IGS-M-PM-104(2) آذرماه ۱۳۹۱

approved مصوب

شرکت ملی گازایران

امورتدوین استانداردها

IGS

مشخصات فنی خرید

دستگاه گرم کننده گاز(غیرمستقیم – آبی) ، نوع مشعل اتمسفریک

Indirect Water Bath Heater , Natural Draught Type

دفتر مدیرعامل

شرکت ملی گاز ایران

تاریخ : ۱۳۹۱/۹/۲۲
شماره : گ ۰/دب ۰/۴۰۸-۱۶۳۸۲

ابلاغ مصوبه هیأت مدیره

مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می رساند در جلسه ۱۵۱۷ مورخ ۱۳۹۱/۷/۱۶ هیأت مدیره، نامه شماره گ۹/۰۰۰/ ۹۲٤٦۲ مورخ ۱۳۹۱/۷/۵ مدیر پژوهش و فناوری و رئیس شورای استاندارد در مورد تصویب نهایی استاندارد تحت عنوان « دستگاه گرم کننده گاز (غیرمستقیم – آبی) نوع مشعل اتمسفریک به شماره تقاضای IGS-M-PM-104(2) » مطرح و مورد تصویب قرار گرفت.

این مصوبه به عنوان مصوبه مجمع عمومی شرکتهای تابعه محسوب و برای کلیه شرکتهای تابعه لازم الاجراء می باشد.

ناصر آبگون
دبیر هیأت مدیره

رونوشت : مدیرعامل محترم شرکت ملی گاز ایران و قائم مقام رئیس هیأت مدیره
: اعضای محترم هیأت مدیره
: مدیر محترم توسعه منابع انسانی
: مدیر محترم هماهنگی و نظارت بر تولید
: مدیرعامل محترم شرکت انتقال گاز ایران
: رئیس محترم امور حسابرسی داخلی
: رئیس محترم مهندسی ساختار
: رئیس محترم امور حقوقی
: رئیس محترم امور مجامع

Table of content

1- SCOPE

This specification covers the minimum requirements for design, material, fabrication, testing, inspection, marking, packing and shipment of natural draught indirect water bath heaters to be used in natural gas pressure reducing stations.

Each deviation of this specification, it shall be clearly stated on the technical information submitted by the supplier/manufacturer.

The supplier/manufacturer shall furnish complete unit including all necessary parts to insure satisfactory, economic and safely operation.

2- REFERENCE

Supplier shall refer to the latest editions of all the following mentioned standards.

All heaters shall be in design and fabrication in accordance to:

2.1. Normative:

API 12K : Specification for Indirect Type Oil-Field Heaters R(1999)

IPS–C–TP–101 & 102 for Surface Preparation and Painting

TEMA, standards of the tubular exchanger manufacturers association

ASTM A105, Standard Specification for Carbon Steel Forgings.

ASTM A350, Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components

ASTMA182, Standard Specification for Forged or Rolled Alloy-Steel.

ASTM A193 B7, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A194 2H, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Temperature Service.

ASTM A234 Gr. WPB,

ASTM A751,

ASTM A370,

ASTM SA36.

ASME sec VIII div1 for coil tube

ASME, Boiler and Pressure Vessel Code, Sec. VIII Div.1 & Section II

ASME, Boiler and Pressure Vessel Code, Section V

ASME, Boiler and Pressure Vessel Code, Sec. IX

ASME, B16.5 for Pipe flanges and flanged fittings, NPS ½ through NPS 24

ASME, B16.47 for Large diameter steel flanges NPS 26 through NPS 60

ASME/ANSI B18.2.2 for Square hex nuts

ASME/ANSI B 1.20.1 for Pipe threads, general purpose

ASME/ANSI B16.25 Butt welding ends

ASME/ANSI 36.10 for Welded and seamless wrought steel pipe

ASME/ANSI B16.9 for Factory made wrought butt welding fittings

ASME/ANSI B16.28 wrought steel butt welding short radius elbows and returns

ASME/ANSI B.16.11 for Forged Steel Fittings, Socket Welding & Threaded

API RP 500C for Classification of Location for Electrical Installation at Pipeline Transportation Facilities

2.2. Informative:

IGS–M–PM–105 for Dry Gas Filters

IGS–M–IN–202 for Gas Pressure Regulators for Nominal Inlet Pressure 5 to 100 bar (72-1450 psig)

IGS–M–PL–010-1,2 & 3 for Ball Valves, Class 150, 300 & 600

IGS–M–PL–002-1 & 2 for Plug Valves,1/2 to 24 Inches.

IGS–M–IN–302 for Relief Valves

IPS–M–EL–174 for Battery and Battery Charger

IPS–M–EL–176 for Uninterruptible Power System (UPS)

IPS–M–GN–130 for Metric Type Fasteners

IPS–E–GN–100 for Engineering Standards for Units

IPS–C–IN–110 for Pressure instruments

IPS–E–IN–120 for Temperature instruments

IEC 60146 for Semiconductor Convectors

IEC 60896 for Stationary lead-acid batteries

IEC 60622 for Secondary cells and batteries ,Third Edition

NFPA 85, Boiler and Combustion Systems Hazards Code Errata

NFPA 87, Recommended Practice For Fluid Heaters

MSS SP-97 for the Integrally Reinforced Forged Branch Outlet Fittings, Socket Welding, Threaded and Butt welding Ends

ASTMA53, Standard Specification for Pipe, Steel, Zinc-Coated, Welded and Seamless

ASTM A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

API 5L, Standard Specification for Line Pipes

API 1104 for Welding of Pipelines and Related Facilities

3- DEFINITIONS :

- Indirect Water Bath Heater:

Heating of gas streams close to preventing hydrate or wax formation. Heating may also be done to prevent liquids from condensing in the gathering line or to facilitate subsequent fluid separations.
An indirect type oilfield heater employs a water solution, maintained below the boiling point, as the heating medium for the purpose of heating the process fluids in the coils. entitled Typical Indirect Heater Assembly,
showing general arrangement of heater components, piping and instrumentation (Appendix 15.4)

- Instrumentation :

Any system or combination for measurement and control.

-Fail – safe:

The action of a device to go to a safe operating condition when a failure occurs.

- Pressure relief device:

A device which is installed to vent gas from a system being protected in order to prevent the gas pressure from exceeding a predetermined limit by venting the gas into atmosphere.

- Ambient temperature:

Usually used to refer to the temperature of the air in which a structure or a device operates.

-Gas pressure regulator:

Device which maintains the outlet pressure constant independent of the variation in inlet pressure and / or flow rate within defined limits.

- Inlet pressure:

Pressure at the inlet of the regulator of station.

- Outlet pressure:

Pressure at the outlet of the regulator.

- Capacity:

The rate of flow through a cabinet type station under standard condition with minimum inlet pressure.

- **Slam shut**:

An ancillary designed to quickly shut off the gas flow in the event of an abnormal pressure being detected within system it protects.

- **Burner system**

System for firing the heater designed for the specific fuel to be used (either natural draft design).

- **Coil area**

Heat transfer area and is normally calculated using the outside surface area of the pipe.

-Firebox

Complete assembly consisting of the fire tube, mounting flange, intake and stack adaptors.

- **Fire tube**

Consisting of one or more U-tubes fired, normally by natural gas, at one end and exhausting through a vertical stack.

- **Heat density**

Heat released through the cross section of the fire tube, expressed as BTU/hr.in^2 of cross sectional area.

-**Heat flux**

Applied to the average transfer rate through the firetube, expressed as BTU/hr.ft^2 of exposed area.

- **Heater bath**

Indirect heating medium, limited to water or water solutions.

-Intake flame arrestor

Device placed on the air intake of the fire tube to prevent propagation of flame from inside the fire tube to the outside atmosphere.

- **Shell**

Normally a horizontal vessel which contains the coil, fire-tube and heater bath.

- **Stack downdraft diverter**

Device attached to the top of the stack designed to reduce the effects of wind currents on the burner system.

- **Stack flame arrestor**

Device placed on the exhaust of the stack to prevent propagation of flame from inside the fire

tube to the outside atmosphere.

- **Stack rain shield**

Device attached to the top of the stack to prevent rain from falling directly into the stack. It may also serve as a stack downdraft diverter.

- Water saver

A chamber that may be directly connected to the heater shell to permit the shell to be completely filled with water.

- Hazardous area:

An area in which an explosive or flammable gas atmosphere is present, or may be expected to be present, in quantities.

Such as to require special precautions for the construction, installation and use of electrical apparatus.

- Hazardous area zones:

Hazardous areas are classified in zones based upon the frequency of the occurrence and the duration of a flammable atmosphere.

- Standard condition:

The conditions to which a volume of gas is converted (i.e. base gas temperature15.56°C (60°F) base pressure 1013.25 mbar (14.696 psi)

- Natural Gas : The natural gas Specification is according to IGS-M-CH-033(0) 2004

4- TECHNICAL SPECIFICATION

4.1. HEATER SHELL

Shell and expansion tank material may be ASTM A36 or any other carbon steel material recommended by manufacturer. All bolt and nuts materials used in shell flanges shall be ASTM A193 & ASTM A194 respectively.

4.1.1. An expansion tank shall be provided on top of heater shell.

4.1.2. A ladder including platform, if any, with handrail and back protection, shall be provided for easy access to the expansion tank.

4.1.3. A 2" gate valve(class 150) with blind flange shall be provided at the bottom of shell for drain purposes.

4.1.4. The shell and heads must be insulated with 50mm thickness fiber glass insulation or equivalent having an aluminum cladding with min. thickness 0.8 mm (The mineral wool shall have specific weight of 100kg/m3 and a thermal conductivity less than 0.7 W/°K.m at an average temperature of 200°C).

4.1.5. Before insulation, shell shall be painted according to painting procedure in this standard (Ref.Clause8).

4.1.6. Shell permissible out of roundness after welding shall be according to ASME Sec. VIII, Div.1 part UG-80

4.1.7. Insulating gaskets used in the shell flanges shall be suitable in high temperature services and durability specification in outdoor conditions. It shall have good characteristics in water and ethylene glycol mixtures.

4.1.8. All T joints welds shall be 100% tested by radiography.100% of nozzle welded connections to shell shall be tested by LPT (liquid penetrate test) method.

4.1.9. Tightening procedure shall be considered by manufacturer for flanges bolt & nuts fastening.

4.1.10. Shell shall be reinforced enough to prevent any deformation because of coils, fire-tubes and water-ethylene glycol mixture weight.

4.1.11. Heater shell shall include permanent lifting lugs.

4.1.12. Shell shall be equipped with1" threadolet and 1"×1/2" thermo well with1/2" NPT male, stainless steel temperature gauge,100mm dial an appropriate stem length with safety glass and red and black lettering, dual scale in centigrade and Fahrenheit, adjustable pointer. Gauge ranging (-30 ~ +100)°C .Thremometer shall be installed on shell via adequate thermowell and threadolet .

4.1.13. Shell shall be equipped with 1" threadolet and1"×1/2" thermo well with 1/2" NPT male temperature transmitter PT100 type, also an appropriate stem length for controlling of shell high temperature. Thremometer shall be installed on shell via adequate thermowell and threadolet.

4.1.14. Construction of heater shall be such that the removal of the coil and fire tube/firebox shall be from opposite ends of the shell.

4.2. Expansion Tank

4.2.1. The expansion tank is designed to reduce internal corrosion within the heater shell by keeping the heater shell liquid packed and moving the wet dray interface of the expanding bath media from the heater shell into the expansion tank.

4.2.2. The expansion tank is designed to contain 100% of the expanded bath media from a temperature of 40°C to the maximum operating temperature. Whereas manufacturer and client agreement is preferred.

4.2.3. Bath media expansion reservoir designed to hold 6% of the total bath media. Whereas manufacturer and client agreement is preferred.

4.2.4. Expansion tank shall be insulated same as main shell insulation instruction. Shell heads shall be insulated same as main shell insulation instruction(mass loss should be consider).

4.2.5. Expansion tank shall be equipped with low level alarm and filling connection. Also for prevention of mass lost, the roof of expansion tank shall be always closed.

4.3.SKID

4.3.1. Heater skid material may be ASTM SA36 or any other carbon steel material recommended by manufacturer.

4.3.2. Lifting lugs shall be provided with sufficient strength to allow lifting the entire assembly without causing any damage to the shell and the other parts.

4.3.3. The heater should be self-contained and skid mounted.

4.3.4. Structural strength of skid shall be sufficient to withstand forces due to shipping and handling as well as support the vessel and equipment. Skid shall be self supporting rigid steel assemblies having adequately sized members to permit handling of the unit without deformation of the skid members.

4.3.5. Before insulation, skid shall be painted according to painting procedure in this standard. (Ref.Clause8).

4.4.COIL

4.4.1. Coil shall be seamless pipe, ASTM A53 Gr. B or ASTM A106 Gr. B/C or API 5L Gr.B, Schedule No.80.

4.4.2. Inter connections of coil passes and header shall be fabricated according to ANSI B16.9,(or standard bend collector according to TEMA) same size and schedule of coil pipe, seamless and with ASTM A234 WPB/C material.

4.4.3. Proprietary fittings should be ASTM A105 or ASTM A182 material

4.4.4. Coil shall be field removable construction of heater shall be such that the removal of the coil and fire tube/ firebox shall be from opposite ends of the shell.

4.4.5. Supporting wheels shall be run on guiding rails, for coil section weight is over than 2000Kg.

4.4.6. The entire coil shall be supported on wheels or roll bearing which shall withstand 15 years of operation .

4.4.7. Precaution shall be taken against buoyancy of the coil.

4.4.8. All coil tubes shall be supported having allowances for thermal expansion.

4.4.9.Maximum allowable gas velocity in coil shall not exceed 20 m/sec.

4.4.10. Inside coil header cross sectional area shall be at least equal to total inside coil branched area.

4.4.11. Inlet and outlet flanges shall be welding neck, raised face, ANSI 600.

4.4.12. All tube weld joints to tube, shall be butt welded and shall be tested 100% by radiography test methods according to ASME Section: IX.

4.4.13. All weldolet and threadolet in seat connections shall be down : for accessible 100% RT , and for non accessible 100% MT.

4.4.14. All 2" and smaller connections between coils and headers shall be weldolet and more than 2" shall be sweapolet ($d \geq 1/3D$) – weldolet ($d < 1/3D$) , according to MSS SP-97.

4.4.15. Inlet and outlet shall be equipped with 1" threadolet and 1"×1/2" thermowell with 1/2" NPT male, stainless steel temperature gauge,100mm dial with safety glass and red and black lettering, dual scale in centigrade and Fahrenheit, adjustable pointer.
Gauge ranging (-30 ~ +100)°C.

4.4.16. Coil outlet header shall be equipped with 1" threadolet and 1"×1/2" thermowell with 1/2" NPT male temperature transmitter type PT100 for controlling of gas outlet temperature.

4.4.17. Inlet and outlet shall be equipped with 1/2" NPT male, stainless steel pressure gauge,100mm dial with safety glass and red and black lettering, dual scale in psi and bar, bourdon tube type, oil filled, adjustable pointer. Gauge ranging shall be 2 to 4 times the operating pressure.

4.4.18. Inlet and outlet shall be equipped with 1" NPTF ball valve as a drain.

4.4.19. All threaded connection on headers shall be done by threadolet class 3000 lb rating.

4.4.20. Coils shall be supported. Spacing, holes diameters and thickness of support baffle plates

shall be considered base on TEMA requirements.

4.4.21. Coil weight shall be supported by traverse pipe / U beam which are connected to inside shell.

Coils shall not have any mechanical stress on its removable flange bolts.

4.5.BURNER

4.5.1. Material

Burner material shall be carbon steel.

4.5.2. Design

4.5.2.1. Burner shall be so designed that gas and air could have good mixing before combustion.

4.5.2.2. Air intake channel shall be pre-filtered before mixing with gas.

4.5.2.3. Each fire tube shall be furnished by separated burners, pilots and control system.

4.5.2.4. Pilot burner shall ensure smooth fired of the main burner during all modes of operation and furthermore the pilot shall remain stable under varying combustion chamber condition and flue way pressure.

4.5.2.5. Power supply Operated ignition system shall be provided for each burner.

4.5.2.6. The high voltage igniter electrode shall be separate from UVZ, if AC power is not accessible, using sensing rod is acceptable with manufacturer and client agreement.

4.5.2.7. Burner shall be so designed that intake air channel does not affected directly during burner fuel/air adjustment (Separated intake air chamber).

4.5.2.8. Suitable burner flame arrestor for protection against abnormal operation shall be provided. The flame arrestor shall be made of light weight non corrosive material.

4.5.2.9. Burner and pilot shall be use preheated natural gas.

4.5.2.10. Each pilot shall be furnished with photocell as the flame detector device.

4.5.2.11. For heater up to 5MMBTU/hr shall be need one fire tube, and for more than 5MMBTU/hr, two fire tubes it furnished with separated pilot (Suitable controlling).

4.5.2.12. The heating fuel is natural gas.

4.5.2.13.The gas velocity in the fuel line and burner manifold shall not exceed 20 m/sec.

4.5.2.14. The heating system is equipped with fuel gas regulating unit that shall be supported on heater. The fuel gas shall be taken from a suitable location downstream the station's gas pressure regulators.

4.5.3. Adjustment

4.5.3.1. An opening shall be provided on the fire tube for easy access so that each burner and pilot could be manually adjusted while installed.

4.5.3.2. Peephole shall be provided and located such that burner and pilot flames could be observed during adjustment and operation.

4.5.3.3. A 3 " threaded opening shall be provided for manually lightening of pilot in case of igniter failure.

4.5.4. Maintenance

4.5.4.1. Provisions shall be included so that the burner could be cleaned with a minimum of disassembly.

4.5.4.2. Burner and pilot shall be field removable.

4.5.4.3. Pilot shall be removable as complete assembly together with igniter electrode and flame detection device to facilitate maintenance.

4. .INSTRUMENT & CONTROL

4.6.1. The heater control and instrument system shall be designed for unattended operation.

4.6.2. Each water bath heater should be supplied with its own control panel, it will be located adjacent to water bath heater. The operation of the water bath heater should be automatically controlled. The control of temperature should be sensed from the outlet in order to automatically control the temperature and the outlet temperature set point can be adjusted from the heater controller.

4.6.3. Gas temperature from heater inlet and outlet, should be measured locally and transmitted to the control panel in cabinet.

4.6.4. All the instruments such as relays, contactors, controllers, switches and indicators shall be separately assembled, tested, calibrated and made ready in every respect for field installation. The relays, contactors, micro switches, indicating lamp, alarms and all necessary equipment related to the control system shall be assembled in a lockable box, easily installable in the field. All electrical connections shall be made with screw lock terminals and firmly secured using good quality terminal blocks.

4.6.5. All electrical instruments shall be installed in a lockable box with IP-54 protection. Level transmitter shall be IP-54 .

4.6.6. Fuel gas system shall be minimum equipped with following items:

4.6.6.1. Inlet isolating ball valve.

4.6.6.2. Filtering system, for pneumatic applications 3-5 micron filtration is necessary.

Equipped by Differential Pressure Gauge & 3-way manifold.

4.6.6.3. Regulator equipped with high pressure slam shut shall be factory adjusted within working pressure range of the main burner.

4.6.6.4.Safety relief valve with a max. blow down not more than 5% maximum burner capacity discharge must be directed away from the firebox.

4.6.6.5. Inlet & outlet pressure indicator.

4.6.6.6. Inlet temperature indicator.

4.6.6.7.Outlet isolating ball valve.

4.6.6.8. One spool as same as the gas meter length.

4.6.7. Process control system shall be design the following characteristics:

4.6.7.1. If automatic burner failed to shut down, it shall be reset manually.

4.6.7.2. If automatic pilot failed to shut down, it shall be reset manually.

4.6.7.3. Low level protection systems shall be equipped with one low level alarm (LLA) switch and one low level shut down switch (LLS).

4.6.7.4. Automatic proportional control on gas outlet temperature

4.6.7.5. Automatic proportional control on water/glycol temperature

4.6.8. All safety alarms and shutdown controls of burner management system shall be design in following condition:

4.6.8.1. Discontinuity in level switch output

4.6.8.2. Discontinuity in Gas/Bath temperature control output

4.6.8.3. Discontinuity in UV-Cell output

4.6.8.4. Discontinuity in UPS output (only alarm) – (Ref.IPS–M–EL–176(2) DATED APRIL 2009).

4.6.8.5. Discontinuity in Main power supply (only alarm).

4.6.8.6. Increasing Pressure in fuel line system.

4.6.8.7. Failure in Ignition system (except manual mode).

4.6.8.8. Failure in outputs of control Box to Fuel gas controlling elements.

4.6.9. All piping and instruments shall be adequately supported.

4.6.10. Each instrument shall be individually identified by a tag or name plate.

4.6.11. Instruments and controls shall be designed to withstand the maximum anticipated temperature and pressure.

4.6.12. Indication of controlled condition shall be provided on each process controller.

4.6.13. Temperature gauge/ indicator shall be bi-metallic type, hermetically sealed, non-reset, heavy duty type, dial size 100mm, white with black and red lettering, dual scale in centigrade and Fahrenheit, adjustable pointer. Gauge ranging -30 ~ +100°C.

4.6.14. Pressure gauge shall be furnished with stainless steel bourdon tube elements, stainless steel rotary gear, movements with blow out disc, dial size 100mm with black and red lettering, dual scale in bar and psi.

4.6.15..All gauges shall be equipped by an insolating valve.

4.6.16. Control valve bodies shall be cast or forged steel, guided plugs and seat rings shall be type 316 stainless steel up to 10 bar pressure drop.

For pressure drop over 10 bar without seat rings but with soft insert.

4.6.17. The control box shall be battery operated on 24 Volts DC power supply.

The system shall contain igniter, flame failure protection and automatic relight of the pilot burner(s).

4.6.18. 12VDC power supply shall consist of rechargeable battery complete with battery charger operating on 220 VAC, 50HZ. The DC power supply unit shall be capable for minimum eight hours operation in case of AC power failure.

4.6.19. Automatic relight system shall be activated in case of pilot flame failure and should start ignition and open pilot(≡ solenoid) valve.

4.6.20. If pilot flame is established then system control shall continue to normal Operation, otherwise result in total shut down.

4.6.21. All electrical valves and instruments shall be explosion proof.

4.6.22. Electrical terminations shall be provided with EEx or EEx-e junction boxes.

4.6.23. Fuel gas system and process control shall be considered to attached informative P&ID.

4.7.IGNITION SYSTEM

Supplier shall provide an ignition system complete with transformer, electrodes, interconnecting wiring and all necessary devices for pilot burner ignition.

Power supply operated ignition system shall be provided for each burner with, 24V DC power supply.

4.8.FIRE TUBE

4.8.1. Fire tubes material shall be pipes ASTM A106 Gr.B,A53 Gr.B, API 5L Gr.B or ASTM A516 Gr.70, wall thickness 0.250” up to 24” diameter and 0.312” for 26” diameter and larger.

4.8.2. The fire tube section is consist of combustion chamber and flue gas return.

4.8.3. The fire tube shall be fully welded. Complete penetration shall be down on all joints and visually inspected by a welding inspector.

4.8.4. Fire tube shall be field removable.

4.8.5. Average heat flux for fire tube shall not exceed 12,000 BTU/hr.ft^2 (33,000 Kcal / hr.m^2).

4.8.6. Fire tube heat density (heat released through the cross-sectional area of the fire tube) is regulated by the burner mixer and burner nozzle. Heater conforming to this specification will have a maximum heat density of 15,000 BTU/hr.in^2 for natural draft burner.

4.9. EXHAUST STACK

4.9.1. A self–supporting, removable exhaust stack designed with adequate height and diameter for maximum draft requirements with 3mm minimum wall thickness shall be provided.

4.9.2. The exhaust stack shall be hinged with suitable rain hood.

4.9.3. The stack shall be insulated with minimum 50mm rock wool or glass wool and clad with aluminum sheet, also applying chimney flashing .The maximum surface temperature shall not exceed 60°C.

4.9.4. The stack shall be equipped with the temperature indicator.

4.9.5.An anti-downdraft stack arrestor device such as flapper shall be provided. The stack arrestor shall be made of light weight non–corrosive material.

4.9.6. Stack height shall be at least 3 meters higher than shell top and shall be designed for maximum wind load (maximum speed 120 km/hr).

4.9.7. The stack shall be so designed that the heater operates from 25 to 100 percent of design.

4.9.8.The stack shall have a suitable guard to a sufficient height for protection against burn when accidentally touched.

4.9.9.The stack shall have three tapping for connecting of a temperature gauge, a gas sampling port and a draft gauge.

4.9.10.The stack shall have three suitable eye rings for the guy wires for protection against wind load. The same eye rings shall also be used for lifting the stack.

4.9.11.A blinded flange shall be installed at lowest point of the stack for removal dust & Debris. Blind Flange Dia.: (4" for Q ≤ 20000, 6" for 20000 < Q ≤ 50000, 8" for Q>50000 SCMH).

4.9.12.Stack bottom connection to fire tube shall be flanged type.

4.9.13.The gasket in fire tube and stack connection shall be suitable for high temperature resistance.

5- WELDING

5.1.WELDING PROCESS:

5.1.1. Welders

Welder qualifications shall be in accordance with section IX of the ASME code.

5.1.2. WPS & PQR

All welding shall be performed according to welding procedure specification (WPS).

The contractor shall submit welding procedure specification (WPS) and procedure qualification record (PQR) according to ASME IX for purchaser's review and approve before welding process started.

All welding procedure specifications shall have been or shall be qualified in accordance with section IX of the ASME Code. All tests shall be performed with equipment calibrated in accordance with applicable ASTM or national standards by an accredited laboratory. Re-qualification or additional qualification tests are required if in the opinion of the purchaser the supporting PQR fails to reasonably simulate the actual conditions during production welding and this could adversely affect weld performance. It will be the responsibility of contractor to carry out all the tests required to the satisfaction of purchaser.

5.2.WELDED JOINTS INSPECTION AND TESTING

5.2.1. General

The inspection and test should be carried out according to a non-destructive test procedure which may be issued for each work piece. Weld inspection may be performed by qualified site staff, quality control personnel or by qualified inspection company. The third part inspector shall have the right to selecting joint and witness the tests according to the provisions of the erection test plan.

5.2.2.Visual Inspection

Visual inspection shall be performed prior to under take any non-destructive tests.

The visual inspection shall be carried out according to the provision of the ASME Sec.

V. Visual check shall be performed to following as a minimum:

- Cracks
- Incomplete penetration
- Lack of fusion
- Under cutting
- Reinforcement
- Porosity
- Slag
- Concave root surface
- Uniformity of welded joint

- Surface finish
- Fillet weld throat
- Fillet weld concavity
- Fillet weld convexity
- Cleanliness

5.2.3. Liquid Penetrate Test

wherever dye penetrate test requested by inspector, shall be performed in compliance with the provisions of the applicable procedure and code.

5.2.4. Radiographic Test

Whenever required, radiographic tests shall be carried out according to the provisions of the applicable procedure and code.

5.2.5. Progress Examination

In case of random examination (i.e. exam by %) according to approved QCP, if a detective joint is found then all welded joints shall be fully tested.

5.3.REPAIR AND RE-INSPECTION

Defects shall be repaired in accordance with approved repair procedures and the joint shall be re-inspected by the same methods, and re-examined to the same extent, and by the same acceptance criteria required for the original weld. All repairs shall be carried out with prior permission of client.

6- TEST

6.1.STANDARD TEST

Heater coils shall be hydrostatically tested in accordance with the ASME boiler and pressure vessel code prior to shipment by the manufacture. Coils shall be tested before installation in main shell and after RT approved reports. Manufacture shall conduct the test in the presence of the purchaser's authorized representative.

In addition to the ASME code requirements for hydrostatic testing, the following measures shall be taken:

- Commercial tap water filtered with a 100 mesh screen having no additives other than wetting agent, rust inhibitors or fluorescent dye shall be used as the hydrostatic testing medium.
- All openings shall be blinded, capped, or plugged prior to test.
- Each heater coil shall successfully withstand the test pressure without failure, leakage,

distress or distortion other than elastic distortion during test period. In the event that a leak or break occurs, manufacturer shall locate and replace the defected part(s).

- The heater coil shall then be re-pressurized and a new test shall be carried out.
- All instruments shall be subjected to approval by purchaser's authorized representative prior to test.
- The test shall be accepted when in the judgment of purchaser's authorized representative the assembly is free of leaks.
- Fire tube shall be pneumatically tested at a pressure of 30 psig before installation in the main body.
- The completed fire tube shall be tightness tested (Preferably with compressed air/30 psig).
- Heater shell shall be tested for leakage and withstand the full load when filled with water.
- Fuel line and shell shall be tested according to client procedure test.
- A test record shall be made and shall include all descriptive or pertinent information to identify each heater coil. The test information as specified below shall be provided in letter of certification that the heater coil was tested and met all requirements of the applicable codes. All records shall be handed over to purchaser.
- The minimum information required on each letter of certification is as follows:
    - Purchase order number, item number
    - Destination
    - Coil serial number
    - Signature of manufacturer's test witness and/or purchaser's representative
    - Test duration
    - Ambient temperature
    - Brief description of test results, including any leaks or breaks
    - Complete with remedial action taken to correct the defect.
- Exhaust gas shall be sampled properly and tested when heater works. Exhaust gas should be comply local regulations regarding to control of emissions to air. According to standards of exhaust gas for industrial work shops and factories (approved by environment protection organization).

6.2. INSTRUMENT TEST

Electrical and instrument functional tests shall include simulation of field signals and loads and each instrument alarm or control loop shall be tested for operation throughout the full specified range.

7- INSPECTION

7.1. INTRODUCTION

- Inspection shall be done base on manufacturer QCP which is approved by client.
- Inspection shall be done by the client.
- Purchaser's authorized representative shall be afforded the opportunity to witness the manufacturing and testing of any part of the heater(s).
- The inspection and testing in no way however relieves the manufacturer of his responsibility for the heater(s) to meet all requirements of this specification.
- Radiographs shall be made available to the purchaser's authorized representative at the time of inspection.
- The manufacturer shall arrange for all necessary inspection for compliance with the ASME boiler and pressure vessel code.
- Each heater shall have a final inspection performed by the purchaser's authorized representative prior to shipment.

7.2. CLIENT'S INSPECTION

The client shall have the right to make inspections during fabrication and to witness any tests when he has so requested. Advance notification shall be given as agreed between the manufacturer and the client. Inspection by the client shall not relieve the manufacturer of his responsibilities. Any additional tests required by the client, above those already agreed to, will be to the client's account. Cost for remedial work as a result of these additional tests will also be to the client's account.

7.3.SUPPLEMENTAL INFORMATION

Certificates of all inspection, welders and material with test report shall be supplied to purchaser.

8- SURFACE PREPARATION AND PAINTING

Surface preparation and painting shall be in accordance to IPS-C-TP-101 & 102.

The applicable standard for surface preparation shall be the latest edition or revision of the international norm ISO 8501-1or SIS 055900 Grade SA 2$^1/_2$ (SSPC VIS1-89).

Coating shall be zinc silicate with a total dry film thickness of 150 microns.

External surface of coil, fire tube, piping and instruments and internal and external Shell`s surface shall be painted.

9- THE HEAT MEDIA SPECIFICATION

Fluid content of bath shall be solution of water, when freezing is possible, ethylene glycol shall be added for anti-freeze protection. Corrosion inhibitors shall be added. Information for this volume fraction for ethylene glycol/water solution, based to site temperature recommended Annexing I. But manufacturer recommended is preferred to this Annex.

10- MARKING

Each heater shall be identified by permanently attached corrosion resistant nameplate.

A stainless steel nameplate shall be located so that it is easily visible after installation.

Heater shall have nameplate containing marking and stamping in accordance with the ASME pressure vessel code plus the additional information as follows:

- Manufacture's name
- Year built
- Serial number
- Thermal absorption on coil Kcal/ hr (BTU/hr)
- Number of coils and number of flow paths
- Coil wall thickness, outside diameter and schedule number of coil pipes
- Coil outside surface area, m^2
- Fire tube outside surface area, m^2
- Coil weight, Kg
- Hydrostatic test pressure, psig
- Purchase order,
- Item number
- Shell weight, empty / full, Kg
- Bath water Capacity, Lit
- Expansion tank capacity, Lit

11- PACKING

For each heater packing shall be in accordance with NIGC protection, packing, marking and dispatching instructions outlined as follows:

All instruments, control systems, etc. shall be packed in accordance with above instruction but in sufficient cases of appropriate size.

All sensing lines (except those which could be packed with instruments) shall be disassembled, covered and wrapped with plastic materials and placed around the heater shell in such a way that they are not damaged during transportation. No. packing for shell is

necessary.

All separately packed parts of each heater (instruments, stack, etc …) shall be supplied in the same shipment with heater itself and identified accordingly.

NOTE 1: After the functional test is approved, then the required disassembling for packing shall be started.

NOTE 2: Supplier shall submit detail installation drawing as well as detail commissioning procedures and all necessary documents prior to shipment.

12- GUARANTEE

Manufacturer shall guarantee the compliance of material and performance of the supplied equipments with this specification.

The period of guarantee shall be one year after equipment goes on stream or eighteen months after date of shipment, whichever occurs first, or according to the contract.

Supplier shall agree to repair or replace any equipment which proves to be defective during the above mentioned period.

13- INSTALLATION

13.1. The heater units shall be positioned on site and provided with sufficient access to allow removal of coil section and fire tube section from the two ends of the heater separately for routine maintenance.

13.2. The heater layout shall be identified in regard to safety and environmental aspects(such as wind direction and speed,…).

13.3. All heater accessories (all gauges, name plate,…) shall be considered according to Agronomical aspects (such as accessibility, visibility, …).

14- DRAWINGS AND DATA

The following drawings and data shall be furnished to the client at quotation and ordering stages.

14.1. QUOTATION STAGE

14.1.1. N.I.G.C Data sheet (IGS-M-PM-104) completed by vendor.

14.1.2. General arrangement drawings showing outline dimensions and weights.

14.1.3. Preliminary play sectional view of heater internals.

14.1.4. List of recommended spare parts to cover initial commissioning and two years operation.

14.1.5. All technical information including description of fuel system, protection and control with relevant drawings and catalogue for each component.

14.2.ORDERING STAGE

14.2.1. Descriptive final arrangement and technical detail of drawings and last revision (as built DRWNG) included weight and load on foundation supports (Hardcopy and electronic files).

14.2.2. Comprehensive catalogues and detailed technical drawings of the supplied instruments.

14.2.3. Operating and installation instructions.

14.2.4. Maintenance manual(s)

15-APPENDIX

15.1. Heater Data sheet

15.2. Heater Nominal Capacity and Duty

15.3. Annex I (informative EG/ W sol vol.)

15.4. Informative P&ID

15.1. Heater Data sheet

	Indirect natural draft water bath heater Data Sheet			
Subject		Unit	To be Filled by NIGC/Client	To be Filled by Supplier
SERVICE CONDITION	GAS FLOW RATE	SCMH	...	
	INLET PRESSURE	psig/bar	Min.( ) Max.( )	
	INLET TEMPERATURE	˚C	Min.( ) Max.(10)	
	Max. OPERATING OUTLET TEMPERATURE	˚C	38	
	NET ABSORBED HEAT DUTY	Kcal/hr	...	
	GROSS HEAT DUTY: Burner /Fire Tube	Kcal/hr	...	
	OVERALL THERMAL EFFICIENCY	Min.%	75	
	MAXIMUM BATH TEMPERATURE	˚C	88	
	MAXIMUM GAS VELOCITY IN COIL	m/sec	20	
	MAXIMUM PRESSURE DROP IN COIL	bar	1.75	
	DESIGN PRESSURE	psig/bar	1.1 Max. Operating Pressure	
	DESIGN TEMPERATURE	℃	100	
	END CONNECTION SIZE	in		
	FUEL GAS SUPPLY PRESSURE	bar	4 – 17	
	AMBIENT TEMPERATURE	℃	MIN( )/MAX( )	
	MAXIMUM WIND VELOCITY	Km/hr		
	MAXIMUM RAIN FALL	mm/Yr		
	RELATIVE HUMIDITY	%		
	MAXIMUM SNOW LOADING	mm		
	EARTH QUAKE ZONE (OBCIV)			
	ELEVATION ABOVE SEA LEVEL	m		
	FUEL GAS CONSUMPTION	SCMH		
	FIRE TUBE HEAT FLUX	BTU/hr.ft²	max. 12,000	
	FIRE TUBE HEAT DENSITY	BTU/hr.in²	max. 15,000	
END CONNECTION	TYPE		FLANGE W.N., R.F.	
	CLASS		600	
	INLET AND OUTLET SIZE	in		

COIL	MATERIAL		ASTM A-53, Gr.B, SCH 80 / ASTM A106, Gr.B, SCH 80	
	OUTSIDE AND INSIDE DIAMETER	mm	…/…	
	No. OF FLOW PATHS	No		
	No. OF PASSES PER FLOW PATH	No		
	TOTAL COIL OUTSIDE SURFACE AREA			
	DESIGN PRESSURE	bar		
	DESIGN TEMPERATURE	˚C	100	
SHELL	MATERIAL		SA.36 or equivalent	
	DIAMETER	mm		
	LENGTH	mm		
	INSULATION MATERIAL AND THICKNESS		50 mm THICKNESS FIBBER GLASS/ ROCKWOOL & ALUMINUIM CLADDING	
EXPANSION TANK	MATERIAL		SA.36 or equivalent	
	DIAMETER	mm	…	
	LENGTH	mm	…	
	INSULATION MATERIAL AND THICKNEE	mm	50 mm FIBBER GLASS/ ROCKWOOL & ALUMINIUIM	
MAIN FIRE TUBE	MATERIAL		ASTM A53	
	NO. OF TUBES		…	
	SIZE	mm	…	
	WALL THICKNESS	in	0.250" FOR 24" AND SMALLER 0.312 " FOR OVER 24"	
	SURFACE AREA	mm²		
RETURN FIRE TUBE	MATERIAL		ASTM A53	
	NO. OF TUBES		…	
	SIZE	mm	…	
	SURFACE AREA	mm²		
	WALL THICKNESS		0.250" FOR 24" AND SMALLER 0.312 " FOR OVER 24"	
BURNER	NO. OF BURNERS		…	
	TOTAL CAPACITY	BTU/hr (Kcal/hr)	...	
	TYPE		Atmospheric	
	MANUFACTURER, MODEL NUMBER		NIGC Vendor List	
	NO. OF PILOTS, TYPE		…	

	TYPE OF FLAME ARRESTOR		…	
STACK	MATERIAL		ST.37 or equivalent	
	DIAMETER	mm	…	
	THICKNESS	mm	3	
	HEIGHT	mm	…	
	DRAFT	mm WC(Pa)	…	
	TYPE OF ANTI DOWN DRAFT DEVICE		Light Weight non Corrosive Material	
PAINTING	STANDARD FOR SURFACE PREPARATION		STS 055900	
	COATING MATERIAL		1. Zinc ethyl Silicate 2. Epoxy Poly amid Top Coat	
	TOTAL THICKNESS OF PAINT		... MICRON	
INSTRUMENT REGULATOR	TYPE		... (FAIL TO OPEN)	
	SIZE	in	...	
	MANUFACTURER		NIGC Vendor List	
	SET PRESSURE	psig		
MAIN SHUT-OFF VALVES	TYPE		…	
	SIZE	in	...	
	MANUFACTURER		NIGC Vendor List	
MANUALLY SWITCH ELECTIC	TYPE		…	
	MANUFACTURER		NIGC Vendor List	
	POWER REQUIREMENT	V	220	
FUEL CONTROL VALVE	TYPE		Fail To Close	
	MANUFACTURER		NIGC Vendor List	
RELIGHT SYSTEM	TYPE		PLC Control	
	MANUFACTURER		NIGC Vendor List	
BATTERY	TYPE		12vx2 Sealed Acid	
	MANUFACTURER		…	
	CAPACITY		…	
	LIFE TIME (IN OPERATION)		8 Hours OPERATION	
AUTOMATIC BATTERY CHARGER	TYPE		RECHARCHABLE	
	MANUFACTURER		NIGC Vendor List	
	INPUT VOLTAGE		220 V AC	

	OUTPUT VOLTAGE		12 V DC Regulated	

15.2. Heater Minimum Requirement in Heat Transfer Area

Minimum operating pressure: 400(psig)

Max. Operating pressure: 1050/1305(psig)

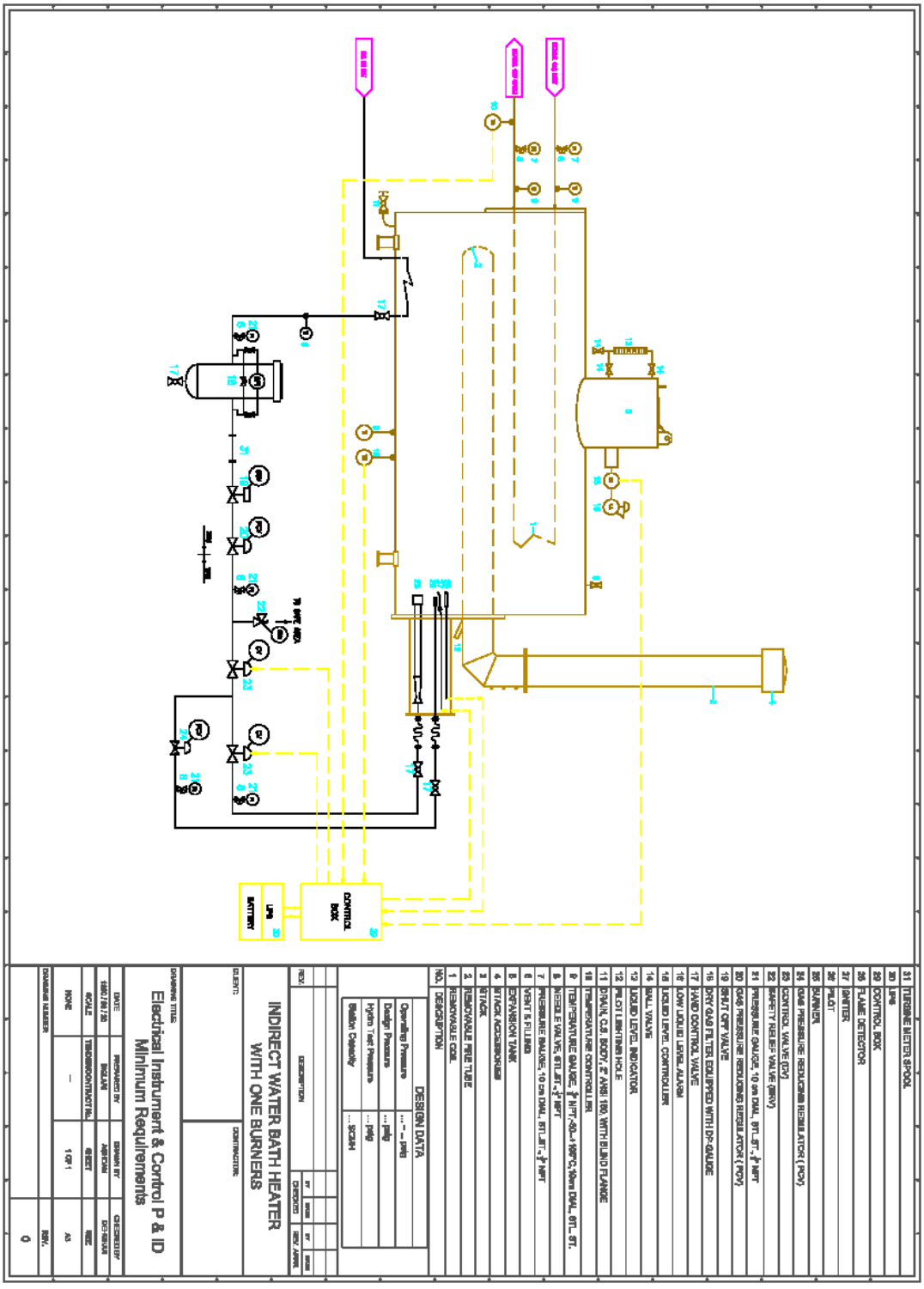
Heater Capacity , SCMH	Minimum Required Net Absorbed Heat Duty , Btu/hr	Minimum Required Coil Cross Sectional Area , m^2	Minimum Required Heat Transfer Area (Coil Surface Area), m^2
2,500	170,000	0.0013	3.3
5,000	335,000	0.0026	7
10000	670,000	0.005	10.5
20,000	1,335,000	0.011	22
30,000	2,010,000	0.016	27
50,000	3,350,000	0.027	45
100,000	6,700,000	0.052	92

15.3. Annex I (informative EG/ W sol vol.)

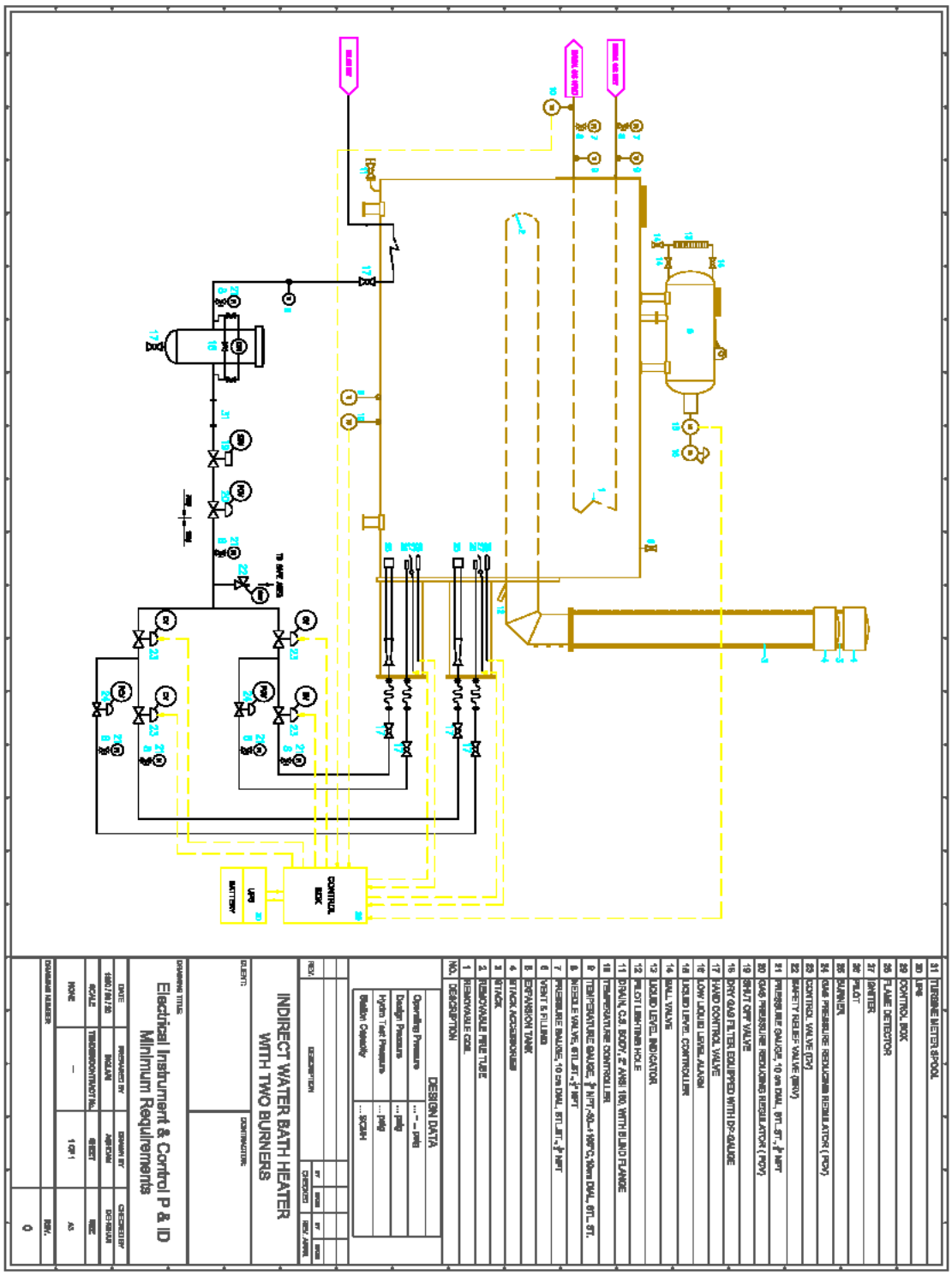
Min. site temperature (°C)	Ethylene glycol Liq. Vol. fraction	Min. site temperature (°C)	Ethylene glycol Liq. Vol. fraction
-5	0.125	-2	0.450
-6	0.147	-29	0.460
-7	0.170	-30	0.470
-	0.190	-31	0.4 0
-9	0.210	-32	0.4 5
-10	0.230	-33	0.495
-11	0.240	-34	0.500
-12	0.260	-35	0.510
-13	0.270	-36	0.515
-14	0.2 0	-37	0.520
-15	0.300	-3	0.530
-16	0.320	-39	0.535
-17	0.330	-40	0.540
-1	0.340	-41	0.545
-19	0.360	-42	0.550
-20	0.370	-43	0.555
-21	0.3 0	-44	0.560
-22	0.390	-45	0.565
-23	0.400	-46	0.570
-24	0.415	-47	0.575
-25	0.425	-4	0.5 0
-26	0.435	-49	0.5 5
-27	0.445	-50	0.590

15.4. Appendix (Informative P&ID)

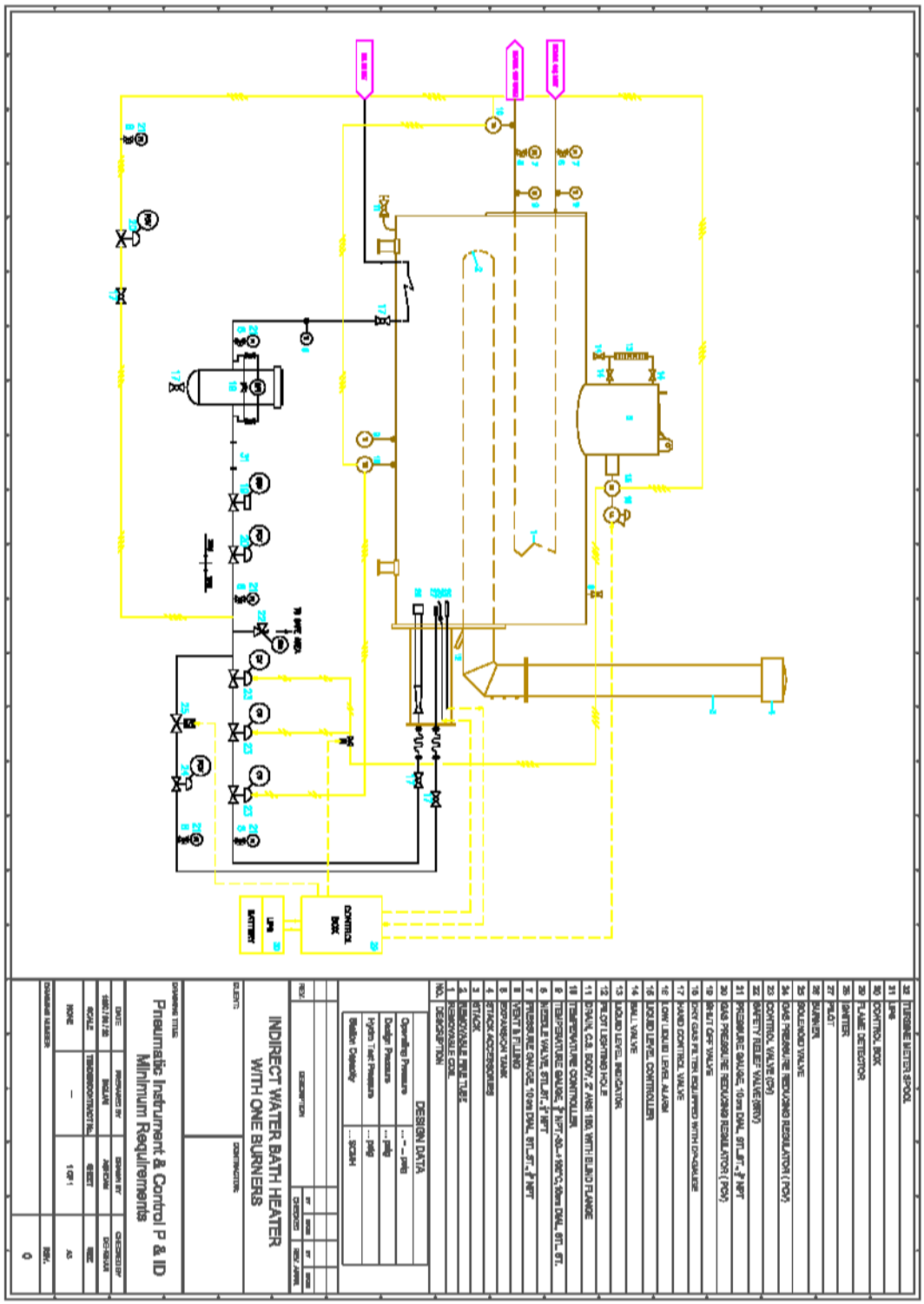
15.4.1. Informative P&ID



15.4.2. Informative P&ID



15.4.3. Informative P&ID


INDIRECT WATER BATH HEATER
WITH ONE BURNERS
Pneumatic Instrument & Control P & ID
Minimum Requirements
DESIGN DATA
CONTROL BOX
BATTERY
UPS

1 5.4.4. Informative P&ID