circuit.

(5) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermo-graphic survey is not required.

(6) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

(1) Perform insulation-resistance tests.

(2) Perform polarity tests.

(3) Perform ratio-verification tests.

3.10.1.3 Metering and Instrumentation

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved

shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

(2) Calibrate watt-hour meters according to manufacturer's published data.

(3) Verify all instrument multipliers.

(4) Electrically confirm that current transformer secondary circuits are intact.

3.10.1.4 Battery Systems

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermo-graphic survey is not required.

(4) Measure electrolyte specific gravity and temperature and visually check fill level.

(5) Verify adequacy of battery support racks, mounting, anchorage, and clearances.

b. Electrical Tests

(1) Set charger float and equalizing voltage levels.

(2) Verify all charger functions and alarms.

(3) Measure each cell voltage and total battery voltage with charger energized and in float mode of operation.

(4) Perform a capacity load test.

3.10.1.5 Engine-Generator Set

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Inspect for correct anchorage and grounding.

b. Electrical and Mechanical Tests

(1) Perform an insulation-resistance test on generator winding with respect to ground. Calculate polarization index.

(2) Perform phase rotation test to determine compatibility with load requirements.

3.10.1.6 Grounding System

a. Visual and Mechanical Inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method defined in IEEE 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. Take measurements in normally dry weather, not less than 48 hours after rainfall. Provide site diagram indicating location of test probes with associated distances, and provide a plot of resistance vs. distance.

3.10.2 Functional Acceptance Tests

The tests must be performed by the start-up engineer. Upon successful test completion, the start-up engineer must provide the Contracting Officer with a written test report within 15 calendar days showing the tests performed and the results of each test. The report must include the completed approved test data forms and certification from the start-up engineer that the test results fall within the manufacturer's recommended limits and meet the specified requirements performance. The report must be dated and signed by the start-up engineer, and submitted for approval by the Contracting Officer. The Contracting Officer and NAVFAC PAC, Code C144 will witness final acceptance tests. Testing must include, but not be limited to, the following:

a. Verify proper functioning of each engine protective shutdown device and pre-shutdown alarm device. Testing of the devices must be accomplished by simulating device actuation and observing proper alarm and engine shutdown operation.

b. Verify proper functioning of the engine over-speed trip device. Testing of the over-speed trip device must be accomplished by raising the speed of the engine-generator set until an over-speed trip is experienced.

c. Verify proper functioning of the crank cycle/terminate relay. Testing of the relay must be accomplished by engaging the starter motor with the engine being prevented from running. Observe the complete crank/rest cycle as described in the paragraph STARTING SYSTEM.

d. Verify proper functioning of the following automatic and manual operations. Testing must include, but not be limited to, the following:

(1) Loss of Utility: Initiate a normal power failure with connected test load of rated kW at 1.0 power factor. Record time delay on start, cranking time until engine starts and runs, time to come up to operating speed, voltage and frequency overshoot, and time to achieve steady state conditions with all switches transferred to emergency position.

(2) Return of Utility: Return normal power and record time delay on retransfer for each automatic transfer switch, and time delay on engine cool-down and shutdown.

(3) Manual starting.

(4) Emergency stop.

e. Operate the engine-generator set at rated current (amperes) until the jacket water temperature stabilizes. Stabilization will be considered to have occurred when three consecutive temperature readings remain unchanged. Continue to operate the generator set for an additional 2 hours. Record instrument readings for terminal voltage, line current, frequency (Hz), engine speed rpm, lubricating oil pressure, jacket water temperature, and ambient temperature at 5 minute intervals for first 15 minutes and at 15 minute intervals thereafter.

3.11 DEMONSTRATION

Upon completion of the work and at a time approved by the Contracting Officer, the Contractor must provide instructions by a qualified instructor to the Government personnel in the proper operation and maintenance of the equipment. 3 Government personnel must receive training comparable to the equipment manufacturer's factory training. The duration of instruction must be for not less than one 8 hour working day for instruction of operating personnel and not less than one 8 hour working day for instruction of maintenance personnel.

3.11.1 Instructor's Qualification Resume

Instructors must be regular employees of the engine-generator set manufacturer. The instruction personnel provided to satisfy the requirements above must be factory certified by the related equipment manufacturer to provide instruction services. Submit the name and qualification resume of instructor to the Contracting Officer for approval.

3.11.2 Training Plan

Submit training plan 30 calendar days prior to training sessions. Training plan must include scheduling, content, outline, and training material (handouts). Content must include, but not be limited to, the following:

3.11.2.1 Operating Personnel Training

This instruction includes operating the engine-generator set, auxiliary equipment including automatic transfer switches in all modes, and the use of all functions and features specified.

3.11.2.2 Maintenance Personnel Training

Training must include mechanical, hydraulic, electrical, and electronic

instructions for the engine-generator set and auxiliary equipment including automatic transfer switches.

a. Mechanical Training: Must include at least the following:

(1) A review of mechanical diagrams and drawings.

(2) Component location and functions.

(3) Troubleshooting procedures and techniques.

(4) Repair procedures.

(5) Assembly/disassembly procedures.

(6) Adjustments (how, when, and where).

(7) Preventive maintenance procedures.

(8) Review of flow diagram.

(9) Valve locations and function.

(10) Valve and hydraulic equipment adjustment and maintenance procedures.

(11) Hydraulic system maintenance and servicing.

(12) Lubrication points, type, and recommended procedures and frequency.

b. Electrical and Electronic Maintenance Training: Must include at least the following:

(1) A review of electrical and electronic systems including wiring diagrams and drawings.

(2) Troubleshooting procedures for the machine and control systems.

(3) Electrical and electronic equipment servicing and care.

(4) Use of diagnostics to locate the causes of malfunction.

(5) Procedures for adjustments (locating components, adjustments to be made, values to be measured, and equipment required for making adjustments).

(6) Maintenance and troubleshooting procedures for microprocessor or minicomputer where applicable.

(7) Circuit board repair procedures where applicable (with schematics provided).

(8) Use of diagnostic tapes.

(9) Recommended maintenance servicing and repair for motors, switches, relays, solenoids, and other auxiliary equipment and devices.

3.12 ONSITE TRAINING

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total 8 hours of normal working time and must start after the system is functionally completed but prior to final acceptance.

a. Submit a letter giving the date proposed for conducting the onsite training course, the agenda of instruction, a description of the digital video recording to be provided. The course instructions must cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as major elements of the operation and maintenance manuals. Additionally, the course instructions must demonstrate routine maintenance procedures as described in the operation and maintenance manuals.

b. Submit a digital video recording of the manufacturers operating and maintenance training course.

c. One full size reproducible Mylar ach drawing must accompany the booklets. Mylars must be rolled and placed in a heavy cardboard tube with threaded caps on each end. The manual must include step-by-step procedures for system startup, operation, and shutdown; drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems together with their controls, alarms, and safety systems; the manufacturer's name, model number, and a description of equipment in the system. The instructions must include procedures for interface and interaction with related systems to include automatic transfer switches. Each booklet must include a CD containing an ASCII file of the procedures.

d. Provide approved operation and maintenance manuals for the training course. Post approved instructions prior to the beginning date of the training course. Coordinate the training course schedule with the using service's work schedule, and submit for approval 14 days prior to beginning date of proposed beginning date of training.

3.13 INSTALLATION

Installation must conform to the applicable requirements of IEEE C2, NFPA 30, NFPA 37, and NFPA 70.

3.14 FINAL TESTING AND INSPECTION

a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Increase the load in steps no greater than the Maximum Step Load Increase to 100 percent of Service Load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

c. Remove load and shut down the engine-generator set after the recommended cool down period.

d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Verify any corrective action for effectiveness by running the engine for 8 hours at Service Load, then re-examine the oil and filter.

e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.

f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

g. Replace air, oil, and fuel filters with new filters.

3.15 MANUFACTURER'S FIELD SERVICE

The engine generator-set manufacturer must furnish a qualified representative to supervise the installation of the engine generator-set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.16 POSTED DATA AND INSTRUCTIONS

Post Data and Instructions prior to field acceptance testing of the engine generator set. Provide two sets of instructions/data, typed and framed under weatherproof laminated plastic, and post side-by-side where directed. Include a one-line diagram, wiring and control diagrams and a complete layout of the system in the first set. Include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions in the second set. Submit posted data including wiring and control diagrams showing the key mechanical and electrical control elements, and a complete layout of the entire system.

a. Include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches). Provide two sets of typed instructions/data in 8-1/2 x 11 inch format, laminated in weatherproof plastic, and placed in three-ring vinyl binders. Place the binders as directed by the Contracting Officer. Provide the instructions prior to acceptance of the engine generator set installation.

b. Include a one-line diagram, wiring and control diagrams and a complete layout of the system in the first set. Include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions in the second set. Include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches).

c. Submit instructions including: the manufacturers pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer

switches). Provide weatherproof instructions, laminated in plastic, and post where directed.

3.17 ACCEPTANCE

Submit drawings which accurately depict the as-built configuration of the installation, upon acceptance of the engine-generator set installation. Revise layout drawings to reflect the as-built conditions and submit them with the as-built drawings. Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and all defects in installation material or operation have been corrected.

-- End of Section --