

1	CONTROLS & INSTRUMENTATION SYSTEM FOR GAS TURBINE DRIVEN CENTRIFUGAL COMPRESSOR					
2	Hazardous Electrical Area Classification	NEC:	Class	Div.	Group	
3		ISO:	Zone	Gas Group		
4						
5	Legends:					
6	LM: Local Mounted:	☐ By Vendor	☐ Others	H : Vendor's Supply and purchaser's remote Mount		
7	LGB: Local Gage Board:	☒ By Vendor	☐ Others	M : Mount by Vendor of Purchaser's items		
8	LCP: Local Control Panel:	☒ By Vendor	☐ Others	AV : Audio Visual		
9	UCP: Unit Control Panel:	☒ By Vendor	☐ Others	C :Cut out for Purchaser's item by vendor		
10	MP : Main Panel	☐ By Vendor	☐ Others	J :Vendor's supply and Mount on local control station		
11	PLC: Programmable Logic Control:	☒ By Vendor	☐ Others	S :Switches vendor's supply and purchaser local mount.		
12	DCS: Distributed Control System:	☐ By Vendor	☐ Others	Vendor to provide A/V (audio/visual) annunciation in LCP		
13	CCR : Central Control Room	For alarms and trips				
14	SRR : Satellite Rack Room	VP : Vendor's Loose Supply and Purchaser's Mount				
15	V : Vendor Supply and Mount	P :Signal / Contacts to be provided by vendor at vendor's				
16		Battery limit (further connection by purchaser)				
17	☒ Scope option & information supplied by Purchaser					
18	☐ Information required from & options left to vendor to cross ☒ the selected option					
19	REMARKS : 1. Flow element & Transmitter , 2. Standby Pump Start					
20						
21						
22						
23	DESCRIPTION	Location				
24		Loose Supply	Locally Mtd.	LGB Mtd.	LCP Mtd.	CCR / UCP
25						
26	I. GENERAL					
27	☒ Start counter					V
28	☒ Fired Hours Run Meter					V
29	- No. Status Counter					V
30	- Start Sequence Timer					V
31	☒ Gas Detection Summary					V
32	☒ Fire Detection Summary					V
33	II INDICATION LAMPS (STATUS INDICATIONS)					
34	☒ AC Power On/Off					V
35	☒ DC Power On/Off					V
36	☒ Control Power On/Off				V	V
37	☒ UPS Power On				V	V
38	☒ Main Lube oil Pumps RUN/STOP (Shaft driven)				V	V
39	☒ Stand-by Lube oil Pumps RUN/STOP (AC Motor driven)				V	V
40	☒ Emergency Lube oil Pump RUN/STOP (D/C Motor driven)				V	V
41	☒ Space Heater On/Off				V	V
42	☒ Lube OIL Heater(if electrical type) On/Off				V	V
43	☒ Ready to Run Light (Plant Ready light)				V	V
44	☒ Preparation Start in progress					V
45	☒ LO Shift Sealing System established					V
46	☒ Loading valve open					V
47	☒ Preparation start complete				V	V
48	☒ Start in progress				V	V
49	☒ Enclosure purged ready to start					V
50	☒ Lube Oil system established				V	V
51	☒ Running indication all auxiliaries (Individual)					V
52	☒ All auxiliaries healthy					V
53	☒ Gas Generator start initiated / Unit running					V
54	☒ Started Motor on					V
55	☒ Gas Generator Purging					V
56	☒ Igniters on					V
57	☒ Fuel on				V	V
58	☒ Gas Generator Lit					V
59	☒ Starter Motor Disengaged					
60	☒ Power turbine running				V	V

61 62 63	DESCRIPTION	Location					
		Loose Supply	Locally Mtd.	LGB Mtd.	LCP Mtd.	CCR / UCP	PLC / DCS
64	■ Gas Generator above idling				V	V	
65	■ Ready to load					V	
66	■ Suction pressure control activated					V	
67	■ Shutdown in progress					V	
68	■ Blow down valve open					V	
69	■ By pass valve open					V	
70	■ GG Decelerating to idling					V	
71	■ Gas Generator Run Down Start Inhibited					V	
72	■ Ventilated shutdown				V	V	
73	■ Alarm system fault					V	
74	■ Valve open / closed indicated for - Shutdown valve on fuel gas supplier - Blow down valve					V	
75	■ Dry crank in progress					V	
76	III. SELECTOR SWITCHES FOR A/M OPERATIONS						
77	■ Master selector switch Compressor control panel/Remote/Crank/Off					V	
78	■ Compressor control panel/DCS Control mode selector switch					V	
79	■ Selector Switch Auto/Remote Manual/Local Manual for the following: - Main L.O. Pump - Standby L.O. Pump - Emergency L.O. Pump (D.C. pump) - Control oil/Hydraulic oil pumps (as applicable) - Ventilation Fan					V	
80	■ Auto/Manual Selector switch for selection of main and standby pump for each auxiliary					V	
81	■ Local/Remote Selector switch for each auxiliary system					V	
82	IV. PUSH BUTTONS						
83	■ Start/Stop Push Button For Standby LO Pump (A/C Motor Driven)				V		
84	■ Start/Stop Push Button Emergency Lube oil Pump (D/C Motor Driven)				V		
85	■ Lamp Test Push Button				V	V	
86	■ Alarm/Trip Acknowledge /Reset Push Button				V	V	
87	■ Start/Stop Lube Oil Heater (if electrical type) Push Button				V		
88	■ Dry Crank Start/Gas Generator Liquid Wash				V	V	
89	■ Manual Gas Generator Start				V		
90	■ Shelter Fan Start / Stop				V	V	
91	■ Preparation start				V	V	
92	■ Auto Sequential Start				V	V	
93	■ Normal shutdown				V	V	
94	■ Ventilated shutdown				V	V	
95	■ Emergency shutdown				V	V	
96	■ All auxiliaries Start / Stop				V		
97	V AMMETERS						
98	■ Ammeters for all auxiliary drive motors(rating >=5.5 kW)	V					
99							

CONTROLS AND INSTRUMENTATION														
DESCRIPTION	Indication					A/V Annun. & Pre-Alarm					Trip & A/V Alarm Annun.			
	Gauge- L M / Local	Gauge- LGB	Indicator -LCP	Indicator - CCR / UCP	Repeat Signal to PLC / DCS / MP	Low - LCP	Low - CCR/UCP	High - LCP	High - CCR/UCP	Repeat Signal to PLC / DCS / MP	Low Low - LCP	Low Low - UCP / CCR	High High - LCP	High High- UCP / CCR
100 1.0 COMPRESSOR														
101 1.1 PROCESS GAS														
102 ■Compressor Suction Pressure	VP		V	P							V	P		
103 ■Compressor Discharge Pressure	VP		V	P										
104 ■Compressor Suction Temperature	VP		V	P									V	P
105 ■Compressor Discharge Temperature	VP		V										V	P
106 ■PressureBalance line(s) / chamber(s) of compressor	V			P					P					
107 ■Differential pressure across inlet strainer (each)	VP		V	P										
108 ■Compressor balance line-Differential pressure	V			P										
109 □Compressor Suction Flow – First (section)														
110 ■Compressor Suction Flow – Second (section)	VP ¹		V	P										
111 ■Compressor Discharge Flow – First (section)	VP ¹		V	P										
112 ■Compressor Spillback Line Flow –each section	VP ¹		V	P										
113 ■Compressor Spillback Line pressure –each section	VP		V	P		V	P							
114														
115														
116 1.2 VIBRATION AND AXIAL DISPLACEMENT & BEARING TEMPERATURE MONITORING SYSTEM														
117 ■Radial shaft vibration (at each bearing) (Note-5)			V					V	P				V	P
118 ■Axial displacement (Note-6)			V					V	P				V	P
119 ■Key phasor (for each speed change)	V													
120 ■Journal bearing metal temp. (Each bearing) (Note-7,8)			V					V	P				V	P
121 ■Thrust bearing metal temp. (Each bearing) (Note-7,8)			V					V	P				V	P
122 ■Display unit (For vibration , axial displacement , key phasor , bearing temperature and other diagnostics alarms and trips)														
123 ■Connectivity to purchaser's DCS/PLC for all repeat indications														
124														
125														
126 1.3 SHAFT SEALING SYSTEM (DRY GAS SEAL)														
127 ■Primary seal gas Supply Pressure (each seal)		V	V	P				P			V	P		
128 ■Primary seal gas Delivery Pressure (each seal)		V	V	P										
129 ■Secondary seal gas Supply Pressure (each seal)		V	V	P				P			V	P		
130 ■Secondary seal gas Delivery Pressure (each seal)		V	V	P										
131 ■Separation gas Supply Pressure (each seal)		V	V	P				p			V	P		
132 ■Separation delivery Pressure (each seal)		V	V	P										
133 ■Seal Gas filters Differential Pressure		V	V	P				V	P					
134 ■Seal and operating gas differential pressure (each seal)		V	V	P			P							
135 ■Separation Gas and Secondary Vent Differential Pressure (each seal)		V	V	P			P							
136 ■Primary seal vent		V												
137 ■Secondary seal vent		V												
138 ■Primary Seal Gas Vent flow / Pressure (each seal)	V			P		V	P	V	P				V	P
139 ■Secondary seal gas flow (inlet)	V			P				V	P					
140														
141														
142 1.4 ANTI SURGE CONTROLLER (ASC)														
143 ■Compressor Anti surge controller, If Offered (located in SRR , with LCD in CCR)				VP										
144 ■Anti Surge, HIC with position indicator If Offered			V	VP										
145 □Differential Pressure across compressor inlet and outlet – Each stage (section) In Case of ASC)														
146 ■All instruments associated with ASC	V													
147 ■Anti Surge Control valve	V													
148 □Emergency Surge Detector (ESD)														
149														
150														

CONTROLS AND INSTRUMENTATION															
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151 1.5 PERFORMANCE CONTROLLER															
152 ☐ Compressor suction pressure (PIC)															
153															
154															
155 2. GEAR UNIT															
156 2.1 VIBRATION AND AXIAL DISPLACEMENT & BEARING TEMPERATURE MONITORING SYSTEM															
157 ☒ Radial shaft vibration (at each bearing) (Note-5)			V					V	P				V	P	
158 ☒ Axial displacement (Note-6)			V					V	P				V	P	
159 ☒ Key phasor (for each speed change)	V														
160 ☒ Journal bearing metal temp. (Each bearing) (Note-7,8)			V					V	P				V	P	
161 ☒ Thrust bearing metal temp. (Each bearing) (Note-7,8)			V					V	P				V	P	
162 ☒ Accelerometer for Casing vibration (X & Y)			V					V	P				V	P	
163 ☒ Display unit (For vibration , axial displacement , key phasor, bearing temperature and other diagnostics alarms and trips)															
164 ☒ Connectivity to purchaser's DCS/PLC for all repeat indications															
165															
166															
167 3.0 GAS TURBINE															
168 3.1 COMBUSTION AIR INLET SYSTEM															
169 ☒ Inlet Air Filter differential pressure	V			V				V					V		
170															
171															
172 3.2 TURBINE ENCLOSURE VENTILATION SYSTEM															
173 ☒ Enclosure Temperature (GG & PT)				V				V						V	
174 ☒ Ventilation system filter Pressure Drop				V				V							
175 ☒ Enclosure Purging differential pressure (GG & PT)			V			V	P			V	P				
176 ☒ Enclosure Door unlocked Indicator			V	V		V									
177															
178															
179 3.3 TURBINE START SYSYTEM															
180 ☒ Fail to Crank												V			
181 ☒ Starting Sequence Incomplete							V					V			
182 ☒ Auxiliary Sequence failure												V			
183															
184															
185 3.4 GAS FUEL SYSTEM															
186 ☒ Fuel Supply Temperature (Battery Limit)															
187 ☒ Fuel Supply Pressure (Battery Limit)															
188 ☒ Fuel supply pressure (downstream of conditioning skid)	V					V				V	P				
189 ☒ Fuel supply pressure (downstream of pressure regulator)	V					V				V	P				
190 ☒ Fuel gas filter differential pressure	V							V	P				V	P	
191 ☒ Fuel governing valve position feed back															
192 ☒ Fuel System Malfunction							V					V			
193 ☒ Fuel Gas Flow indication Note-2				V											
194 ☒ Fail to Ignite												V			
195 ☒ Flame out												V			
196															
197															
198 3.5 GAS GENERATOR															
199 ☒ Air Compressor Inlet Air Temperature				V											
200 ☒ Air Compressor discharge Air Temperature				V				V							
201 ☒ Turbine firing temperature (Inlet to GG)															
202 ☒ GG compressor Discharge Pressure				V											
203 ☒ Speed Indicator			V	V					V					V	
204 ☒ GG under speed												V			

CONTROLS AND INSTRUMENTATION															
DESCRIPTION	Indication					A/V Annun. & Pre-Alarm				Trip & A/V Alarm Annun.					
	Gauge- L M / Local	Gauge- LGB	Indicator -LCP	Indicator – CCR / UCP	Repeat Signal to PLC / DCS / MP	Low - LCP	Low – CCR/UCP	High - LCP	High – CCR/UCP	Repeat Signal to PLC / DCS / MP	Low Low - LCP	Low Low – UCP / CCR	High High - LCP	High High- UCP / CCR	Repeat Signal to PLC / DCS / MP
205	3.6 POWER TURBINE														
206	■PT/Inlet temp. / GG Exhaust Temp.														
207	■PT Locked Rotor (Under Speed)														
208	■Speed														
209	■Speed Raise / Lower Control (Governor control)														
210	■Turbine exhaust temperature (Mean of 8 points minimum)														
211	■Turbine exhaust pressure														
212	■Failure Exhaust over-temperature S/D Device (Open Thermocouple Condition)														
213	■Running at Peak Load														
214															
215															
216	NOTE : 1 – Differential temperature protection														
217	NOTE : 2 – Pressure and temperature compensated														
218	NOTE –3 : Only if waste heat recovery unit is provided														
219															
220															
221	3.7 VIBRATION AND AXIAL DISPLACEMENT & BEARING TEMPERATURE MONITORING SYSTEM														
222	■Radial shaft vibration (at each bearing) (Note-5)														
223	■Key phasor (for each speed change) (Note-6)														
224	■Journal bearing metal temp. (Each bearing) (Note-7,8)														
225	■Thrust bearing metal temp. (Each bearing) (Note-7,8)														
226	■Display unit (For vibration , axial displacement , key phasor , bearing temperature and other diagnostics alarms and trips)														
227	■Connectivity to purchaser's DCS/PLC for all repeat indications														
228	■Accelerometer for Casing vibration (X & Y)														
229															
230															
231	3.8 FIRE & GAS EXTINGUISHING SYSTEM														
232	■CO 2 released														
233	■CO2 leaked off														
234															
235															
236	4. LUBE OIL SYSTEM (Common for Compressor/Gear unit and Gas Turbine)														
237	■Lube oil reservoir-Oil temp.														
238	■Lube Oil Reservoir-Oil level														
239	■Lube oil Reservoir purge (N2) flow														
240	■Main Lube Oil pump suction pressure														
241	■Main Lube Oil pump discharge pressue														
242	■Standby Lube Oil pump suction pressure														
243	■Standby Lube Oil pump discharge pressue														
244	■Standby Lube oil pump –Start/Running														
245	■Emergency Lube Oil pump suction pressure														
246	■Emergency Lube Oil pump discharge pressure														
247	■LO Cooler - Cooling Water Pressure at inlet														
248	■LO Cooler - Cooling Water Pressure at outlet														
249	■LO Cooler Cooling Water Temperature at inlet														
250	■LO Cooler Cooling Water Temperature at outlet														
251	■LO Cooler - Oil Temperature at inlet														
252	■LO Cooler- Oil Temperature at outlet														
253	■Lube oil cooler differential pressure														
254	■Lube oil teperature after TIC														
255	■Lube oil filters differential pressure (DP Indicator)														

	CONTROLS AND INSTRUMENTATION															
	DESCRIPTION	Indication					A/V Annun. & Pre-Alarm				Trip & A/V Alarm Annun.					
		Gauge- L M / Local	Gauge- LGB	Indicator -LCP	Indicator – CCR / UCP	Repeat Signal to PLC / DCS / MP	Low - LCP	Low – CCR/UCP	High - LCP	High – CCR/UCP	Repeat Signal to PLC / DCS / MP	Low Low - LCP	Low Low – UCP / CCR	High High - LCP	High High- UCP / CCR	Repeat Signal to PLC / DCS / MP
	256	■Lube Oil header pressure (each level) (Independent for lube oil to compressor and turbine bearings respectively)	V		V	P										
	257	■Accumulator (lube & control oil) pre-charge gas pressure	V			P				P						
	258	■Lube oil supply Pressure in each line from header			V	P		V				V	P			
	259	■Lube Oil Temp.at the outlet of each Journal bearing of GTC package	V							V	P			V	P	
	260	■Sight flow indicator - drains lines from each Journal bearing of compressor	V		V	P				P						
	261	■Sight flow indicator - drains lines from each Journal bearing of gear unit	V		V	P				P						
	262	■Sight flow indicator - drains lines from each Journal bearing of electric motor	V													
	263	■Lube Oil Temp.at the outlet of each Thrust bearing of GTC package	V							V	P			V	P	
	264	■Sight flow indicator - drains lines from each Thrust bearing of compressor	V		V	P				P						
	265	■Sight flow indicator - drains lines from each Thrust bearing of gear unit	V		V	P				P						
	266	■Lube Oil rundown tank-Oil level			V	P		V	P							
	267	■Sight flow indicator-Lube oil rundown tank outlet	V			P		P		P						
	268	■Sight flow indicator -Lube Oil circulation lines between filters, coolers to Tank	V													
	269															
	270															
	271	5. MISCELLANEOUS														
	272	■Unit shutdown		V												
	273	■All permissive start switches (connected starting interlock)				P										
	274	■Common pre-alarm of all the machine alarms			V	P										
	275	■Common pre-alarm of all the process alarms			V	P										
	276	■Common trip alarm for all machine trips			V	P										
	277	■Common trip alarm for all process trips			V	P										

Electric Supply:

Lamps	:	☐	V;	AC/DC;	☐	☐	Hz.
Alarm Circuit	:	☐	V;	AC/DC;	☐	☐	Hz.
Trip Circuit	:	☐	V;	AC/DC;	☐	☐	Hz.
Control Circuit	:	☐	V;	AC/DC;	☐	☐	Hz.
Solenoid Valves	:	☐	V;	AC/DC;	☐	☐	Hz.

Notes

- (1). Pre-Alarms to proceed Trips.
- (2). Instruments to be connected to junction boxes on skid and consoles.
- (3). All Tubings, pipings, wiring between instruments and junction boxes, local gauge boards and local panels to be supplied by vendor.
- (4). Instrumentation, Controls & Annunciation indicated are minimum required. Vendor shall add any additional instruments, which in his view may be required to ensure safe & reliable operation of the machines or additionally required as per API 617/616 and other documents/standards referred in the inquiry document.
- (5). Journal (Radial) bearings: Two numbers radial vibration probes (non-contacting proximity) per radial bearing.
- (6). Thrust bearings: Two numbers axial vibration probes (non-contacting proximity) per thrust bearing (active/inactive side).
- (7). Journal (Radial) bearings:
 - For tilting pad bearings, each bearing shall have RTD's in no less than 50% of the shoes.
 - For sleeve bearings, each bearing shall have two (2) RTD's located at two locations.
- (8). Thrust bearing:
 - For tilting pad bearings, each bearing shall have RTD's in no less than 50% of active side & 2 in the active side.
- (9).
- (10). Vendor shall also refer to P&ID's enclosed and any additional instruments required as per P&ID's shall be included by vendor in his scope of supply.
- (11). All switching devices (hardware/software) for prealarms, trips, trip alarm, and interlocking shall be in the vendor's scope.
- (12). Separate ASC system shall be provided for each compressor stage/section as per the purchaser's specification and P & ID attached elsewhere.
- (13). Any additional instruments, indications, control valves, relief valves, alarm and trip switches etc. required for dry gas seal system shall also be included in the vendor's scope of supply and shall be added to the above listing by vendor during detailing and the same shall be subject to approval of the Purchaser/Owner.
- (14). For further details, instrumentation specifications may please be referred.

25.03.2019	A	AS	NK
DATE	REV	JOB ENGINEER	REVIEWED & APPROVED BY