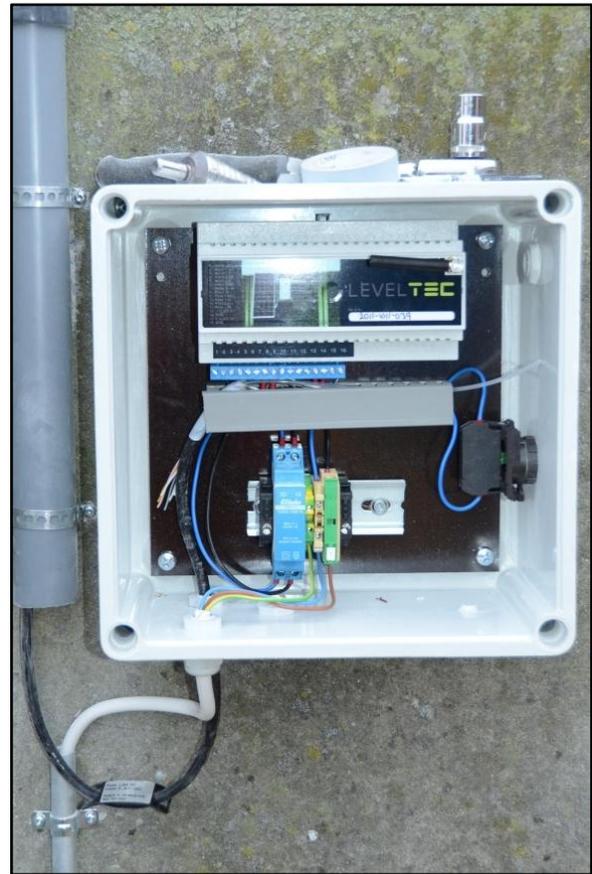


LevelTec Online monitoring of slurry storage tanks

Verification report





Document information

Document title	LevelTec. Online Monitoring of Slurry Storage Tanks. Verification report.
Project	ETV Test Center and Test Organisation
Responsible	Torkild S. Birkmose, AgroTech
Distribution	DANETV website
Version	2-0
Date	17-12-2012
Status	Approved for publication

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1 INTRODUCTION

Environmental technology verification (ETV) is an independent (third party) assessment of the performance of a technology for a specified application, under defined conditions and quality assurance.

This document is the verification report resulting from verification of LevelTec online monitoring system for slurry storage tanks.

1.1 Name of technology

The technology verified was LevelTec.

1.2 Name and contact of proposer

LevelTec is developed and produced by PlusTec Aps, Mads Bjerresvej 8, DK-7500 Holstebro, Denmark. Website: www.plustec.dk. Contact person of PlusTec Aps: Jørgen Seerup. E-mail: js@plustec.dk. Phone: +45 96 10 40 80. Mobil phone: +45 20 32 66 54.

1.3 Name of verification body and verification responsible

The verification was performed by DANETV, Test Centre AgroTech, Agro Food Park 15, DK-8200 Aarhus N, Denmark. Verification responsible: Torkild S. Birkmose. Phone: +45 87 43 84 06. E-mail: tsb@agrotech.dk.

1.4 Verification organisation including experts

The verification was conducted by Danish Centre for Verification of Climate and Environmental Technologies, DANETV, which performs independent tests and verifications of technologies for the reduction of climate changes and pollution. The verification was planned and conducted to satisfy the requirements of the EU ETV pilot programme (EU ETV) established by the European Union.

An internal and an external technical expert provided independent reviews of the planning, conducting and reporting of the verification and tests. The technical experts assigned to this verification and responsible for review of the verification plan and report documents include:

Internal expert: Thorkild Q Frandsen, AgroTech, Agro Food Park 15, DK-8200 Aarhus N. Phone: +45 8743 8468, e-mail: tqf@agrotech.dk. Part of the test results have also been reviewed by Anders Bonde Kentved, Venlighedsvej 4, DK-2970 Hørsholm. Phone: +45 72 19 42 75, e-mail: abk@delta.dk.

External expert: Jørgen Hviid, Knowledge Centre for Agriculture, Agro Food Park 15, DK-8200 Aarhus N, Denmark. Phone +45 87 40 55 69. E-mail: jrh@vfl.dk. An overview of the organisation associated with test and verification is given in figure 1.

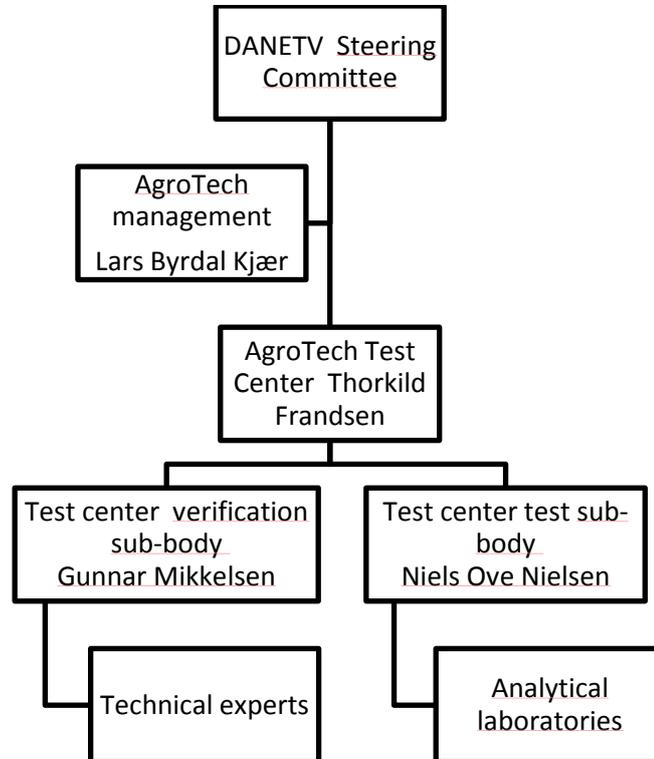


Figure 1. Organisation of test and verification

1.5 Verification process

The verification and the test were conducted in two separate steps, as required by the EU ETV pilot programme. The steps in the verification are shown in Figure 2.

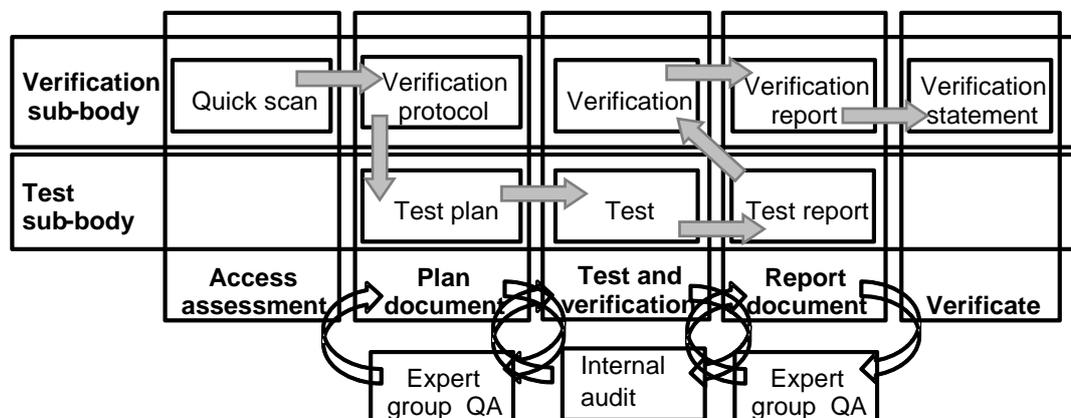


Figure 2. Verification steps.

The verification process is described in the AgroTech Test Centre Quality Manual [1].

This verification protocol, the test plan and the process document shall be seen as one consolidated verification description.

1.6 Deviations to the verification protocol

There have been no deviations to the verification protocol.

2 OVERALL DESCRIPTION OF THE TECHNOLOGY TYPE

The technology verified is one of several technologies on the Danish market used for online monitoring of slurry storage tanks. The basic function of these technologies is to register sudden drops in the slurry level and to report this to the owner or employee electronically. The purpose is to make it possible to take immediate actions in case of leakages and thereby avoid or minimize pollution of nearby streams and lakes. In addition to the basic function the different technologies have a number of extra features and functions.

The online monitoring systems can be based on different operating principles. Most of the systems on the Danish market in 2012 are based on a pressure measuring sensor installed inside the slurry storage tank near the bottom. The sensor is connected to a control unit from which a text message is transmitted to mobile phones in case of a sudden drop in the slurry level.

3 DESCRIPTION OF TECHNOLOGY FOR VERIFICATION

Like most other online monitoring systems on the Danish market LevelTec is based on a pressure sensor and the alarm messages are communicated to the farm owner or his employee via SMS messages. The LevelTec pressure sensor and cable are placed in a PVC tube mounted on a galvanised steel frame mounted on the inner side of the slurry tank wall. At the end of the PVC tube there is a stand in which the pressure sensor is kept in a fixed position approximately 0.20 meter above the bottom of the slurry tank. The control unit including the GSM modem used for communication with mobile phones is installed on the outside of the slurry tank wall. See Figure 3 and Figure 4.

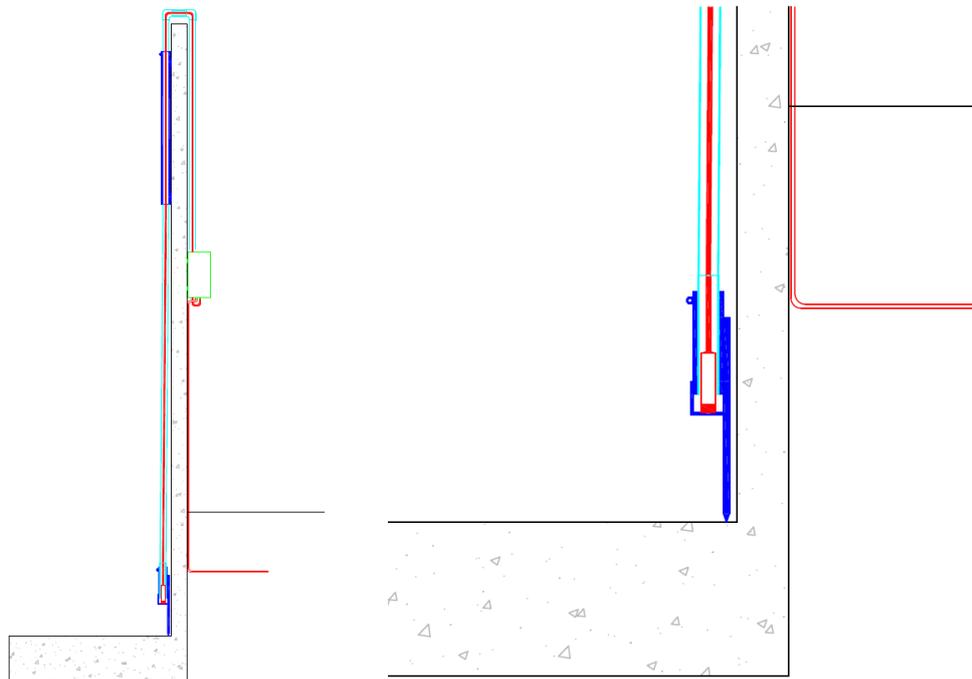


Figure 3. To the left is shown a cross section of a slurry storage tank with LevelTec installed on the tank wall. A PVC tube is mounted on the inner side of the tank wall (light blue). The pressure sensor (drawn in red colour) is placed inside the tube and lowered to a position approximately 0.20 meter above the bottom of the tank. To keep the pressure sensor in a fixed position a stand is mounted at the end of the PVC tube. The stand is shown in dark blue colour on the right side of the figure.

LevelTec requires a 230 VAC power supply. For slurry tanks without power supply installed PlusTec offers a power solution based on a solar panel mounted on the slurry tank. However, the solar panel has not been tested as part of this verification.

Even small changes in the slurry level are measured by the pressure sensor. A decrease in the slurry level results in a lower pressure and vice versa. LevelTec is programmed so that when a sudden pressure decrease is measured a SMS-message is sent to the owner of the slurry tank or another person responsible for the slurry tank. The purpose of the SMS-message is to make it possible to take immediate actions in case of leakages. Thereby, it is possible to avoid or minimize pollution of nearby streams and lakes.

LevelTec can also be used as a slurry storage management system that gives the farmer online information about actual available capacity via log-in to an internet based database showing all inputs and outputs from the specific slurry tank. Furthermore, the slurry management system can be used for an online registration of on which farms and fields the slurry is used. This information can be used as input to making the annual manure account, which is mandatory for all livestock farms in Denmark. However, this feature is not tested as part of this verification.

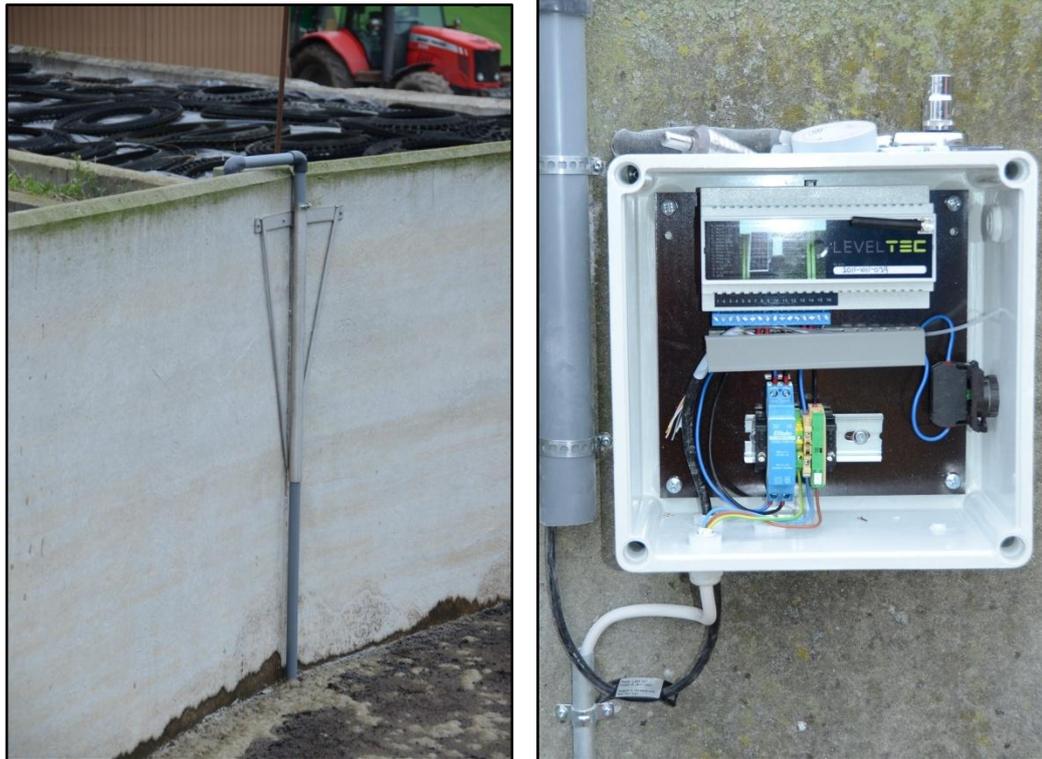


Figure 4. The photo on the left shows the PVC tube installed on the inner side of the tank wall. The photo on the right shows the control unit installed on the outside of the tank wall.

3.1 Application and performance parameter definitions

The intended application of LevelTec is defined in terms of the matrix, the purpose and exclusions.

The matrix is the type of material that the LevelTec online monitoring system is intended for. As part of this verification LevelTec has been tested for pig slurry and cow slurry. It is assumed that the results of the tests will also be valid for LevelTec used for digested biomass from a biogas plant and for mink slurry. Normally, the total solids content of such matrices is within the range of 2.0 – 10.0 %.

The purpose of a technology is defined in terms of what measurable properties that are affected by the technology and how these properties are affected. In case of LevelTec the overall purpose is to 1) detect a potential risk for leakage and 2) to report this electronically to the slurry storage tank owner or his employee. To evaluate this, the performance parameters listed in table 1 have been included in this verification.

Table 1. Performance parameters for the verification of LevelTec.

Parameter	Value
Threshold value for reporting leakage measured as decrease in slurry level	0.05 meter
Time from threshold value in slurry level has been reached to SMS message is received by the person responsible for the tank	2 minutes
Warning and alarm messages are received by the tank responsible person in case of slurry tank overflow	Yes / no

An alarm is registered and communicated to person responsible for the tank in case of failing power supply	Yes / no
Alarm is forwarded to a new person in case the communication to the first person did not result in actions that reset the alarm	Yes / no
The LevelTec system is automatically switched on following a manual switching off (e.g. during emptying of storage tank)	Yes / no

The verified technology includes a complete LevelTec Online Monitoring System including a pressure sensor, cabling and a control unit. In order to do the test and verification auxiliary equipment in terms of various mobile phones has been used for communication with LevelTec Online Monitoring System.

The technology supplier offers a solution for power supply based on solar panel for slurry storage tanks without electric supply installed. However, this additional solar panel was excluded from this verification.

3.2 Additional parameters

Apart to the performance parameters a number of additional parameters were defined as part of this verification. Some of the additional parameters were evaluated as part of an environmental test of LevelTec performance by DELTA. Moreover, the user manual of LevelTec was evaluated as part of this verification.

3.2.1 Environmental test parameters

The main purpose of the environmental test was to verify the ability of LevelTec to withstand or operate within specified tolerances, while being exposed to the environmental conditions likely to be encountered during normal use.

Table 2 includes a list of environmental test parameters for this verification and corresponding reference standards.

Table 2. Environmental test parameters included in the verification of LevelTec.

No.	Parameter	Purpose
1	Dry heat, operational	To verify the ability of the test object to operate according to specifications at the upper temperature limit of the use environment.
2	Cold, operational including cold start-up	To verify the ability of the test object to initiate normal operation and operate according to specifications at the lower temperature limit of the use environment.
3	Humidity	To verify the ability of the test object to operate under and withstand the deteriorative effects of high temperature/humidity and cold condition.
4	Water, operational	To verify the ability of the test object to operate according to specifications when exposed to water in the use environment.
5	Transient shock, operational	To verify the ability of the test object to withstand shocks likely to occur during normal use.
6	Impact (surface point), operational	To verify the ability of the test object to operate during impacts likely to occur during normal use.
7	Cable bending	To verify the mechanical integrity of cable connections during conditions of cable bending likely to occur during

		normal use.
8	Electrostatic discharge	To verify that electrostatic discharge occurring on the equipment, or in its vicinity, does not affect its performance or causes malfunction or permanent damage. It is also a test of proper grounding or shielding inside the test object.
9	Radiated RF immunity	To verify the immunity of the test object to fields generated by intentional transmitters (radio, TV, cell etc.).
10	Conducted radio frequency	To verify the immunity of the test object to low frequency fields generated by intentional transmitters (AM radio, TV, cell, etc.). Applicable to AC input and I/O cabling greater than 3 m in length.
11	Burst/Fast transients	To verify the immunity of the test object to switching and transient noise. Applicable to AC/DC input and I/O cabling greater than 3 m.
12	Surge voltage	To verify the immunity of the test object to switching and lightning-induced transients. Applicable to AC/DC power inputs, as well as I/O cabling which exceeds 30 m.
13	Radiated emission	To verify that the unintentional E-field emissions from the test object in normal operating mode is below the specified limits.
14	Conducted emission	To verify that the unintentional emissions conducted back on the AC power mains is below the specified limits.
15	Power frequency H-field immunity	To verify the immunity of the test object to low frequency magnetic fields.
16	Voltage dips and interruptions	To verify the immunity of the test object to fluctuations on AC power input.

3.2.2 User manual

The LevelTec user manual was evaluated as part of the verification.

4 EXISTING DATA

4.1 Accepted existing data

No data from previous tests have been included in the verification of LevelTec.

5 EVALUATION

5.1 Evaluation of performance parameters

The performance parameters have been defined on the basis on two overall purposes:

- To verify that LevelTec meets the requirements for slurry storage tank alarms as described by the Danish Environmental Protection Agency [5], [6]
- To verify that LevelTec is functioning as claimed by the proposer (PlusTec) and described in the LevelTec product sheet [2] and LevelTec User Manual [3]

The test activities were undertaken in a small scale slurry container installed on a bio-gas plant to facilitate fast simulations of leakages under controlled conditions. Leakages are simulated by opening a tap installed in the bottom of the slurry container. Figure 5 shows the small scale slurry container used for the performance test of LevelTec.



Figure 5. The small scale slurry container used for the performance test of LevelTec. On the left photo the LevelTec control unit is seen as a grey box installed on the end of the slurry container.

By undertaking the performance test at a biogas plant using slurry from many different farms it was possible to test the LevelTec Online Monitoring System using different slurry types. The performance of LevelTec was tested and verified using five different slurry types (matrices). An overview of the five slurry types is given in table 3 below.

Table 3. Overview of the five slurry types used for the performance test of LevelTec.

No.	Description	Total solids (%)
1	Mixture of sow- and piglet slurry	1.60
2	Mixed pig slurry with fodder residues	4.76
3	Cow slurry	9.35
4	Mixed pig slurry	5.35
5	Fattening pig slurry	5.74

5.1.1 Detection and reporting a decrease in slurry level of 0.05 meter

A number of test activities have been performed to verify the basic alarm function of the LevelTec Online Monitoring System: To detect a decrease in slurry level and when the threshold value is reached to report this via a SMS message.

Leakages of different sizes are simulated by opening the tap to different extent. In tests to simulate large leakages the tap was full open and in tests to simulate small leakages the tap was open to a very small extent. As part of the test the time from the leakage started until the alarm-SMS was received on the mobile phone was measured. Also the decrease in slurry level from the leakage started until reception of the SMS-message was measured. Results from these test activities are presented in table 4.

Table 4. Results from testing the basic alarm function in small scale slurry container.

Slurry type 1: 1.60 % TS¹	Small leakage 7 mm/minut	Medium leakage 43 mm/minut	Large leakage 130 mm/minut
Time to reception of SMS	7 min, 30 sec.	2 min, 6 sec.	1 min, 0 sec.
Decrease in slurry level	50 mm	90 mm	130 mm
Slurry type 2: 4.76 % TS	Small leakage 6 mm/min.	Medium leakage 33 mm/min.	Large leakage 140 mm/min.
Time to reception of SMS	8 min, 50 sec.	2 min, 18 sec.	1 min, 19 sec.
Decrease in slurry level	55 mm	75 mm	185 mm
Slurry type 3: 9.35 % TS	Small leakage 6 mm/min.	Medium leakage 13 mm/min.	Large leakage 54 mm/min.
Time to reception of SMS	7 min, 40 sec.	4 min, 13 sec.	1 min, 45 sec.
Decrease in slurry level	45 mm	55 mm	95 mm

¹ TS refers to total solids, a measure of the dry matter content of the slurry.

Table 5. Results from testing the threshold value for triggering an SMS alarm message.

Test no.	Type of leakage simulation	Decrease in slurry level (mm)	Time from leakage to reception of alarm-SMS
1	One single leakage	55	1 min, 30 sec.
2	One single leakage	50	1 min, 34 sec.
3	One single leakage	50	1 min, 52 sec.
4	Leakage, part 1 Leakage, part 2 Total leakage	25 40 65	No alarm after 15 min. 38 sec. ---
5	Leakage, part 1 Leakage, part 2 Total leakage	20 30 50	No alarm after 15 min. 44 sec. ---
6	Leakage, part 1 Leakage, part 2 Total leakage	25 30 55	No alarm after 15 min. 55 sec. ---

5.1.2 Full tank warning and tank overflow alarm functions

Leakages from slurry storage tanks can result from tank overflow. This will occur if slurry is pumped from the animal housing system to a storage tank, which is already full.

It is claimed by the technology producer that LevelTec can be used to prevent this situation. According to the user manual an SMS warning message is sent to the tank owner when the level reaches 0.10 meter from the rim of the storage tank. The tank owner

has to reset LevelTec after reception of an SMS warning message. If the slurry level continues to raise LevelTec sends an SMS alarm message, when the slurry level reaches 0.02 meter from the rim of the storage tank.

As part of this verification the full tank warning and the tank overflow alarm functions were tested. The tests were performed using the small scale slurry container. First, the height of the container was artificially set to 0.45 meter. This was done by sending SMS-commandos to LevelTec. Then slurry was led to the slurry container and SMS-messages were waited for. Table 6 shows the results from these tests.

Table 6. Results from testing the full tank warning and tank overflow alarm functions

Message from LevelTec	Slurry level measured when SMS was received	Comments
Full tank warning	0.380 meter	In the time from LevelTec registers that the 0.10 meter threshold value is reached to the SMS warning message is received on the mobile phone the slurry level continues to raise. That is the reason why there is only measured 0.07 meter from the slurry level to the (artificial) rim of the slurry tank.
Tank overflow alarm	0.450 meter	In the time from LevelTec registers that the 0.02 meter threshold value is reached to the SMS warning message is received on the mobile phone the slurry level continues to raise. That is the reason why the slurry level has reached the (artificial) rim of the slurry tank when the SMS alarm message was received.

It is seen from table 6, that LevelTec both the full tank warning message and the tank overflow alarm message were received. Thus, these functions are working as claimed by the technology supplier.

5.1.3 Alarm function in case of failing power supply

LevelTec online monitoring system has to be in operation 24 hours per day throughout the year to give the desired security. Thus, a stable power supply is required. Still, it is an advantage if the slurry tank owner receives a message in case the power supply is failing. This can be secured by installing a battery that makes it possible for LevelTec to send an SMS alarm message.

The technology supplier claims that LevelTec has this function. This is tested as part of this verification. In table 7 the results from this test are shown.

Table 7. Results from testing LevelTec in case of failing power supply.

Time when power supply was disconnected	Time for reception of SMS alarm
12.03.2012 07:38	12.03.2012 07:39
15.03.2012 10:48	15.03.2012 10:50
15.03.2012 13:42	15.03.2012 13:43

It is concluded from the test, that the alarm function in case of failing power supply is working as claimed by the technology supplier.

5.1.4 Alarm forwarding function

If a potential leakage is registered from the slurry storage tank it is crucial that the SMS alarm message is actually received by a person, who can take immediate actions to stop the leakage and minimize the risk for pollution of nearby streams and lakes. There is a risk that the person, to whom the SMS alarm message is sent, will not see this immediately. Perhaps the person has put the mobile phone away or the mobile phone has run out of battery.

According to the technology supplier LevelTec will send an SMS alarm message to another mobile phone number if LevelTec is not reset 5 minutes after the SMS alarm message is sent. And if there is still no reaction from the receiver of the second SMS message an SMS alarm message is sent to a third mobile number. LevelTec can forward the SMS alarm message to up to five mobile numbers. If there is still no action taken LevelTec sends SMS messages to the first mobile number again.

This function has been tested as part of the verification. A leakage has been simulated in the small scale slurry container. When the SMS alarm messages were received re-setting the LevelTec was omitted. The time for reception of the SMS alarm messages were registered. The test was repeated twice and the results are presented in table 8.

Table 8. Results from testing the SMS alarm forwarding function of LevelTec.

Time from reception of the first SMS alarm message	Event
5 minutes	SMS alarm message received on mobile number 2.
25 minutes	SMS alarm message received on mobile number 1 again.

It is concluded, that the alarm forwarding function is working as described by the technology supplier.

5.1.5 Automatic switching-on LevelTec after manual switching-off

Sometimes slurry is pumped from the storage tank to a slurry trailer to be applied on the field or to be moved to another tank or transported to a biogas plant. This will cause the slurry level to decrease and an SMS alarm message will be generated even though there is no leakage.

To avoid SMS alarm messages in such situations it is possible to switch off the LevelTec alarm function for a certain number of hours. This is done by sending an SMS message to LevelTec. In the SMS message it is specified for how many hours LevelTec should be switched off. According to the technology supplier LevelTec will automatically switch on again after the specified number of hours. This function is tested and the results are presented in table 9.

Table 9. Results from testing the automatic switching on LevelTec after manual switching-off

Time	Event
8:41	An SMS-command is sent to LevelTec to switch off the alarm function for 1 hour: GYLLEOFF01
8:41	Reception of SMS message confirming switching off for 1 hour: OK
8:42	The tap is opened to decrease the slurry level in the slurry container.
8:46	The tap is closed after 0.30 meter slurry is drained off the slurry container.

Result 1	OK – no SMS alarm message is sent even though 0.30 meter slurry is drained off the slurry container. LevelTec has been switched off.
8:50	The tap is opened to decrease the slurry level further.
8:54	The tap is closed after 0.30 meter slurry is drained off.
Result 2	OK – no SMS alarm message is sent even though 0.30 meter slurry is drained off the slurry container. LevelTec is still switched off.
9:42	Reception of SMS message confirming that LevelTec is now switched on again.
9:57	The tap is opened to decrease the slurry level in the slurry container.
9:58	Reception of SMS alarm message.
Result 3	OK – the alarm function of LevelTec has been automatically switched on again after 1 hour. SMS alarm messages are now sent when a decrease in slurry level is registered.

It is concluded that the functions of manual switching off and automatic switching on are working as claimed by the technology supplier.

5.2 Performance parameter summary

An overview of the evaluated performance parameters is given in table 10 below.

Table 10. Results from evaluation of performance parameters for LevelTec.

Parameter	Verified value
Threshold value for reporting leakage measured as decrease in slurry level	0.05 meter
Time from threshold value in slurry level has been reached to SMS message is received by the person responsible for the tank	Maximum 2 minutes*
Warning and alarm messages are received by the tank responsible person in case of slurry tank overflow	Yes – these functions work as claimed.
An alarm is registered and communicated to person responsible for the tank in case of failing power supply	Yes – this function works as claimed.
Alarm is forwarded to a new person in case the communication to the first person did not result in actions that reset the alarm	Yes – this function works as claimed.
The LevelTec system is automatically switched on following a manual switching off (e.g. during emptying of storage tank)	Yes – this function works as claimed.

*Note: Under assumption of satisfactory mobile phone connection coverage.

5.3 Evaluation of test quality

5.3.1 Control data

The performance test was done using a small scale slurry container made of plastic which is semi-transparent. The slurry level inside the plastic container is measured using a rule mounted on the outer side of the container. Due to foam occurring on the slurry surface there is some uncertainty involved when reading the slurry levels.

Thus, in the performance test performed as part of this verification slurry levels have been read and reported within 5 mm intervals since it gives no sense to report levels with higher accuracy. The data on slurry levels, which are read manually, are compared with the data registered by LevelTec and logged in the internet database. The comparisons showed that the manually read slurry levels were in accordance with the slurry levels logged in the internet database.

5.3.2 Audits

No audit was undertaken for this specific verification task.

5.3.3 Summary of amendment and deviations

Due to many other on-going tasks of the involved test staff it was not possible to follow the time schedule described in the test plan. Consequently, the test report and the verification report were delayed.

5.4 Additional parameter summary

The following two sections include a summary of the additional parameters for this verification.

5.4.1 Environmental test parameters

Table 11 shows for each environmental test parameter the reference standard or reference specification used together with the results of the test activities.

Table 11. Results from evaluation of environmental test parameters.

No.	Parameter	Reference standard / specification	Result
1	Dry heat, operational	IEC/EN 60068-2-2:2007	No malfunction was observed during the exposure. Further, no damages or deteriorations were observed during the visual inspection at standard atmospheric conditions.
2	Cold, operational including cold start-up	IEC/EN 60068-2-1:2007	No malfunction was observed during the exposure. Further, no damages or deteriorations were observed during the visual inspection at standard atmospheric conditions.
3	Humidity	IEC 60068-2-30 (2005)	No malfunction was observed during the exposure. Further, no damages or deteriorations were observed during the visual inspection at standard atmospheric conditions.
4	Water, operational	IEC 60529:2001	Neither ingress of water nor malfunction was observed after the exposure.
5	Transient shock, operational	IEC/EN 60068-2-57:1999	No malfunction was observed during the exposure. Further, no damages or deteriorations were observed during the visual inspection performed after the exposure.
6	Impact (surface point), operational	IEC 60068-2-63:1991	No malfunction was observed during the exposure. Further, no damages or deteriorations were observed during the visual inspection at standard atmospheric conditions.

			ditions, except for cracking of black plastic part.
7	Cable bending	Not available	No malfunction was observed during the exposure. Further, no damages or deteriorations were observed during the visual inspection at standard atmospheric conditions.
8	Electrostatic discharge	IEC 61000-4-2:2001 Performance criterion: B	No malfunction was observed during the exposure and the function of the test objects was OK after the exposure. Performance criterion: B.
9	Radiated RF immunity	IEC 61000-4-3:2006 Performance criterion: A	No malfunction was observed during the exposure and the function of the test objects was OK after the exposure.
10	Conducted radio frequency	IEC 61000-4-6:2007 Performance criterion: A	No malfunction was observed during the exposure, and the function of the test objects was OK after the exposure.
11	Burst/Fast transients	IEC 61000-4-4:2004 Performance criterion: B	No malfunction was observed during the exposure and the function of the test objects was OK after the exposure.
12	Surge voltage	IEC 61000-4-5:2005 Performance criterion: B	No malfunction was observed during the exposure and the function of the test objects was OK after the exposure.
13	Radiated emission	CISPR 16-2-3:2006	The radiated emissions were within the specified limits.
14	Conducted emission	CISPR 16-2-1:2008	The conducted emissions were within the specified limits.
15	Power frequency H-field immunity	IEC 61000-4-8:2001 Performance criterion: A	No malfunction was observed during the exposure and the function of the test objects as OK after exposure.
16	Voltage dips and interruptions	IEC 61000-4-11:2001 Performance criterion: B	No malfunction was observed during the exposure and the function of the test objects was OK after the exposure.

During the EMC immunity testing the following generic acceptance criteria for compliance were in force:

- Performance Criterion A: (For continuous phenomena): The EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed as defined in the relevant equipment standard and in the technical specification published by the manufacturer.
- Performance Criterion B: (For transient phenomena): The EUT shall continue to operate as intended after the tests. No degradation of performance or loss of function is allowed as defined in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance

which is self-recoverable is, however, allowed but no change of actual operation state or store data is allowed.

It is concluded that the test object (LevelTec online monitoring system complete with pressure sensor and cabling) meets the relevant requirements of the reference standards / reference specifications. Full information about the environmental test is included in the DELTA Test Report “Environmental Testing of LevelTec Online Monitoring System” performed for Plus Tec ApS.

5.4.2 User manual

The LevelTec user manual is 18 pages and formulated in Danish. The manual is read and evaluated as part of this verification.

According to the user manual switching off the LevelTec alarm function can be done using two commands: ALARMOFFXX and GYLLEOFFXX. XX refers to the number of hours the alarm function shall be switched off. However, during the test it was only the command GYLLEOFFXX that actually switched off the alarm function. It is recommended that the user manual is updated accordingly. Moreover, it is recommended that the user manual is updated so it includes instructions for calibration of LevelTec. In addition,

In general, the user manual contains full information and it is clearly formulated.

5.5 Operational parameters

Normally, slurry contains a certain amount of sand e.g. from the fodder or from the wheels of the machines moving in and out of the livestock housing systems. Especially large amounts of sand are found in slurry from cow housing systems, where sand is used as bedding material for the cows.

During storage the sand will sediment in the slurry storage tank under the formation of a base layer in the bottom of the tank. Over time this sand layer will accumulate since it is difficult to pump this out even after mixing the storage tank. Thus, since the pressure sensor is installed only 0.20 meter from the bottom of the slurry tank there is a risk that the pressure sensor will be covered by sand and this could potentially give problems for the performance of the LevelTec.

As part of this verification the function of LevelTec was tested in a situation where the pressure sensor was covered. Figure 6 shows the test set-up.



Figure 6. Photo 1 shows the LevelTec pressure sensor installed in the small scale slurry container used for the performance test. Photo 2 shows the LevelTec sensor covered by sand. Photo 3 show how the sand is placed around the LevelTec sensor after the slurry container was filled with slurry and emptied again. It is seen that the sand is still laying around the sensor.

It was concluded from the test activities that uncertainties in the pressure measurements can occur when the LevelTec sensor is fully covered by a thick layer of sand. Thus, in such situations there is a risk that LevelTec will not detect a sudden decrease in the slurry level and send a SMS alarm message.

To avoid this situation it is recommended the slurry tank owner to check the thickness of the sand layer once a year immediately after the storage tanks has been emptied in connection with land application of slurry. If the bottom layer has become so thick that there is a risk the pressure sensor will be covered actions should be taken to remove the sand (e.g. using an excavator) before slurry is pumped to the tank. Alternatively, the pressure sensor can be raised so that it is now place 0.40 - 0.50 meter from the bottom of the tank. However, if the pressure sensor is raised LevelTec has to be calibrated again.

5.6 Recommendations for verification statement

It is recommended to issue a verification statement based on the verified performance described in section 5.1, 5.2 and 5.4.

6 QUALITY ASSURANCE

Internal review of the verification protocol, verification report, test plan and test report was done by Thorkild Q Frandsen, AgroTech. In addition, Anders Bonde Kentved, DELTA, has reviewed the test results of the environmental test activities performed by DELTA. No system audit was done for this verification.

External review of the test report and verification report was done by Jørgen Hviid, Knowledge Centre for Agriculture.

7 REFERENCES

- [1] AgroTech (2009): AgroTech Test Centre Quality Manual. Not published.
- [2] PlusTec (2011): Product Sheet for LevelTec. In Danish. 2 pp.
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- [5] Miljøministeriet (2011): Bekendtgørelse nr. 100 af 9. februar 2011 om ændring af bekendtgørelse om husdyrbrug og dyrehold for mere end 3 dyreenheder, husdyrgødning, ensilage m.v. (Krav om gyllebarrierer m.v.). In Danish.
- [6] Miljøstyrelsen (2011): Miljøstyrelsens vejledning til kravene i § 15a i husdyrgødningsbekendtgørelsen om etablering af beholderbarrierer, terrænændringer og beholderalarmer. Revideret 20. december 2011. Miljøstyrelsen, Erhverv. 15 pp. In Danish.



A P P E N D I X A

Terms and definitions

Word	DANETV
Analytical laboratory	Independent analytical laboratory used to analyse test samples
Application	The use of a product specified with respect to matrix, target, effect and limitations
DANETV	Danish center for verification of environmental technologies
DANETV test center	Preliminary name for the verification bodies in DANETV with a verification and a test sub-body
Effect	The way the target is affected
Environmental product	Ready to market or prototype stage product, process, system or service based upon an environmental technology
Environmental technology	The practical application of knowledge in the environmental area
Evaluation	Evaluation of test data for a technology product for performance and data quality
Experts	Independent persons qualified on a technology in verification
Matrix	The type of material that the product is intended for
Method	Generic document that provides rules, guidelines or characteristics for tests or analysis
Liquid fraction	Liquid or thin fraction derived from the separation of slurry.
Performance claim	The effects foreseen by the vendor on the target (s) in the matrix of intended use
Performance parameters	Parameters that can be documented quantitatively in tests and that provide the relevant information on the performance of an environmental technology product
Procedure	Detailed description of the use of a standard or a method within one body
Producer	The party producing the product
Standard	Generic document established by consensus and approved by a recognized standardization body that provides rules, guidelines or characteristics for tests or analysis
Target	The property that is affected by the product
Test center, test	Sub-body of the test center that plans and performs test

Word	DANETV
sub-body	
Test center, verification sub-body	Sub-body of the test center that plans and performs the verification
Test/testing	Determination of the performance of a product for parameters defined for the application
Verification	Evaluation of product performance parameters for a specified application under defined conditions and adequate quality assurance



A P P E N D I X B

Quick scan

QUICK SCAN REPORT

Product name:	LevelTec
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Test center		Proposer	
Name:	AgroTech A/S	Name:	Plus Tec Aps
Contact:	Thorkild Frandsen	Contact:	Jørgen Seerup
Address:	Agro Food Park 15	Address:	Mads Bjerresvej 8
	8200 Aarhus N		7500 Holstebro
	Denmark		Denmark
Telephone:	+45 87 43 84 68	Telephone:	+ 45 96 10 40 81
E-mail:	tqf@agrotech.dk	E-mail:	js@plustec.dk

Quick scan		Previous quick scan				
Date:	15.12.2011	Yes		Date:	No	X

Product description							
LevelTec is developed to reduce damages from slurry leaking from storage tanks. Level-Tec is continuously measuring the liquid level in storage tanks. If unexpected changes in the liquid level are registered a SMS-message is sent to the farmer or his employees.							
Product ready to market				Product in last development phase			
Yes	X	No		Yes	X	No	
Performance claims							
Matrices:	The LevelTec system is intended for use in storage tanks for livestock slurry and storage tanks for digested biomass at biogas plants.						
Targets:	Number of centimetres of slurry measured from the bottom of the tank Number of centimetres of slurry measured from the upper edge of the tank.						
Effects:	In case of unexpected decreases in the liquid level or if the storage tank is full and there is a risk of overflow the LevelTec system shall generate a SMS-message which can be sent to 1-5 different mobile numbers.						

Product description clear				Performance claims clear			
Yes	X	No		Yes		No	X

Existing test data							
Tests performed				Test body qualified			
Yes		No	X	Yes		No	
Test report available				Test report qualified			
Yes		No	X	Yes		No	
Test methods available				Test methods adequate			
Yes		No	X	Yes		No	
Raw data available				QA of raw data adequate			
Yes		No	X	Yes		No	
Performance claims sustained				Performance claims relevant			
Yes		No	X	Yes		No	

Conclusions quick scan		
Since there are no existent data a test has to be performed to generate the data necessary for the verification. Performance claims should be discussed with proposer before planning the test.		
Date	Name	Signature
15.12.2011	Thorkild Q Frandsen	Original signed 15-12-2011



A P P E N D I X C

Proposal

VERIFICATION PROPOSAL

Verification body		Proposer	
Name:	AgroTech A/S	Name:	PlusTec Aps
Contact person:	Torkild S. Birkmose	Contact person:	Jørgen Seerup
Address:	Agro Food Park 15	Address:	Mads Bjerresvej 8
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E-mail:	tsb@agrotech.dk	E-mail:	js@plustec.dk
Date quick scan	15-12-2011		

Previous verification performed

Yes, date		No	X
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Description of technology – technical documentation

LevelTec is developed to reduce damages from slurry leaking from storage tanks. LevelTec is continuously measuring the liquid level in storage tanks. LevelTec is based on a pressure sensor and the alarm messages are communicated to the farm owner or his employee via SMS messages. The LevelTec pressure sensor and cable are placed in a PVC tube mounted on a galvanised steel frame mounted on the inner side of the slurry tank wall. At the end of the PVC tube there is a stand in which the pressure sensor is kept in a fixed position approximately 0.20 meter above the bottom of the slurry tank. The control unit including the GSM modem used for communication with mobile phones is installed on the outside of the slurry tank wall. LevelTec requires a 230 VAC power supply. For slurry tanks without power supply installed PlusTec offers a power solution based on a solar panel mounted on the slurry tank. However, the solar panel has not been tested as part of this verification.

Even small changes in the slurry level are measured by the pressure sensor. A decrease in the slurry level results in a lower pressure and vice versa. LevelTec is programmed so that when a sudden pressure decrease is measured a SMS-message is sent to the owner of the slurry tank or another person responsible for the slurry tank. The purpose of the SMS-message is to make it possible to take immediate actions in case of leakages. Thereby, it is possible to avoid or minimize pollution of nearby streams and lakes.

Intended application of the technology

The intended application of LevelTec is defined in terms of the matrix, the purpose and exclusions. The matrix is the type of material that the LevelTec online monitoring system is intended for. As part of this verification LevelTec has been tested for pig slurry and cow slurry. It is assumed that the results of the tests will also be valid for LevelTec used for digested biomass from a biogas plant and for mink slurry. Normally, the total solids content of such matrices is within the range of 2.0 – 10.0 %.

The purpose of a technology is defined in terms of what measurable properties that are affected by the technology and how these properties are affected. In case of LevelTec the overall purpose is to 1) detect a potential risk for leakage and 2) to report this electronically to the slurry storage tank owner or his employee.

Initial performance claim:

Description/principles clear?	Yes	X	No	
Declared performances described?	Yes	X	No	
Innovative technology?	Yes	X	No	

Ready to market?	Yes	X	No	
Prototype in advanced stage of development?	Yes	X	No	

Remarks out of quick scan to be considered:

It is relevant for this technology to verify both the basic functionality (performance test) and the ability of LevelTec to withstand or operate within specified tolerances, while being exposed to the environmental conditions likely to be encountered during normal use (environmental test).

Verification body:

Date	Name	Signature
13-01-2012	Torkild S. Birkmose	Original signed 10-01-2012



A P P E N D I X D

Specific verification protocol



The specific verification protocol is attached to the verification report as a separate document.



A P P E N D I X E

Amendment and deviation report for verification



See description of deviation from original time schedule under chapter 5.



A P P E N D I X F

Test report



The test report (with the test plan included as appendix) is attached to this verification report as a separate document.