ENGINEERING SERVICES DEPARTMENT

SPECIFICATION SHEET FOR ELECTRICAL HEATER H1507

Project	NW PlasGas and CWOPG Demonstration Facilities.	**Unit Tag No.**	H1507
Datasheet Document No.	ENS-NWPVR-SPE-24024	**Revision**	3
Description	Shared electrical heater (H1507) for the Low-Level Waste Plasma Gasification (NW PlasGas) and the Uranium Contaminated Waste Oil Plasma Gasification (CWOPG) Demonstration Facilities is used to heat up the off-gas exiting the scrubber from a temperature of 35 ^{o}C to 60 ^{o}C. The gas is drawn through the electrical heater using a blower downstream of the heater. Two in-line HEPA filters are installed in series between the heater outlet and blower inlet [9].		
Plant location	NECSA, Pelindaba, North-West Province.		
Equipment location	Merged NW PlasGas and CWOPG Demonstration Facilities - Process area inside Laboratory-150, Building V-H2 [a].		
Safety Classification	SC-3 (N) and SC-2 (C) [b].		
Quality Classification	QC-3 (N) and QC-2 (C) [c].		
Process Fluid	NW PlasGas: Gas mixture containing CO_2, HCl , O_2 and N_2 . Composition varies as per Note [e] below.	CWOPG: Gas mixture containing CO_2, O_2, N_2,HCl, and HF. Composition varies as per Note [e] below.	
Fluid state	Gas.		
Solid content	Possible uranium-containing solid particulates.		
Corrosive due to	Hydrogen Chloride (HCl) gas - entering heater at a maximum rate of 10 g/h. Hydrogen Fluoride (HF) gas - entering heater at a maximum rate of 0.2 g/h		

	UNITS	DESIGN CONDITIONS (NW PlasGas)	DESIGN CONDITIONS (CWOPG)
Operating pressure	**kPa (abs)**	78	78
Operating temperature	**K**	333 [2]	333 [2]
Mass flow rate	**kg/h**	47.98 [1]	44.68 [7]
Volume flow rate	**m^3/h**	43.2	40.7
Density	**kg/m^3**	1.112 [f]	1.098 [f]
Viscosity	**Pa.s**	1.727 X 10^{-5} [g]	1.756 X 10^{-5} [g]
Thermal conductivity	**W/m.K**	0.022 [h]	0.022 [h]
Specific heat capacity (Cp)	**kJ/kg.K**	1.066 [i]	1.063 [i]

ELECTRICAL INTERFACE

Heat load (min)	**kW**	0.5 [j]		**Volt**	Supplier to Advise.
Frequency	**Hz**	Supplier to Advise.		**Phase**	Supplier to Advise.
Materials of construction		**Wetted**	Supplier to Advise.		
		Non-wetted	Supplier to Advise.		

FLANGE CONNECTION

Size	200 mm (8")
Flange rating	150#, RF
Flange Materials of construction	SS, ASTM A182-F304/304L, ASME B16.5
Gasket	1/16" thick flexible graphite w/304 SS or 316 SS corrugated insert, ASME B16.21

MATERIAL OF CONSTRUCTION

Available working length (along the pipe) of the electric heater	350 mm
Available working Width of the electric heater	700 mm
Element sheath material	Supplier to Advise.
Tubesheet material	Supplier to Advise.
Baffles/element supports	Supplier to Advise.
Terminal box material	Supplier to Advise.
Tubesheet-to-vessel flange bolting material	Supplier to Advise.
Tubesheet-to-vessel flange joint gasket	Supplier to Advise.

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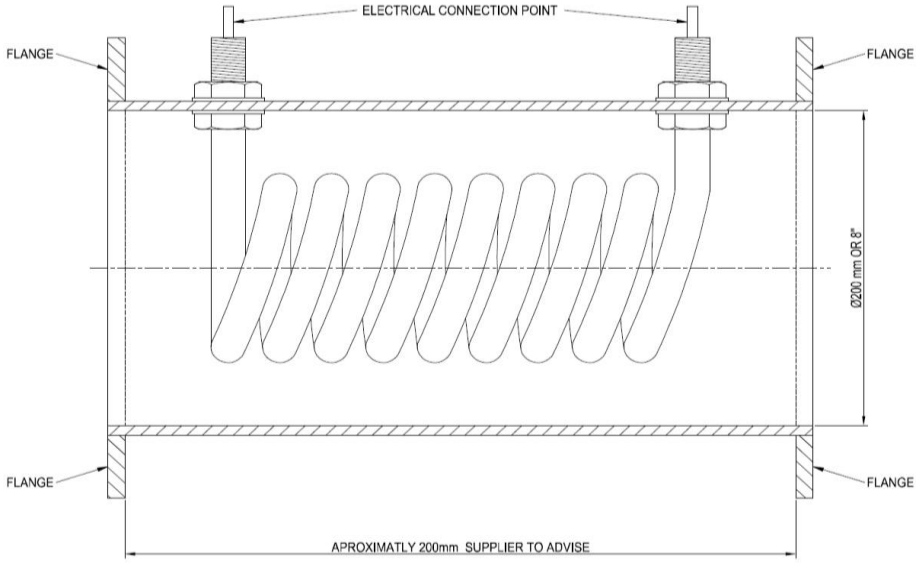
Information on electric heater potential parts:

1. Electric heater coil.
2. Suitable flanges for a 200mm (8") pipe, class 150, RF (or supplier to advise)
3. Pipe diameter of 200mm (8") 40S or advised by the supplier to be able to fit an electric heater coil inside.
4. Suitable fasteners for the electric heater coil to hold and give leak proof connection between the pipe and the electric heater coil.
5. Electrical connection points.



GENERAL	
Heater type	Flanged In-line heater with heating element mounted inside housing. Direct contact between process fluid and heating element, as fluid flows through the heater.
General notes	Factory acceptance test required.

REFERENCES

[1] ENS-NWPVR-REP-24015: Mass Balance Report for the NW PlasGas Demonstration Facility

[2] ENS-NWPVR-CLC-24012: Energy Balance Calculations for NW PlasGas Demonstration Facility

[3] AC-ENGBKG-SPE-21001: Properties of Liquid and Gas Mixtures

[4] ENS-NWPVR-REP-24013: Mass & Energy Balance (Zutari Report) for the Low-Level Waste Plasma Gasification (NW PlasGas) Demonstration Facility.

[5] Perry, R. H., & Green, D. W. (1997). Perry's Chemical Engineers Handbook, 7th Edition, McGraw-Hill Company.

[6] Sinnot, R. K. (2005). Coulson & Richardson's CHEMICAL ENGINEERING, Chemical Engineering Design, Volume 6, 4th Edition.

[7] ENS-OWPVR-CLC-24006: Scrubber Design for the Uranium Contaminated Waste Oil Plasma Gasification Project

[8] ENS-OWPVR-CLC-24002: Mass & Energy Balance Calculations for the Basic Engineering Design of the Uranium Contaminated Waste Oil Plasma Gasification Project

[9] ENS-NWPVR-PID-24002, P&ID Diagram - NW PlasGas Demonstration Plant Subsystem 15

NOTES AND ABBREVIATIONS

[a] The NW PlasGas and CWOPG Facilities will not be operated simultaneously. Therefore this electrical heater will only be servicing one of the facilities at a time.

[b] SC - Safety Class

[c] QC - Quality Class

[d] Supplier to advise on special requirements for installation of the heater.

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NOTES AND ABBREVIATIONS

[e] In both the NW PlasGas and CWOPG Facilities, the composition of the scrubber off-gas, which passes through the heater, changes over time due to chemical reactions taking place in the scrubber. The gas compositions (% w/w) are as follows for the two Facilities:
- NW PlasGas Facility: 1.3% CO_2, 0.1% HCl, 51.9% O_2 and 46.7% N_2 at the start of the process, and 74% CO_2, 0.02% HCl, 13.7% O_2 and 12.3% N_2 at the end of the process [1].
- CWOPG Facility: 10.3% CO_2, 0.01% HCl, <0.01% HF, 56.7% O_2 and 33.0% N_2 at the start of the process, and 69.6% CO_2, Traces of HCl, Traces of HF, 19.2% O_2 and 11.2% N_2 at the end of the process [7].

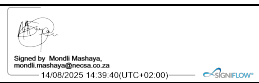
[f] Ideal gas behaviour was assumed to estimate the density due to low pressure and low temperature

[g] Mixture viscosity estimated using the equation in [3] section 4,2. Pure component densities estimated using nomograph given in [5] Fig 2-32, page 2-321, with nomograph cordinates from [5] Table 2-364, page 2-320, (HCl/HF contribution assumed to be negligible).

[h] Mixture thermal conductivity estimated using equation 8.14 in [6] section 8.8.4. Pure component thermal conductivities estimated using Table 2-363 given in [5], page 2-319, (HCl/HF contribution was assumed to be negligible).

[i] Mixture specific heat capacity estimated by weighted average calculation. Pure component specific heat capacities estimated from Table 4.10 in [1], (HCl/HF contribution assumed to be negligible)

[j] Heat duty of 0,35 kW is given for NW PlasGas in [2] and 0.28 kW for CWOPG in [8]. A safety margin was incorporated to obtain the final heat load.

	Name	Signature & Date
Compiled by	M Mashaya (Process Engineer)	
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