

GENERAL SPECIFICATION

ELECTRICAL

GS EP ELE 251

Closed Cycle Vapour Turbogenerator (CCVT)
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1. Scope

This specification covers the minimum requirements for the design, manufacture, inspection, and testing, certification, preparation for transport and installation on offshore platform in hazardous area of "Closed Cycle Vapour Turbo generator" (CCVT) for continuous power supply of electrical loads.

This document treats only fuel gas CCVT systems installed in hazardous areas (Zone 2).

When CCVT is located outside hazardous areas, it shall be in accordance with the particular project specification.

Related power generation generally consists of one, two or three CCVT's.

Any substitution or deviation from this specification shall be highlighted by Manufacturer, who shall notify the Company in writing. Manufacturer shall not proceed with any substitution or deviation prior to receiving the Company written approval. Manufacturer shall confirm that proposed substitution or deviation do not entail the current certification.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
94/9/EC (ATEX 100a / ATEX 95)	European Directive 94/9/EC on the approximation of the laws of the members states concerning equipment and protective systems intended for use in potentially explosive atmosphere
Motive Fluid Cycle / Vacuum Enclosure Materials	
ASTM A 240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A 249	Standard Specification for Welded Austenitic Steel Boiler, Heat-Exchanger, and Condenser Tubes
ASTM A 269	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 312	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
Welding Q.C	
ASME Section V	Radiography
ASME B 31.3 - K 341.3.2	Acceptance criteria

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Reference	Title
Electrical Boxes / Cabinets	
EN 60079 (Parts 0; 1, 7, 15)	Electrical apparatus for potentially explosive atmospheres - Parts 0; 1; 7; 15
IEC 60079	Electrical apparatus for explosive gas atmospheres
IEC 60146	Semiconductor converters
IEC 60228	Conductors of Insulated Cables
IEC 60255	Relays
IEC 60269	Low voltage fuses
IEC 60332-2-1	Tests on electric and optical fibre cables under fire conditions - Part 2-1: Test for vertical flame propagation for a single small insulated wire or cable Apparatus
IEC 60335-2-29	Safety of household and similar electrical appliances, battery chargers
IEC 60529	Degrees of protection of enclosures
IEC 60622	Sealed nickel-cadmium rechargeable cells
IEC 60947	Low voltage switch-gear and control-gear
IEC 62262	Degree of protection against mechanical impacts - IK code
IEC 62402	Obsolescence management - Application guide
Shelter Materials	
UL 94 - V0	Fibre glass
Alternator	
IEC 60034-1	Rotating electrical machinery
Fire & Gas detection and protection	
NFPA 12	Design & installation (protection)
NFPA 72	Design & installation (detection)
Gas Safety Components	
ANSI Z-21	Components

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Total General Specifications

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Reference	Title
Not applicable	

3. Environmental conditions

CCVT shall be designed for installation in area in accordance with the environmental conditions Project Particular specification.

For information purpose, the drawings shown in the appendix are typical for equipment to be installed with following environmental conditions:

- 5 to 40°C
- Wind maximum velocity: 144 km/h sustained, 160 km/h gusts.

4. Electrical characteristics

4.1 Output parameters (at service conditions)

CCVT Model	Max Output Power (W)
10AG	800
12AG	1200
20AG	2000
30AG	3000
40AG	4000

Output voltage shall be preferably 48 VDC and optionally 24 VDC or 125 VDC.

All auxiliaries shall be fed by the same voltage as defined above. Auxiliaries requiring different voltage will be converted internally.

4.2 Functional requirements

Several CCVT shall be able to operate in parallel and share equally the total load. In case of one CCVT failure, the remaining unit(s) shall automatically supply the full station load. Load-shedding operation might have to be considered by Company. CCVT rectifier system shall prevent reverse flow of power to the alternator during any parallel operation.

In the event of a complete failure or shutdown, CCVT shall be restarted in local & manual mode, auxiliaries shall be fed by platform battery back-up system.

Typical single line diagram is shown in Appendix 8.

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4.3 Voltage Quality and Current Rating

Electrical power provided at the CCVT output terminals shall comply with the following requirements.

- 4.3.1 At steady state, maximum operating tolerances shall be $\pm 3.5\%$ of voltage setting.
- 4.3.2 Adjustable voltage limits shall be provided. Accuracy of the limits shall be $\pm 5\%$ from the voltage limit set points.
- 4.3.3 Maximum DC ripple voltage shall be 200 mV peak-to-peak.
- 4.3.4 Electrical output of CCVT shall be connected to a two (2) wire DC unearthed system.

4.4 Safety requirements

Earthing and bonding to the platform of all CCVT metallic parts shall be ensured.

CCVT shall be provided with surge arrestors to protect electronic components against lightning spikes.

5. CCVT description

5.1 General

5.1.1 The CCVT shall comprise the following equipment

- a. Vapour generator
- b. Turbo alternator
- c. Condenser
- d. Lubrication system
- e. Combustion system
- f. Flue
- g. Frame and shelter
- h. Electrical control panel
- i. Gas detection system
- j. Fresh air supply system
- k. Fire detection and protection systems.

5.1.2 CCVT operation

CCVT shall operate on the principle of the Rankine Cycle, with the working fluid operating in a closed cycle between the vapour generator, turbo alternator and condenser:

- Organic fluid is vaporised in the vapour generator by heat provided by the gas burner and vapours expand in the turbine to drive an alternator.
- Exhaust vapours from turbine flow into an air cooled condenser, where they are condensed and returned to the vapour generator.

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- The alternator, which has a common shaft with the turbine, produces an electric voltage proportional to the speed of the turbine, with the power output proportional to amount of heat provided by the burner.
- The control system rectifies, filters and conditions the output power to the required level, and provides system status and control data.
- CCVT rated output is based on fuel supply with the following characteristics:
Dry natural gas with at least 80% of methane and max. 4 ppm of H₂S at a pressure of 1 - 1.5 bar.
With other gas compositions, Manufacturer shall specify actual output power as well as other impacts.
- The CCVT shall be suitable for a complete unattended operation after manual start-up.
- CCVT shall be suitable for recharging platform batteries and simultaneously supplying power to the loads up to generators capability provided. Manufacturer and Company to agree upon system calculation.
- CCVT shall be designed to operate with minimal maintenance.
- CCVT shall not sustain any damage due to open circuits or short circuit conditions across the CCVT control or power terminals.
- Air purging to guarantee dilution of accumulated hydrocarbon to below L.F.L (Lower Flammability Limit) in CCVT enclosure shall be carried out each time before re-starting.

5.2 Vapour generator

Vapour generator shall be located inside the CCVT enclosure and shall be constructed from stainless steel 316 L. Vapour generator will be thermally insulated to reduce heat losses.

5.3 Turbo alternator

- 5.3.1 Complete turbo alternator assembly shall be mounted in a stainless steel enclosure. Cable connections to the stator shall be made through the insulating bushings in the enclosure. Bushings shall maintain a hermetic seal.
- 5.3.2 Alternator winding insulation shall be class H as per [IEC 60034-1](#) standard.
- 5.3.3 Organic fluid shall be used to provide lubrication to the turbo-alternator bearings (hydrostatic/hydrodynamic type).

5.4 Condenser

- 5.4.1 Condenser shall be air cooled by natural convection and if necessary, by means of a fan driven by Ex"d" induction motor equipped with thermistors.
- 5.4.2 Condenser tubes and cooling fins shall be constructed from the following materials:
 - Tubes: Stainless Steel, Grade 316 L
 - Fins: Aluminium
- 5.4.3 Condenser shall be provided with a vacuum test valve.

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5.5 Lubrication system

Lubrication system shall consist of tubes and reservoirs that shall transfer the fluid from the condenser outlet to lubricate the bearings of the turbo alternator.

5.6 Combustion system

Combustion system shall consist of:

- 5.6.1 A Venturi type atmospheric burner complete with pilot burner and an automatic re-ignition system. Manual ignition shall be ensured by a piezo-electric system.
- 5.6.2 A gas control panel (including valves, filters, etc.) shall control the gas flow to the main and pilot burners.
- 5.6.3 CCVT shelter shall be suitably designed to ensure burner operation under windy site conditions.
- 5.6.4 Burner shall be installed under the vapour generator. Burner shall be seen as a naked flame.
- 5.6.5 CCVT gas supply line shall be equipped with the following:
 - 1 safety gas flow control solenoid valve to isolate the CCVT in case of emergency shutdown (by remote signal from ESD platform)
 - 1 PCV to set inlet pressure to CCVT operating pressure. Manufacturer shall advise for impact of other pressure than mentioned in § 5.1.2.

5.7 Flue

- 5.7.1 In accordance with current certificate (refer to part 6), the flue shall be of an adequate size to carry combustion products without imposing excessive back pressure on the combustion chamber.
- 5.7.2 Flue shall have the following features:
 - a. Damper (draft regulator and automatic isolation in case of fire detection).
 - b. Rain cowl suitable for satisfactory operation under windy and rainy site conditions.
 - c. Discharge above the condenser.
 - d. Thermal insulation on exposed lengths of flue to allow control of chimney draft under variable wind speeds and directions and of chimney temperature.
 - e. A condensation drain opening at the bottom of the external elbow.
- 5.7.3 Flue shall enter through the shelter interior.
- 5.7.4 All metallic components of the flue assembly, including sheathing, shall be constructed from stainless steel 316, to prevent corrosion.
- 5.7.5 Exhaust outlet shall be placed at least 2 m outside from the border of hazardous area Zone 2 and 9 m from the border of any hazardous area Zone 1 or 0. Manufacturer shall advise impact of design different than as shown in Appendix 2.

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5.7.6 Engineering for layout and installation of exhaust pipe shall be submitted to Manufacturer for approval.

5.8 Frame and Shelter

- 5.8.1 CCVT unit shall be mounted within a metal frame assembly with the vapour generator mounted within the CCVT shelter. Condenser with fluid reservoir and the turbo-generator shall be placed over the shelter on top.
- 5.8.2 All working fluid piping and reservoirs shall be made of 316L stainless steel.
- 5.8.3 CCVT shelter shall have all entries sealed (except for air supply) to prevent burner flame from extinguishing due to gusts of wind, and to ensure that CO₂ concentration can be maintained for twenty minutes after CO₂ discharge for fire extinguishing.
- 5.8.4 CCVT air supply system shall be able to provide one hundred complete air changes in shelter per hour. Design shall ensure adequate mixing and dilution and avoidance of stagnant areas. System shall remain in operation following shutdown to ensure adequate cooling and dilution of gas leaks. The air intake must be at least two meters away from the border of any hazardous area limit.
- 5.8.5 The complete assembly shall be capable of withstanding the environmental conditions. In addition, the shelter shall be equipped with dampers on air ducting at appropriate locations in order to seal the enclosure before filling it with CO₂ for fire extinguishing.
- 5.8.6 CCVT frame shall be hot dipped galvanised and painted according to Manufacturer painting specification 24.3.7.097. Vendor supplied components shall be supplied as painted by the Vendor. The Shelter painting shall be conductive painting (electrostatic free).
- 5.8.7 Index of protection of the electrical boxes outside the CCVT shelter shall be at least IP55 as per [IEC 60529](#) and IK08 as per [IEC 62262](#).
- 5.8.8 Shelter door shall be provided with a lock and key. Sign shall be provided in appropriate language (English and local language, if different) prohibiting access without permit.

5.9 Electrical Control Panel

Construction of each CCVT control panel shall comply with the following:

- 5.9.1 Control panel shall be wall mounted in the shelter.
- 5.9.2 Equipment shall be arranged to permit easy removal of all components without interference to the panel structure, other parts or cabling.
- 5.9.3 All the components shall be housed in the control panel including a control section and a power section. The power section contains transformers, heat sinks and protection devices, and the control section contains all electronic circuits for measurement and control of the operation of the CCVT system.
- 5.9.4 Degree of protection for the electronics enclosures shall be IP43 minimum and IK08.
- 5.9.5 Suitably fixed earth bar (made of tinned copper) or terminal shall be provided within the control panel.
- 5.9.6 Tropicalised treatment is required for all electrical equipment.

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- 5.9.7 CCVT control system shall be based on a Digital Turbine Control Unit (DTCU). The DTCU will monitor and control the operation of the CCVT in all conditions. The DTCU will automatically perform control sequences of start-up, normal shutdown and shutdown in failure conditions.
- 5.9.8 Any Emergency Shut-Down (ESD) system shall be completely hard wired and fail safe.
- 5.9.9 DTCU contains the Human Machine Interface (HMI) operating push buttons and digital display on which operating parameters can be read.
- 5.9.10 DTCU shall have a communication serial link for communication and data transmission.
- 5.9.11 DTCU shall monitor and store various CCVT operating parameters and conditions. As a minimum the following parameters/conditions shall be accessible (by manual selection) in the CCVT control panel and via the numerical communication link

- CCVT DC output voltage
- CCVT DC output current
- CCVT DC control voltage
- Alternator frequency
- Condenser temperature
- Vapour generator temperature
- CCVT failure condition and type of failure.

DTCU and control shall provide the following remote discrete signals via SPDT (Single Pole Double Throw) volt free contacts:

- CCVT ON
- CCVT general failure
- Remote/Emergency stop (SPDT by others)
- Flame out

- 5.9.12 CCVT system shall include a gas supply shut-off valve controlled by the DTCU. It will be triggered by any abnormal operating conditions to shut off the gas supply. Manual re-start of the CCVT shall be required.

5.10 Battery Voltage Regulation

Each CCVT control panel shall enable a variable voltage, with limitations.

This will be to control the voltage under particular load conditions, especially during re-charge of battery bank.

CCVT voltage regulation shall allow the two following modes of operation:

5.10.1 "Charge" mode

"Charge" mode shall be initiated upon restoration of CCVT power after an outage.

CCVT rating shall be suitable for re-charging platform battery from "discharged".

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CCVT shall be capable of limiting the output current at its rated value and of limiting the battery charging current to the safe value corresponding to the mode of operation and the battery Manufacturer's requirements to prevent the battery from being overcharged.

5.10.2 "Float" mode

In this mode, CCVT shall supply the DC load and maintain the battery charged.

The float mode shall be initiated automatically.

CCVT voltage regulation shall be provided by the DTCU and shall include the following:

- Charge regulation: float charge achieved by controlling burner ON/OFF operation, system monitoring DC bus (both the CCVT and the battery)
- Voltage-free, change-over contact for remote malfunction alarm (high/low battery voltage).

Company shall provide battery characteristics to Manufacturer.

Manufacturer shall verify CCVT suitability with the two modes of operation described here above.

5.11 Electrical Wiring

All power wiring, shall be carried out by 1000 V insulated cables of appropriate sizes. Minimum section for power cables shall be 2.5 mm². Cables shall be of flame retardant type ([IEC 60332-2-1](#)).

All internal control wiring shall be carried out with flexible copper conductors.

Cabling external to the CCVT shall be supplied by others. All power cables external to the CCVT control panel should be of flexible copper conductor (class 2 as per [IEC 60228](#)).

Connection shall be done using cable glands made of marine bronze and fit for the selected type of cables. Non-metallic cable glands are completely forbidden. Alternatively Stainless steel cable glands or nickel plated brass can be used.

Cable penetrations into shelter shall be through cable glands.

In case of cable entry from the shelter into junction boxes that are mounted on the external shelter walls, the gland shall be located directly at the junction box penetration.

5.12 Protections

5.12.1 CCVT Gas detection system

- In case of gas detection in CCVT enclosure before start-up, the control system shall not be energised and burner ignition shall not be permitted.
- In case of gas detection in CCVT enclosure during normal operation, burner shall be turned off, CCVT shall be shutdown and inlet air fans shall be kept in operation for not less than ten minutes. A signal shall be sent to the process control system.
- Pilot burner re-ignition system (refer to CCVT - O & M manuals) shall be disabled as well upon gas detection or ESD trip signal.

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- One detector shall be provided and installed by Manufacturer inside the CCVT enclosure, in accordance with certification.
- Three other detectors shall be provided and installed by Contractor in the entry of the additional clean air ducting (see § 7.2).

5.12.2 Over-voltage

CCVT over-voltage protection ensures operation within the designed voltage range. In case of voltage increase above a pre-set level, the controller will adjust the output voltage to the proper level.

Should the voltage still increase and reach a second higher output limit for a time period of 10 sec., the controller shall initiate a CCVT over-voltage failure shutdown. Then, manual reset and CCVT re-start shall be required.

5.12.3 Under-voltage

Under-voltage protection system shall initiate a CCVT shutdown and remote alarm when the CCVT output voltage decreases below a pre-set value. Then, manual reset and CCVT re-start shall be required.

5.12.4 Short circuit

CCVT shall be protected against short circuit at output terminals. To clear this failure, a manual reset shall be required.

5.12.5 Vapour generator high temperature

Controller monitors the vapour generator temperature via a PT 100 probe which is placed in a deep well located at the vapour generator front panel. A thermal-switch is also installed on the vapour generator and set to open its contact at a pre-set level of high temperature thus sending a digital signal the controller.

If vapour generator temperature increases above the pre-set level, the controller initiates high vapour generator temperature shutdown. Manual CCVT restart will be required.

5.12.6 Condenser high temperature

Controller monitors condenser temperature via a PT 100 probe. Should this temperature rise above a pre-set value, the condenser fan motor shall be switched on.

5.12.7 Over-speed protection

For CCVT models over 1200 W, controllers shall protect the turbine against over-speed.

Controller shall also ensure over-speed protection, when a control hardware failure occurs. In such case, an additional separate analog circuit shall activate all dummy loads at the same time.

5.12.8 Pressure Relief Valve

A Pressure Relief Valve shall be installed on the fuel gas piping downstream the PCV (Refer to Appendix 4) as per Company design standard, to protect the piping against overpressure in

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case of PCV fault. Alternatively, this PRV can be removed if the piping/tubing downstream the PCV is designed for the same pressure than the upstream side of PCV.

5.13 Fire Detection and protection systems

A fixed CO₂ total flooding system shall be installed to protect CCVT against fire.

5.13.1 Technical requirements

5.13.1.1 System description

System shall include skid mounted high pressure CO₂ cylinders with quick release valves manifold together for simultaneous discharge (in case multiple cylinders are required for normal discharge) and associated distribution pipe work and discharge nozzles. The quantity of CO₂ provided shall be sufficient for one discharge, in addition to a CO₂ reserve equal to 100% of the initial load. A main/reserve selector switch shall be provided. The cylinders shall be easily interchangeable for maintainability and refilling operation.

When one or several bottles are required for one discharge, the releasing facilities shall be provided with one main pilot valve, connected by a pilot line, to each individual pilot valve on the associated cylinders. The main pilot valve shall be provided with a mechanical manual releasing facility. Each cylinder shall be connected to the manifold by a flexible hose. Each cylinder connection shall be provided with a non-return valve. A pressure switch with dry contact shall be provided on the manifold to indicate CO₂ release.

CO₂ master cylinder valve design shall allow the solenoid or pilot valve to be tested without releasing the extinguishing agent.

A manual isolation valve shall be provided in order to ensure positive isolation of the release system.

The system shall be of total flooding type, sized for the risk and based on net volume with minimum concentration as given in [NFPA 12](#). Discharge time shall be 60 seconds or less for achieving extinguishing concentration.

A dry contact shall indicate CO₂ release, which in turn shall drive associated alarms and signals.

Each bottle shall be fitted with a mechanical weighting device.

The skid and its components parts shall be able to withstand and operate in the more extreme temperatures 0-50°C without detrimental effect.

The specified CO₂ concentration is to be maintained for 20 minutes.

CCVT shall be supplied with appropriate louvers that shall automatically close (system de-energised to close) in case of fire detection and before CO₂ release.

CCVT shall be considered as a small package and as such the warning system may be simplified. Local audible and visual alarms, plus remote indication of the CO₂ release to supervision system may be installed.

CO₂ release shall be activated automatically in case of fire detection inside the CCVT enclosure (fusible plug or heat detector). In case of heat detector use, voting logic 2 out of 2 is required.

In addition, manual activation by the Operator shall be possible, locally on the platforms/unit, or remotely from the control room, if required.

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Local inhibition of CO₂ release shall be by key operated mechanism and information shall be transmitted to remote control room.

Appropriate warning sign shall be posted.

5.13.1.2 Calculation and Design

Manufacturer shall be in charge and responsible for all required studies such as flow calculations, pipes and nozzle sizing, etc.

Manufacturer shall provide the design of the piping system layout.

5.13.1.3 Skid Arrangement

Number of cylinders, their arrangement and the maximum size of the skid shall be specified by the Vendor. The Vendor shall confirm that the minimum concentration shall be achieved and maintained for the required time period based on the number of cylinders and the net volume provided.

The skid and its support structure shall be fabricated out of steel. The skid and the piping shall include the supports for all components of the system.

For lifting, transportation and installation requirements, the skid shall be complete with all equipment fully installed and piped including the cylinders fully charged (CO₂ charging of cylinders might be done by Contractor on site).

The skid layout shall provide maximum accessibility to all valves and instruments, for ease of use and maintenance.

A simple sunshade structure or a full enclosure shall be provided, fabricated out of steel.

If necessary, adequate mechanical protection shall be provided.

5.13.1.4 Cylinders

In the interest of standardisation and minimising the number of spares, all cylinders of the same extinguishing agent shall be of the same size.

Cylinders shall be in compliance with the regulations in force for pressurised containers in the considered country.

A cylinder handling and installation device shall also be supplied.

The technology of package fire system controller, could be based on pneumatic system for the fusible plug sensor or SIL-2 programmable electronics controller for the heat detectors.

5.13.1.5 Other Component requirements

Discharged nozzles shall be fabricated out of stainless steel type 316L, and threaded NPT.

Cylinder heads shall be fabricated in corrosion resistant material.

Contact between dissimilar metals shall be minimised. Any contact that creates a galvanic potential shall be provided with a protection system that prevents any corrosion.

Aluminium shall not be used for any of the fire extinguishing components.

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Operating instructions shall be provided in both English and country of installation languages and shall include a warning that describes the dangerous nature of the extinguishing agent and identify the protected area. The nameplate shall be fabricated in traffolyte or equivalent. Prior to fabrication, Manufacturer shall submit for approval, detailed drawings including instructions for operation.

Scope of supply shall include all instruction tags and also selector switch for main/reserve bank selection.

5.13.1.6 Piping requirements

Manifolds, valves, and discharge piping provided within the skid and between the skid and nozzles shall be galvanized and painted schedule 40 steel piping.

5.13.1.7 Instrument requirements

Instruments shall be selected and installed so as to allow maintenance, testing and calibration without disconnection or removal of cable or tubing.

All equipment under pressure shall be in accordance with the relevant piping class.

The degree of protection provided by enclosures shall be IP65 minimum for outdoor equipment.

6. Certification and marking

CCVT package shall be certified in accordance with the CENELEC standard [EN 60079-0](#) and [EN 60079-15](#).

CCVT marking shall be:

-  II 3 G as per the [European Directive 94/9/EC](#)
- Ex nA II T3, as per the CENELEC standards [EN 60079-0](#) and [EN 60079-15](#).

Type examination Certificate shall be delivered by Notified Body.

EC declaration of conformity shall be delivered by the Manufacturer.

A warning safety label shall be posted on CCVT shelter with the following text:

“Warning - Do not open when an explosive atmosphere may be present”

“Do not open - Permit required”

7. Interface

7.1 Mechanical

7.1.1 Anchoring information

CCVT shall be installed on the deck plate (solid plate) using four anchoring bolts as specified in drawing in Appendix 2 and soft gasket under the frame.

Alternative attachment method can be full welding around CCVT base frame.

For bolts size - Refer to the drawing in Appendix 2.

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7.1.2 Gas inlet port

A 3/8" SS double ferule connection shall be provided by the Manufacturer on the electric valve EVS, or at the inlet of the optional gas pressure reduction system, if such exists.

7.1.3 Gas pressure and temperature

Max gas pressure 1.5 bar G.

Max gas temperature 70°C.

Higher pressure and temperature could be accepted by adding optional gas reduction system, heat exchangers and water separators.

7.2 Clean air ducting

Additional ducting shall be supplied by Contractor with the corresponding additional air-intake fans provided by Manufacturer. Air-Intake fan size shall be based on 2 x 50% operation, so two fans have to be installed. Fan motor units shall be brushless AC type, and supplied complete with dedicated inverters, breakers, and common fault contacts for remote indications. The overall motor/fan assembly package shall be suitable for zone 2 IIA T3 area, ATEX compliant. The motor shall be Ex "d", category 2, as per [94/09/EC](#) directive, and equipped with thermistors.

Manufacturer shall provide twin fan box module with 250 mm diameter connection sleeve.

The two fans & ducting shall be suitable with one hundred complete air changes in shelter per hour.

Fan material shall be non-sparking in order not to create ignition source in case of contact of the fans with the metallic box enclosure.

Fresh air fans power and ducting diameter are suitable for up to 10m of ducting with up to two 90 degrees bends. For different routing or length, pressure loss calculations shall be submitted to the Manufacturer for review and approval.

7.3 Electrical

7.3.1 Earthing

A minimum of two M10 studs shall be made available on the frame for earth connection.

7.3.2 Junction boxes

Junction boxes shall be Ex "e", category 2 certified.

7.3.3 Output power terminals

CCVT output power terminals shall be connected by cables to a circuit breaker fitted with shunt trip coil and housed in a box with certification Ex "d", category 2. This box shall be equipped with an handle and a reset switch (alternatively a three positions handle can be provided with the same function) in order to operate the CB without opening the box.

Generator bars within the panel shall be insulated or protected by a non conductive cover.

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7.3.4 Semiconductors

Blocking diodes and other semiconductors shall not be installed at this power line.

8. Design Life & Obsolescence

Facilities are typically designed with an expected design life in the order of 20 to 25 years.

The CCVT design shall therefore take into account the requirement that the equipment will most probably require to be upgraded during the design life of the facilities in particular for all the electronic based components. These requirements shall be incorporated from Basic Engineering stage.

The design will include provisions to allow an upgrade of the CCVT to be performed with minimal disturbance to the power generation and distribution systems, fixed cabling infrastructure and infrastructure.

All hardware and software that may be developed by the Supplier further to the CCVT delivery, shall ensure full ascending compatibility to allow for easy replacement of equipment that became obsolete with limited reconfiguration.

At the Bid stage, the CCVT Supplier shall detail his lifecycle management strategy focusing on product obsolescence, support options and further migration alternatives. The lifecycle/obsolescence management plan and associated cost shall be part of the Bid process evaluation.

The CCVT Supplier shall complete an inventory of all provided equipment (hardware and software) matching to different lifecycles phases, including all Sub-Vendors equipment (e.g. electronic cards and associated software, switches, HMI (Human Machine Interface, etc.).

CCVT **Supplier** shall guarantee that:

- CCVT components (including software and hardware) shall remain in the “active products” range (i.e. supporting developments and releases) over a period of at least 10 years after the SAT
- An announcement to Customer is provided 5 years prior the end of the commercial phase
- CCVT components (including software and hardware) shall be fully supported and available over a period of at least 20 years after the SAT
- Maintenance services including availability of engineering services shall be available to support the CCVT during the plant life time.

9. Limits of supply

	Manufacturer	Contractor
1.0 Anchoring		
1.1 Supply - Anchoring bolts		X
1.2 Supply - Soft Gasket under frame	X	
1.3 CCVT frame welding to deck or CCVT anchoring		X

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	Manufacturer	Contractor
2.0 Gas Inlet Connection		
2.1 Supply - Gas Inlet Solenoid Valve	X	
2.2 Supply - Gas inlet bulkhead 3/8" SAE 45 Flare or s.s. 3/8" double ferrule, on CCVT wall	X	
2.3 Supply and Install - 3/8" (or larger) tubing from gas supply to CCVT wall		X
2.4 Supply and Install - Gas Pressure reduction system down to 1.5 BarG	X	
3.0 Clean Air Supply & Exhaust Systems		
3.1 Supply - Clean air twin fan box module	X	
3.2 Supply - CCVT Clean Air Inlet fitting	X	
3.3 Install twin fan box module		X
3.4 Supply and Install - 200 mm minimum Dia. Clean Air Ducting from Fan box module to CCVT inlet air connector		X
3.5 Supply exhaust outlet from CCVT to 2 meters outside hazardous area (Manufacturer typically supplies this as a standard length chimney + an optional extension to the standard chimney. In such case the routing has to be pre-approved by Manufacturer, and a test with the actual chimney is performed during assembly in the factory to assure proper combustion)	X	
3.6 Installation of CCVT exhaust duct		X
4.0 Earthing		
4.1 Earthing and bonding of all metallic parts within CCVT	X	
4.2 Earthing of CCVT Frame to earth		X
5.0 Power		
5.1 Supply and Install - 4 wire 2.5 mm ² Clean Air Fan feeder cables as per requirements of 5.10.1, Conduits, Gable Glands, Trays		X
5.2 Supply and Install - Power Output (±) 2 Wire Cable		X
5.3 Supply and install CCVT output circuit breakers fitted with shunt trip coil		
They shall be housed in a "category 2" certified box dedicated to 48 Vdc power distribution		X

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	Manufacturer	Contractor
6.0 Controls		
6.1 Ex "e", Category 2 certified protection system Emergency Shut Down push button	X	
6.2 Ex "e", Category 2 certified CCVT protection system Reset switch	X	
6.3 CCVT Shut down Relay	X	
6.4 Supply and Install - CCVT Failure cable 1.5 mm ²		X
6.5 Supply and Install - Gas Detection Signal cable 1.5 mm ²		X
6.6 Supply and Install - Remote Stop cable 0.75 mm ²		X
6.7 Supply and Install - 1.5 mm ² Clean Air control cable, Conduits, Cable Glands, Trays		X
7.0 Fire Detection and Protection systems		
7.1 Entire system including: - The skid - The cylinders with required capacity of CO₂ - Pipes, nozzles, manifolds, instrument and accessories to provide an operational system - Audible and visual alarm - Junction boxes on skid limits for instrumentation and electrical connections	X	
8.0 Gas detection		
8.1 Gas detection in CCVT enclosure	X	
8.2 Gas detection at entry of additional clean air ducting		X
9.0 Miscellaneous		
9.1 Special tools for maintenance (if any)	X	
9.2 Commissioning spare parts	X	

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10. Documentation

10.1 Each CCVT shall be supplied with a set of Operation, Installation and Maintenance Manuals in English

The list of drawings to be supplied shall be as follows:

- Gas Fired CCVT
- CCVT Shelter Safety Features
- CCVT Gas Burner Schematic Diagram
- Electrical Diagram Safety Control System
- Shelter
- Equipment data-sheet, including all technical characteristics
- Equipment part list
- Warranted MTBF figures of delivered CCVT
- Recommended spare part list for commissioning and Start-up
- Recommended spare part list for start-up and two years of operation and maintenance with itemised priced list
- Trouble shooting diagram
- Test procedure for FAT and Test reports
- Long term storage instruction
- Type test certificates
- Obsolescence management dossier.

10.2 Certification documents (as per directive [ATEX 94/9/EC](#))

- EC declaration of conformity (issued by the Manufacturer)
- Type examination certificate (issued by a Notified Body).

11. Factory Acceptance Tests (FAT)

- Visual Inspection
- Vacuum check
- Operation and Calibration of the Control System and of the Burner
- Complete tests of the fire and gas detection systems, PLC shutdown, closing of air dampers etc.
- 100 hr (4 days) continuous operation test and final vacuum test
- Final report of functionality and performance (as per the CCVT test report attached).

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12. Other references

Following external documents are applicable: [ASTM A 240](#), [ASTM A 249](#), [ASTM A 269](#), [ASTM A 312](#), [ASME Section V](#), [ASME B 31.3 - K 341.3.2](#), [IEC 60079](#), [EN 60079-1](#), [EN 60079-7](#), [IEC 60146](#), [IEC 60255](#), [IEC 60269](#), [IEC 60335-2-29](#), [IEC 60622](#), [IEC 60947](#), [IEC 62402](#), [UL 94 - V0](#), [NFPA 72](#), [ANSI Z-21](#).

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Appendix 1

Appendix 1 Questionnaire for use of CCVT on Offshore platforms

General

Project Name			
Country		Location	
Geographic Coordinates	N	E	
Number of Stations/Platforms		OEC per Station/Platform	1
Contact Person			
Phone		Email	

Environmental Conditions

Environment		Offshore	
Altitude	m		
Ambient Temperature	°C	Min.	Max.
Max Wind Speed	m/sec	Continuous	Gusts
Relative Humidity	%	Normal	Max.
Hazardous Area Classification		Unclassified	

Estimated Load List

Load	Voltage (Volts)	Power (Watt)	Type	Duty Factor (% or min/day)	Essential (F1 for help)
Telecommunication	24		DC		Yes
Telecommunication	24		DC		Yes
Telecommunication	24		DC		Yes
Telecommunication	24		DC		Yes
Telecommunication	24		DC		Yes
Telecommunication	24		DC		Yes

Battery Backup

Voltage	Vdc	
Autonomy	hours	
Type		VRLA
Capacity	Ah	(F1 for help)

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Appendix 1
Process Data

Fuel Type		NG
<i>In case of Gas:</i>		
Pressure	bara	
Max. Temperature	°C	
Min Temperature	°C	
Methane (CH ₄)	% vol.	
Ethane (C ₂ H ₆)	% vol.	
Propane (C ₃ H ₈)	% vol.	
Butane (C ₄ H ₁₀)	% vol.	
CO ₂	% vol.	
H ₂ O	% vol.	
N ₂	% vol.	
H ₂ S	% vol.	
LHV	mJ/Nm ³	

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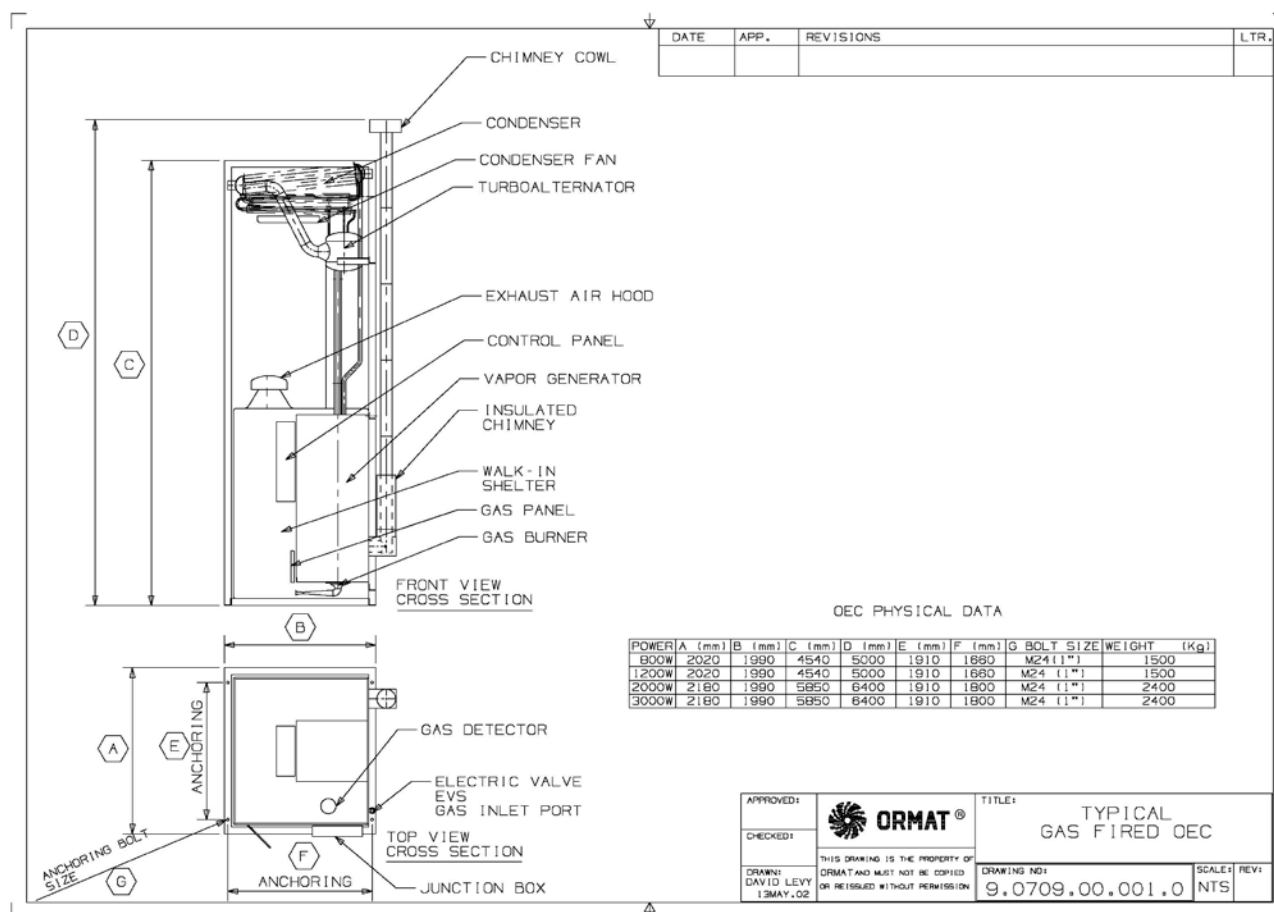
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Appendix 2

Appendix 2 Gas Fired CCVT

(800 W to 3 kW Ormat CCVT)



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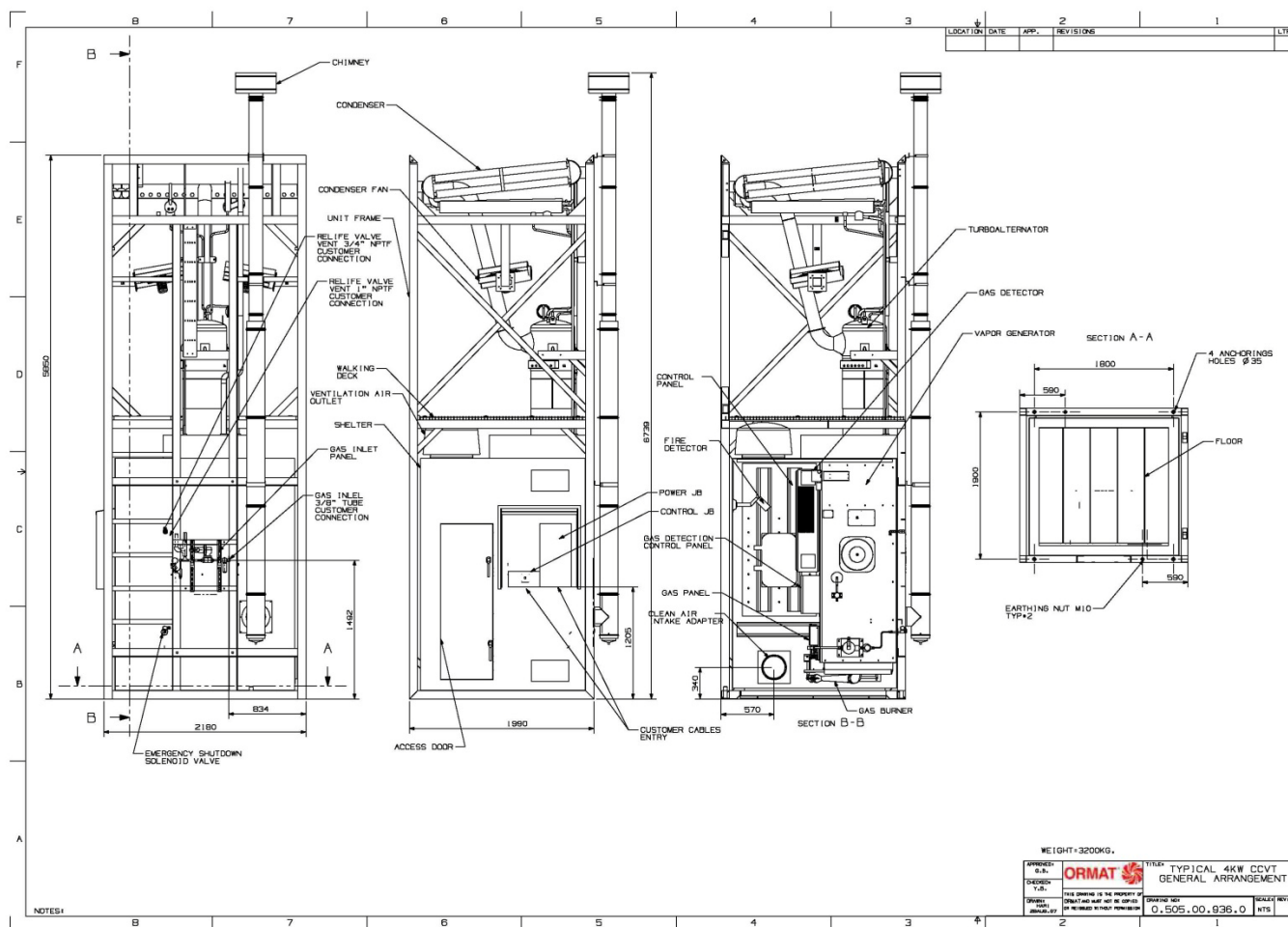
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Appendix 2

4 kW Ormat CCVT



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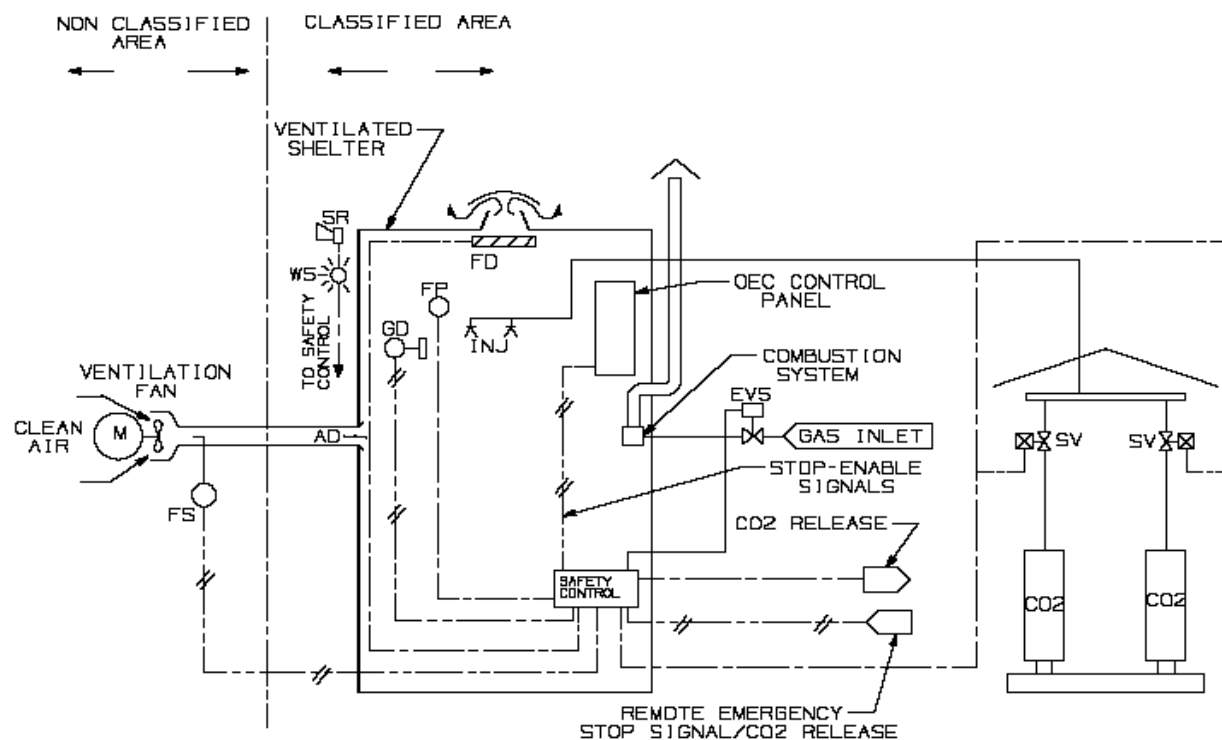
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Appendix 3

Appendix 3 CCVT Shelter Safety Features (Example)



LEGEND

GD GAS DETECTOR
FS AIR FLOW SWITCH
EVS SAFETY SOLENOID VALVE-GAS SUPPLY
FD FIRE DAMPER NORMALLY CLOSED
INJ CO2 INJECTOR
FP FUSIBLE PLUG
WS WARNING SIGNAL
SR SIREN
AD AIR DAMPER
SV SOLENOID VALVE



PRELIMINARY

OEC SHELTER - SAFETY FEATURES
SCHEMATIC DIAGRAM

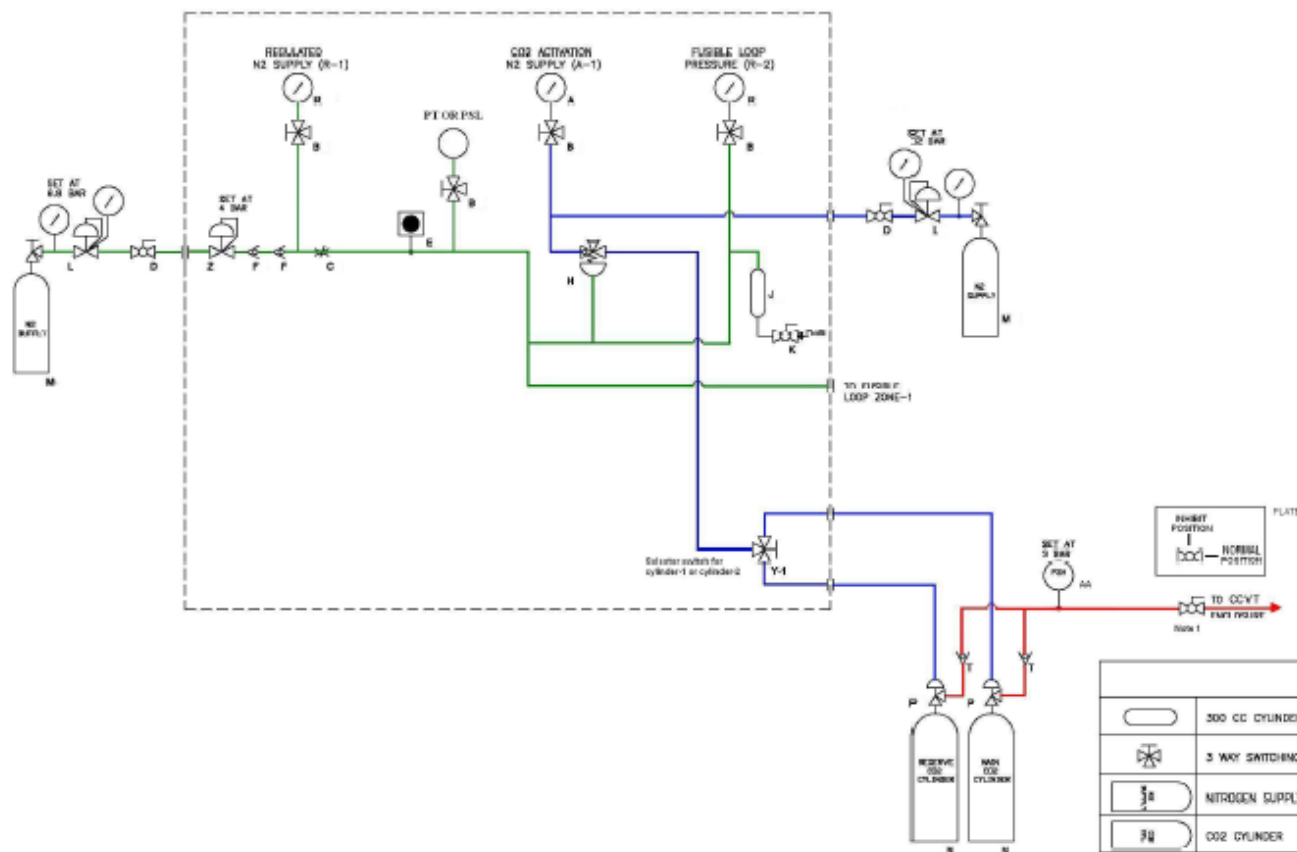
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Appendix 3



BILL OF MATERIALS (TENTATIVE)	
ITEM	DESCRIPTION
A	4" PRESS GAUGE 0 - 200 PSIG (EXAMPLE)
B	BLOCK AND BLEED VALVE
C	RESTRICTION ORIFICE
D	3/8" BALL VALVE
E	PRESSURE INDICATOR WITH FLAG
F	CHECK VALVE
H	3 WAY NORMALLY OPEN VALVE
J	300 CC CYLINDER (EXAMPLE)
K	1/4" FNPT DRAIN VALVE, 316 SS
L	NITROGEN REGULATOR 316 SS
M	10 LT NITROGEN CYLINDER (EXAMPLE)
N	45 Kg (100 LB) CO2 CYLINDER (EXAMPLE)
P	DISCHARGED HEAD PRESSURE OPERATED
Q	DISCHARGE NOZZLE CO2
R	1" PRESS GAUGE 0 - 180 PSIG (EXAMPLE)
S	1/2" DISCHARGE HOSE
T	1/2" CHECK VALVE FOR DISCHARGE HOSE
W	TUBE 1/2" OD x 0.049" WT 304L SS 316
X	CONDUIT BOX
Y	3 WAY SWITCHING VALVE
Z	FILTER REGULATOR, AUTO DRAIN
AA	PRESSURE SWITCH
BB	WEIGHING SCALE

Note 1: If we need to send the valve position (Normal or Inhibit), we can use blank/lock valve (as we used on coast TB-2 or TB-10)

LEGEND			
	300 CC CYLINDER		PRESSURE GAUGE
	3 WAY SWITCHING VALVE		BLOCK AND BLEED VALVE
	NITROGEN SUPPLY CYLINDER		RESTRICTION ORIFICE
	CO2 CYLINDER		BALL VALVE
	REGULATOR		PRESSURE INDICATOR WITH FLAG
	NITROGEN REGULATOR		CHECK VALVE
	DISCHARGED HEAD PILOT OPERATED		3 WAY NORMALLY CLOSE VALVE
	ELECTRICAL PRESSURE SWITCH		3 WAY NORMALLY OPEN VALVE

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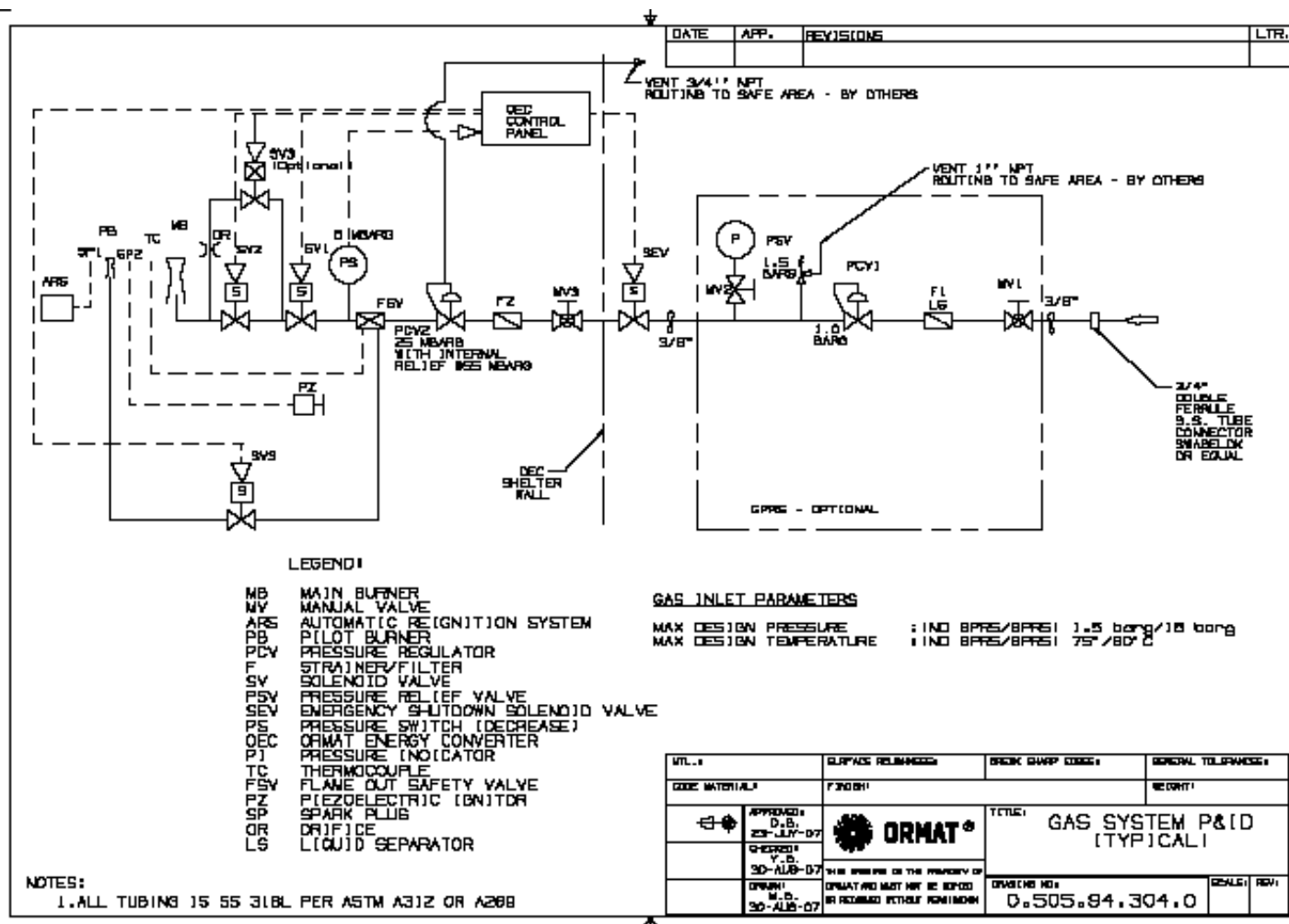
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Appendix 4

Appendix 4 CCVT Gas Burner Schematic Diagram (Example)



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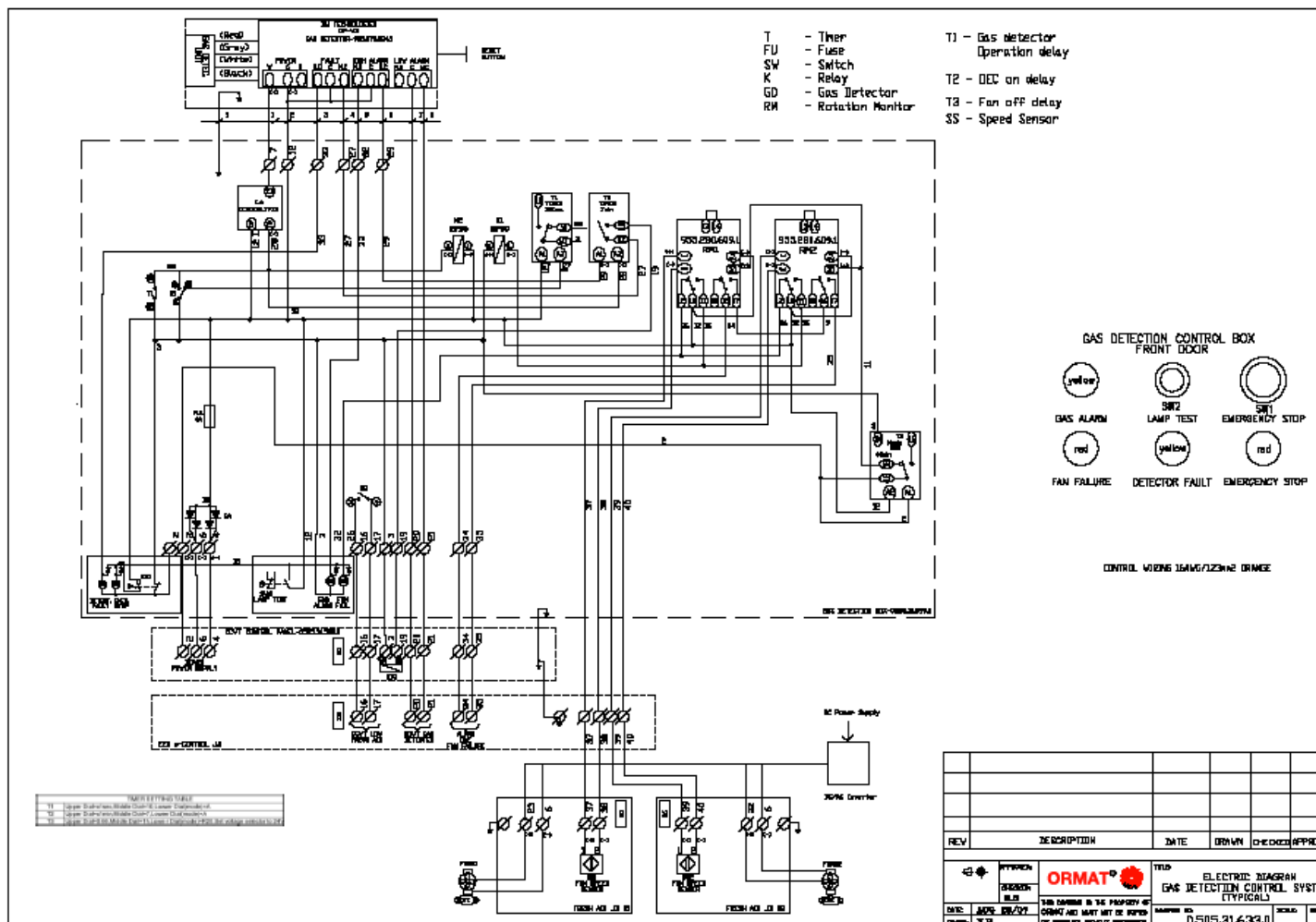
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Appendix 5

Appendix 5 Electrical Diagram Safety Control system (Example)



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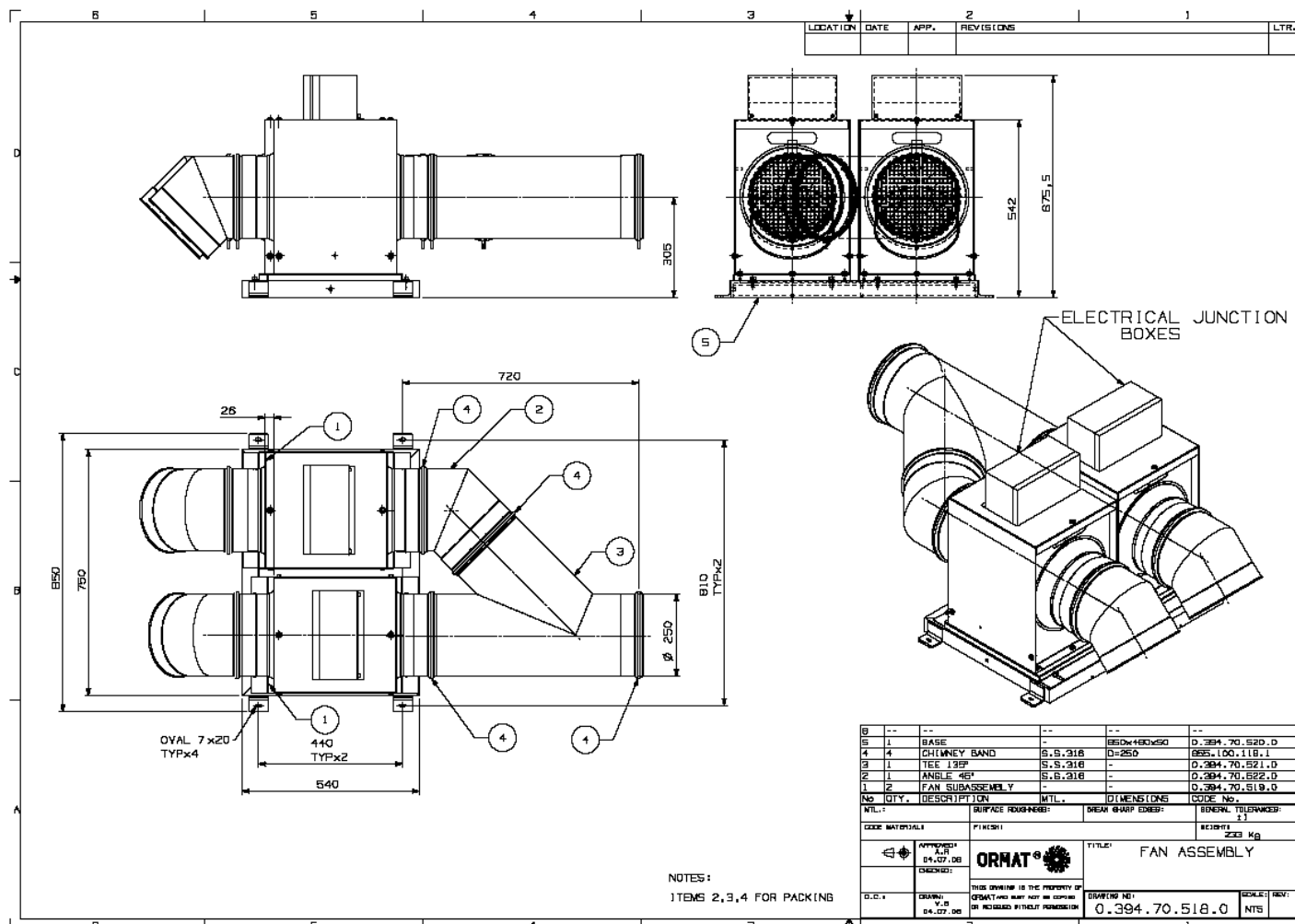
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Appendix 6

Appendix 6 Air Intake fans



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Appendix 7
Appendix 7 CCVT Test Report - Preliminary

Model:		CCVT TEST REPORT - PRELIMINARY		Page 1/1				
Serial No.:				Name:				
T.G Serial No.:				Date:				
Controller Serial No.:		Control panel S/N _____		Rev.: 0				
Fuel: Gas	Voltage: _____ Vdc (TBD)	Power: _____ W(TBD) (TBD)	Electrical Insulation Test	Req. < 1mA	Req. <_ Vdc (TBD)			
Controller Circuit Information				-mA	+mA	-V	+V	
MANUFACTURER No.:	The Controller Set-Points and Timers Tables are part of this document.			Short Circuit [] Open Circuit []				
Project name: (Req.) _____								
Boot Version: (Req. 02.01) _____			100 hr Test	Start up		Shutdown		
Software Version: (Req. 02.05) _____	Vbat Coefficient 2.66 []			Date:	Date:			
Set-Points Version: (Req. 02.06) _____	Vout Coefficient 2.66 []			Hour:	Hour:			
Timers S.P Version: (Req. 02.06) _____	Cont. Volt: Req. (110) ____		Start-up Temp. (°C) Req.<125					
Name:	Date:	Sign.: _____	Vacuum Check					
Alternator Phase Balance < 5% Deviation			Req. < 1/2	Date:				
V. dc:	V_{rs}	V_{rt}	V_{st}	Mbar (A)	Temp. °C	Mbar		
_____ V.	Vac	Vac	Vac	Name:				
Performance			FC Calibration					
Load%	Req. @ 100%	Max.	100	50	Constant Current (mA)	Req. 310±20		
Ambient Temp. (°C)	5 - 40				Voltage Limit (Vdc)	Req. 135- 0.5		
Boiler Temp. (°C)	Ref. 175±5				Frequency Limit (Hz)	Req. 560±10		
Condenser Temp (°C)	Ref. 90±15							
Voltage (volt)	Ref.129±1.0				Failures and protection			
Current (Amp.)	Ref. 23±0.5				Description	Checked	Display	
Power (Watt)	Ref. 3000				OSP 1	[]		
Frequency (Hz)	Ref. 550±30				OSP 2	[]		
Ripple (Mvp-p)	< 200				OSP 3	[]		
Excitation (mA)	Ref.				Turbine Fail to Run	[]	FAIL 71	
Condenser Fan	On / Off				Over Voltage	[]	FAIL 72	
Burner Adjustment		Combustion Test @100% load		Under Voltage			[]	FAIL 73
Combustion:	Stack Temp. (°C)	Req. 400±30		High Temp.			[]	FAIL 74
	CO (%)	Req. < 0.3		Flame Out			[]	FAIL 76
	CO ₂ (%)	Req. 9±2		Short Circuit			[]	FAIL 79
	Combustion Effi. %	Req. 85±5		CCVT ON (Info.)			[] []	*
	Draft (mm. H ₂ O)	Req. 1.8±0.3		Failures Relay (Info.)			[] []	*

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Appendix 7

Operation					0-135V=4-20mA (Info.)	[] []	*
Burner System	Reignition	EVH	EVL	Safety Valve (EVS)	0-30A =4-20mA (Inf.)	[] []	*
	[] Vac_____	[]	[]	[]	Burner ON/OFF (Info.)	[] []	*
Orifice Dia: __ mm	Supp. Gas Pressure: (Kg/H ₂ O)			Req. 1 - 1.5	Remote-Stop (Input)	[]	E-OFF *
	Burner Gas Press.: (cm/H ₂ O)			Req. 28±2	Parallel Operation	[]	CCVT# _____
<u>Thermocouple</u>	<u>Pilot Burner</u>			<u>Pilot & Main Burner</u>	Clear History	[]	Date:
Open Circuit (mV)	Req. >18			Req.>22	Main burner orifice replace	[]	Sign:
Fix Load (mV)	Req. >12			Req. >14	Notes: * - At CCVT J.B		
Release (mA)	Req. < 200				-----		
					Controller Name & Signature		Date:
Gas Consumption	Time End	Time Begin	Time Measured		____/____/____		
Req.2.1±0.2__ (m ³)	_____	_____	_____		Acceptance Name & Signature		Date:
Burner Components					____/____/____		
Pressure Switch	Req. 3±1(CM/H ₂ O)	_____ (CM/H ₂ O)[]			Customer Name & Signature		Date:
Cond. Fan Operation	(Req. T > 87°C)	[]			____/____/____		

* The final test has been performed using LPG gas with calorific value equal to 25000 Kcal/Nm³.

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Appendix 8

Appendix 8 Typical Single Line Diagram

