STATEMENT OF VERIFICATION

Technology: VRT – Vacuum Rain Tank

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Signed, 30/11/2015

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1. TECHNOLOGY DESCRIPTION

VRT system ensures the absence of rainwater and/or groundwater within interspaces, confined areas and in particular within manholes of underground tanks of fuel stations.

In the latter case, in fact, a risk analysis applied to the fuel load process during rainfalls allowed to underline that rainwater can infiltrate within the manholes.

Actually, despite the correct construction and positioning of the manholes, the normal activity daily involves their opening for the duration of tanks loading and their inspection. If the activity, whose average duration is about 1-2 hours/day, occurs in the presence of rainfall, rainwater can fall into the manholes.

As the operations of connection, fuel load and disconnection of pipes may lead to fuel dripping phenomena, infiltrated rainwater can be polluted by hydrocarbons and/or can penetrate the tank through valves, polluting the fuel. Therefore it cannot be excluded that a low seal resistance of manholes leads to the same phenomena during rainfalls.

VRT system provides the suction and the following depuration of rainwater in the manholes of fuel storage tanks and in other closed areas characterized by the presence of water polluted by hydrocarbons. It has been designed and implemented in order to ensure a continuous path from the sampling point up to the terminal discharge in full compliance with regulations (art. 74 D. Lgs. 152/06 and followings).

Applied technology is intended for an integrated and reliable management of rainwater in any operative condition respecting the environment and the safety of workers. In particular, the components of VRT system, where necessary, have been classified as ATEX II and can be installed in potentially explosive environments.

Installation of VRT system, consisting of ATEX II components, properly communicated to competent bodies, does not alter the administrative and control requirements provided by DPR 151 of 01/08/2011, regarding the regulation scheme for the discipline of procedures relative to fire prevention.

The full range of models of the VRT system includes:

VRT - 219 l/h
VRT - 650 l/h
VRT - 3600 l/h

CONCEPTUAL DESIGN AND TECHNICAL COMPONENTS

The principle used by VRT System is Vacuum suction and physical water treatment with oil separators.

The scheme below (Fig.1) represents the components of VRT plant that are in summary:

- suction pipes installed in the manholes – PEHD DN 20-25 SDR 11 (Fig. 2);
- control cabinet equipped with: a) peristaltic pump ATEX2IIG dimensioned for 219 l/h, 650 l/h and 3600 l/h; b) collector provided with nr.10 sphere valves; c) ON-OFF pushbutton system ATEXII; d) pump discharge pipe – PEHD SDR 11;
- electrical panel, installed outside of ATEX zone, 380 V, connected with pushbuttonsystem and pump in the control cabinet through a 24V (or 230V Atex) cable;
- siphon shaft installed underground between control cabinet and oil separator;
- sludge/oil separator, installed underground, provided with coalescent insert, that allows the treatment of wastewater ensuring a maximal hydrocarbons concentration of 5 mg/l (class 1 according to UNI EN 858);

- sampling shaft, installed underground, to control discharge concentrations according to law-limits.

The following scheme represents VRT System conceptual design (Figure 1).

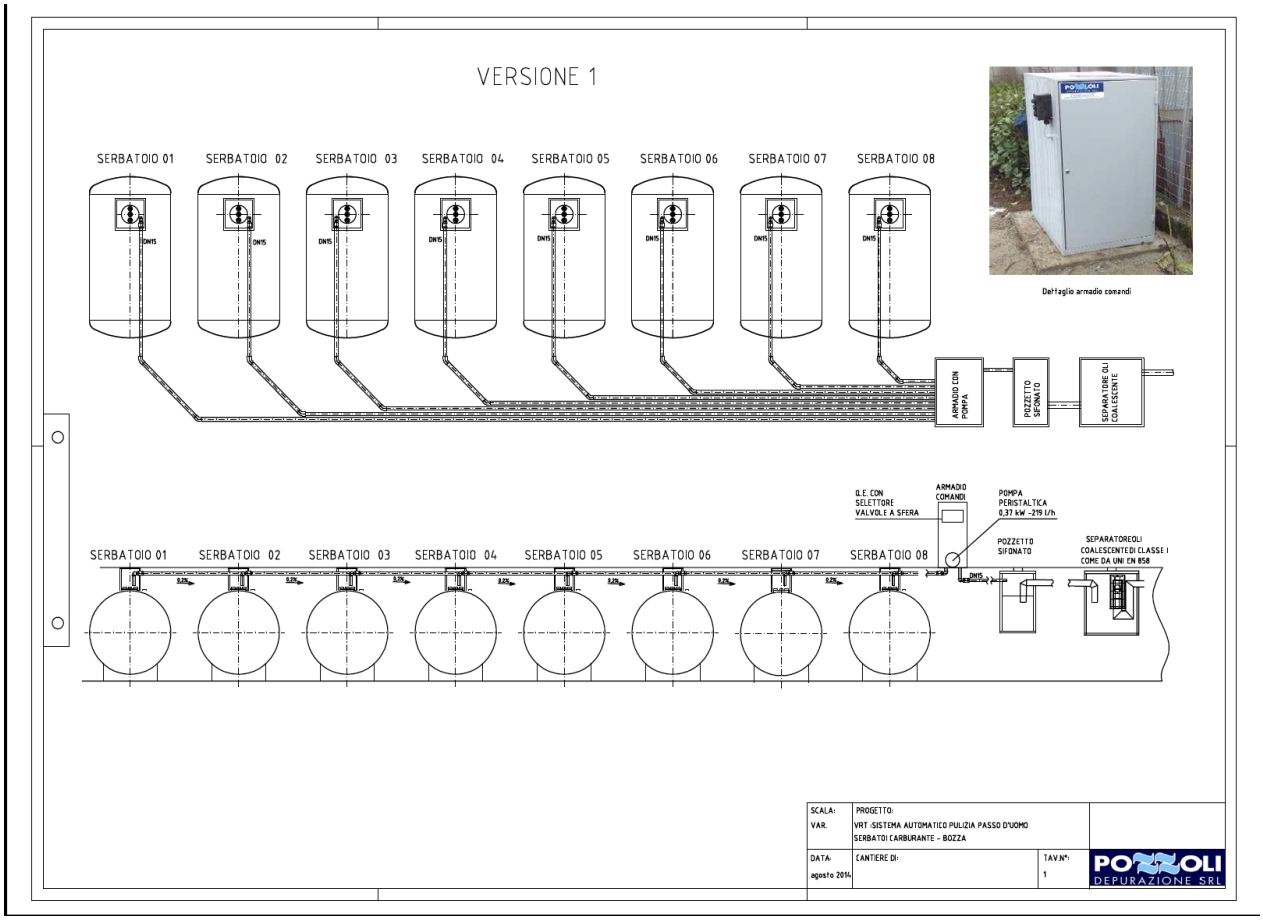

Figure 1. VRT System conceptual design

Figure 2. Manhole with VRT suction pipe installed

2. APPLICATION

2.1 MATRIX

VRT system provides the suction and the following depuration of rainwater in the manholes of fuel storage tanks installed by fuel stations, transport areas, private commercial activities and so on.

2.2. PURPOSE

The purpose of this system is to avoid the contamination of terrains and groundwater through collection of contaminated rainwater, treating in oil separator and subsequent conveyance of treated waste water to the existing sewerage system.

Although VRT system is conceived for suction and depuration of the water within the manholes, it can be also used in other closed areas interested by infiltration of water potentially polluted by hydrocarbons.

2.3 CONDITION OF OPERATION AND USE

VRT is suitable for the treatment of water with a percentage of hydrocarbons within the mixture up to 5 %. In case of higher percentage (e.g. in case of incidental fuel spreading) the removal must occur through cleaning truck services according with the local legislation.

Normally, the quantity of rainwater that can be found within a manhole does not exceed 100 liters.

Hence, for a fuel service station, the most suitable model of VRT system is VRT - 219 l/h or VRT - 650 l/h. VRT – 3600 l/h is a model to be used only for particular applications. For this reason the EU ETV verification of the VRT systems focus on the following models:

VRT - 219 l/h
VRT - 650 l/h

The sludge/oil separator ordinary maintenance must be carried out twice a year and consists in:

- verification of sludge and oil quantities and eventual removal;
- verification of correct working and cleaning of the emergency float;
- wash of the coalescent filter;
- verification of the ATEX II alarm system (if present).

2.4 VERIFICATION PARAMETERS DEFINITION SUMMARY

In table 1 a summary of the performance parameters are presented.

Table 1: Summary of the performance parameters

Parameter	Value claimed *at the 95% confidence level*	Comments
Pump discharge flow rate: VRT - 219 l/h VRT - 650 l/h	*219 l/h ± 15%,* *650 l/h ± 15%*	*The claimed pump discharge rate fits the user needs; the quantity of rainwater that can be found within a manhole does not exceed 100 liters.*
Total hydrocarbons concentration downstream of the VRT system	*≤ 5 mg/l*	*5 mg/l is the limit for direct discharge in superficial water bodies by D.LGS. 152/06 (Italian law as transposition of EU norms 96/61/CE, 2000/60/CE, 91/156/CE and followings).*
Total suspended solids downstream of the VRT system	*≤ 80 mg/l*	*80 mg/l is the limit for direct discharge in superficial water bodies by D.LGS. 152/06 (italian law as transposition of EU norms 96/61/CE, 2000/60/CE, 91/156/CE and followings)*

3. TEST AND ANALYSIS DESIGN

3.1. EXISTING AND NEW DATA

The" VRT – Vacuum Rain Tank" has not been tested previously. Therefore, this verification is based on new data since no existing data were available.

3.2. LABORATORY OR FIELD CONDITIONS

Two VRT full scale models (model VRT - 219 l/h or VRT - 650 l/h) were tested at field conditions in two operating fuel service stations (Fig.2 and Fig.3):

- PV Eni 4817 Viale Montegrappa 250, 59100 Prato (VRT-219 l/h model composed by peristaltic pump Verderflex VF 15 and sludge/oil separator NEUTRAcom 3/300);
- PV Eni 55857 Viale Montegrappa 300, 59100 Prato (VRT-650 l/h model composed by peristaltic pump Verderflex VF 25 and sludge/oil separator NEUTRAcom 3/300).

VRT systems have been in operation in the fuel station above for more than one year. Sludge/oil separators NEUTRAcom 3/300 follow an ordinary maintenance programme. Before the verification no specific extraordinary maintenance have been made.

The testing and verification activities were performed simulating real pollution events in the manholes of fuel storage tanks:

- the manholes (completely emptied before starting the test) were filled with different fuels (diesel or gasoline) in water emulsions (up to 5% of fuel) with 25 liters of water for the VRT-219 l/h and with 50 liters of water for the VRT-650 l/h;
- a hydrocarbons concentration in volume within the oil separator >0,5% (separated oil) was ensured.

The needed environmental conditions during the tests were satisfied:

- external temperature > 0 °C;
- good lighting conditions;
- absence of rainfalls during the whole duration of the test.

Figure 2. One of the tested VRT Systems:
the sludge/oil separator (left), the control cabinet (center) and the peristaltic pump (right).

Figure 3. Testing performance of the VRT System: sampling operations (left), the testing site (centre) and testing preparation of the manholes (right).

3.3. MATRIX COMPOSITIONS

The VRT System is verified for the suction and the following depuration of rainwater in the manholes of fuel storage tanks installed by fuel stations. More specifically, in the present verification the matrix is the emulsion of fuel (diesel or gasoline) and water in volume within the manholes (%) as describe below:

- 1st manhole: 0,5 % diesel – 99,5 % water;
- 2nd manhole: 2,5 % gasoline – 97,5 % water;
- 3rd manhole: 5 % diesel – 95 % water

3.4. TEST AND ANALYSIS PARAMETERS

Test parameters and analysis parameters and the respective analytical methods are presented in table 2.

Table 2. Parameters and relative methods

Parameter	**Value *at the 95% confidence level***	**Test or Measurement method(s)**
Pump discharge	*219 l/h ± 15%, 650 l/h ± 15%*	*In house method developed as for the Specific Verification Protocol.*
Total hydrocarbons concentration downstream of the VRT system	*≤ 5 mg/l*	*APAT CNR IRSA 5160 B2 Man 29 2003*
Total suspended solids downstream of the VRT system	*≤ 80 mg/l*	*APAT CNR IRSA 2090 B Man 29 2003*

3.5. TESTS AND ANALYSIS METHODS SUMMARY

For each test site, three manholes were filled in with the fuel-water emulsion as described in 3.3. After a required mixing period of 5 minutes the peristaltic pump was activated and the emulsion was aspirated from each manhole (one manhole per time). For each manhole water samples were collected upstream and

downstream the separator. Also measurements of flow rates were performed. The samples were transported to an accredited EN ISO/IEC 17025 laboratory for the measurement of “Total hydrocarbons” and “Total Suspended Solids”. A detailed description of the test method is described in the Test Plan.

3.6. PARAMETERS MEASURED

Test parameters and analysis parameters and the respective analytical methods are described in section 3.4

4. VERIFICATION RESULTS

4.1. PERFORMANCE PARAMETERS

In table 3 the verified performance is presented as a mean value together with the respective 95 % confidence intervals and compared with the claimed performance. According to the ETV verification performed the pump discharge flow rate of the VRT models (VRT - 219 l/h and VRT - 650 l/h) is in line with the claimed performance.

The VRT is system, in the correct condition of operation and use (see Chapter 2.3), and in the field conditions described above (see Chapter 3.2) is able to ensure “total hydrocarbons” and “total suspended solids” concentration downstream of the VRT System in full compliance with regulations (art. 74 D. Lgs. 152/06 and followings) as described in Table 3.

This performance has been verified with the operational conditions specified in section 4.2.

Table 3. Verified Performance

Parameter	Claimed Performance	Verified Performance	Comments
PUMP DISCHARGE FLOW RATE (model 219 l/h)	*219 l/h ± 15%,*	*229,17 l/h [225,29 – 233,35]*	*Average of six measurements*
PUMP DISCHARGE FLOW RATE (model 650 l/h)	*650 l/h ± 15%*	*644,75 l/h [635,71 – 653,79]*	*Average of six measurements*
TOTAL HYDROCARBONS *(Total hydrocarbons concentration downstream of the VRT System)*	*≤ 5 mg/l*	*1,45 mg/l [0,9 – 2]*	*Average of six samples*
TOTAL SUSPENDED SOLIDS *(Total suspended solids concentration downstream of the plant)*	*≤ 80 mg/l*	*16,33 mg/l [12,62 – 20,04]*	*Average of six samples*

4.2. OPERATIONAL PARAMETERS

Results from measurements of Hydrocarbons in volume within the oil separator and Hydrocarbons in volume within the manholes (%) in table 4.

Table 4. Operational Parameters

Operational Parameter	Value Verified	Comments
Hydrocarbons in volume within the oil separator (%)	*> 0,5%*	*Using a graduated rod and a reagent paste it was measured the thickness of separated oils within the sludge and oil separator. Through this thickness was calculated the volume of separated oils contained in the separator*
Hydrocarbons in volume within the manholes (%)	*1st manhole: 0,5 % diesel – 99,5 % water; 2nd manhole: 2,5 % gasoline – 97,5 % water; 3rd manhole: 5 % diesel – 95 % water*	*Mixture preparation was carried out by Pozzoli Depurazione operators according to the instructions of the ACCREDIA certified EN ISO/IEC 17025 laboratory Tecnologie d'Impresa Srl as verified on site.*
Environmental Conditions	*T > 0 °C No rainfalls*	*Verified on site*

4.3. ENVIRONMENTAL PARAMETERS

The relevant environmental parameters are included as performance parameters as described in section 4.1

5. ADDITIONAL INFORMATION

Additional information can be found in the verification report. Technologies and technical conditions are reported at chapter 2.2.

6. QUALITY ASSURANCE AND DEVIATION

The test and verification activities were planned and undertaken in order to satisfy the requirements on quality assurance described in the General Verification Protocol Version 1 developed for the EU ETV Pilot Programme.

Test activities were undertaken in house by Pozzoli Depurazione. Pozzoli Depurazione has a quality management system in place that follows the principles of EN ISO 9001 and it is judged that it fulfils the requirements of the EU ETV General Verification Protocol (Chapter C.III).

Laboratory analyses were performed by Tecnologie d'Impresa Srl, accredited according to the ISO 17025 for methods in the area of analysis relevant for the verification process (Accreditation n° 0175).

The personnel and experts responsible for quality assurance as well as the different quality assurance activities are described in the table 5.

- Review of the SVP: an internal technical review and an external technical review from an external technical expert. The internal review was performed by Mattia Fazzi (qualified as ETV Inspector). External review was performed by Claudia Cattaneo (qualified as Technical Expert);
- Test Plan and Test Report review: the Test Plan and the Test Report were subject to a review by Massimiliano Monetti, a qualified technical expert from RINA. The ETV inspector Felice Alfieri (Coordinator for this specific inspection activity) approved the Test Plan and the Test Report;
- Test system control: it was performed by Andrea Invernizzi (Pozzoli Depurazione);
- The internal audit of the testing process was performed by Bruno Soracco;

- Test system audit / test performance audit: a physical audit was conducted by the ETV Inspector Felice Alfieri and by the Technical Expert Fabio Olivieri during the actual testing of the technology;
- The Verification Report and the Statement of Verification were reviewed according to EU ETV pilot programme. External review was performed by Claudia Cattaneo. An internal review was performed by Mattia Fazzi. The Verification Report has been finally approved by the RINA's ETV Technical Manager Laura Severino.

Table 5: Verification and Quality Assurance plan

	ETV Inspector	**ETV Technical Expert**	**Technical Expert (ATEX Directive)**	**ITR**	**E-ITR**	**Proposer**	**Proposer (Internal Auditor)**
Personnel Responsible	Felice Alfieri	Massimiliano Monetti	Fabio Olivieri	Mattia Fazzi	Claudia Cattaneo		Bruno Soracco
Task							
Specific Verification Protocol	Draft			Review	Review	Review and approve	
Test Plan	Approve	Review					Review
Test System at test site	Audit		Audit				Audit
Test Performance	Audit					Test System Control	Audit
Test Report	Approve	Review					Review
Verification Report	Draft			Review	Review		
Statement of Verification				Review	Review	Acceptance	