Netherlands Emission Guidelines for Air

Section 3.7

Monitoring of emissions

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3.7.1 Introduction

If a permit includes emission limit values based on the Netherlands Emission Guidelines for Air (NeR), it is important to monitor whether the requirements are complied with.

If the permit does not include emission limit values based on the NeR, but does include the application of abatement technologies, the proper functioning of the abatement technology should, in any case, be checked. For this purpose it is not necessary to go through the methodology all the way as described in this section. Checking the proper functioning of an abatement technology is discussed in § 3.7.2.

The monitoring of emissions is defined as the determination of the emission and the assessment of the results thereof. The determination of the emission is done by carrying out measurements and by using emission-relevant parameters (ERPs). The determination of emissions is a task for the operator. Exceptions are enforcement measurements that take place under the responsibility of the competent authority. Assessing the emissions is being done by the competent authority.

The obligation of the operator to determine the emissions must, for each separate source, be recorded in the permit (see also legal framework). In addition, it must be recorded in the permit how the operator determines the emissions. This is done, preferably, in consultation with the operator and a measurement expert. Finally, it must be recorded in the permit how the assessment of the results is to take place.

Legal framework

In 2005, the Dutch Environmental Protection Act (Wm) was amended on a number of points in connection with the IPPC directive. Article 8.12, fourth paragraph of the Wm now explicitly states that in case of IPPC-installation the competent authority, provided emission limit values are linked to the permit, must include regulations in the permit that require the operator to determine whether it meets the emission limit values. The regulations must, in any case, indicate the method and frequency of the monitoring, and the procedure for the assessment of the data obtained. In addition, it may be indicated in the requirements, how the monitoring and assessment must be organized, and how the data obtained and the result of the assessment are recorded. Article 8.12, fourth paragraph adds that the competent authority must include provisions for IPPC companies requiring that the data obtained should be reported to the competent authority, or provided for its inspection, or otherwise made available.The prescription of periodic measurements was possible, but becomes easier with these amendments to the Wm. The foregoing shows that at the time of the licensing decision it must be clear what monitoring requirements an IPPC installation must comply with. For companies with NeR emission limit values this, in any case, means that it must be clear how they must determine the emissions (through measurement or through use of ERPs), how often this should happen, and how the results are assessed. Additional issues that are relevant in monitoring emissions (e.g. measurement standards, quality assurance) may also be included in the permit. An alternative is that these additional issues are elaborated in a monitoring plan by the operator, in consultation with a measurement expert.

A monitoring plan may be submitted with the permit application or prescribed in the permit. In the latter case, the permit conditions are formulated to which the monitoring plan must comply. The competent authority must then approve the monitoring plan.

Structure of the section

In § 3.7.2 attention is first paid to the monitoring of the proper operation of a emission abatement technique or process-integrated measure. Then in § 3.7.2 and § 3.7.3 it is described how the competent authority may determine the monitoring requirements, i.e. which monitoring types and frequency are applicable.

Within the NeR, a number of monitoring types are distinguished, which are elaborated in § 3.7.4 and § 3.7.5:

- Monitoring of emission-relevant parameters (ERPs), § 3.7.4;
- Periodic measurements, § 3.7.5;
- Continuous measurement, § 3.7.5.

In § 3.7.6, it is elaborated how the monitoring results (based on the measurements or the ERPs) can be assessed.

Consistency with other legislation

In addition to monitoring requirements based on the NeR, other requirements may apply on the basis of laws and regulations:

- Decree on Emission Limits for Combustion Plants A (BEES A)
- Decree on Emission Limits for Medium-Sized Combustion Plants (BEMS)
- Decree on Waste Incineration (Bva)
- Decree on Trading in Emission Rights
- Solvents Decree (OMB)
- Activities Decree
- Implementing Decree PRTR
- ministerial regulations for the above decrees

The BREF Monitoring also contains information on monitoring requirements. This BREF is not a directly effective decision, but an information document for the competent authority and IPPC installations with respect to the monitoring of industrial emissions. The method for monitoring emissions on the basis of the above-mentioned legislation is not dealt with in the NeR. However, in each section for the relevant aspects, it is indicated how they correspond with, or deviate from, the NeR.

NeR and PRTR

There is a difference between monitoring emission limit values within the framework of the NeR and reporting annual loads within the framework of the Implementing Decree PRTR. Because the goal and the background of the monitoring requirements differ in both frameworks, the monitoring methodology differs. The methodology in the NeR is designed to verify whether the emission limit values based on the NeR are being complied with. The strictness of the monitoring requirement is dependent on the harmfulness of emissions and the increase in emissions if an emission abatement technique or process-integrated measure fails.

The annual loads reported in the integral PRTR report must be complete, consistent and reliable, based on the best available information. An operator can have in the permit emission limit values expressed as concentration requirements and load requirements . The above-mentioned monitoring methods complement each other.

3.7.2 Monitoring the proper operation and specifying the monitoring requirements

This section focuses first on the assessment of the proper operation of the emission abatement technique or process-integrated measure. Whether or not the emission limit values are listed in the permit, checking the proper functioning of a technique or measure is always important. The second part of the section deals with the situation where emission limit values are included in the permit. In that case, the method of monitoring the emissions must also be included in the permit. This section describes the steps to identify the monitoring requirements and addresses the monitoring requirements in the permit and the monitoring obligations in other legislation.

Monitoring the proper operation

Monitoring the proper operation of an emission abatement technique or process-integrated measure occurs by means of maintenance and inspections.

The term "maintenance" means performing on a regular basis activities to ensure the proper functioning of a technique. Maintenance can be performed by the supplier or a technical expert within or outside the company. The nature and frequency of the activities can be derived from the specification of the supplier or from information about a similar installation. By means of a registration, the operator must demonstrate that the agreements made are complied with. In this connection it is also important that, if relevant, the consumption of energy and auxiliary materials (such as, for example electricity, chemicals, technical components) are recorded.

In addition to maintenance, inspection should take place. The term "inspection" means ensuring the actual proper functioning of the installation on a regular basis. Inspection takes place at least once a year, or if there is a reason to do so, for example on the basis of the results of emission-relevant parameters (ERPs) or measurements. The nature and frequency of the inspection activities can be derived from the specification of the supplier or from information about a similar installation. It might then concern a periodic visual inspection of the equipment, the assessment of relevant parameters, the control of the recording of maintenance activities and, if relevant, the consumption of energy and auxiliary materials.

To get a picture of the parameters that are relevant for the different techniques, an overview of ERPs can be used in § 3.7.4 (table 3a and 3b).

Values of ERPs and/or measurements can possibly also be assessed. Identified problems should be remedied as soon as possible. The results of the inspections should also be recorded.

It is important that the above-mentioned aspects are laid down, for example, in a maintenance and inspection plan. The maintenance and inspection plan can be implemented by concluding a maintenance and inspection contract with an external party, such as the supplier. The requirement to draw up a maintenance and inspection plan must be included in the permit. The period within which the plan must be available and the conditions that the plan must meet must also be included in the permit, such as: organisation of maintenance and inspection;

- what are the nature and frequency of the activities;
- how the results are dealt with;
- what is recorded and how does the registration take place.

If, in connection with the monitoring of emissions, a monitoring plan is also prescribed or established, the maintenance and inspection plan can be combined with the monitoring plan.

Determining the monitoring requirements

If the emission limit values are included in the permit, the method of monitoring these limit values have also to be provided. To determine how the emissions must be monitored, the following steps are to be taken:

1. Determination of the failure emission.
2. Determination of the mass flow check value.
3. Determination of the failure factor (F) and the monitoring regime.
4. Specification of the monitoring requirements.

These steps are hereafter further explained and clarified on the basis of examples.

Example – Company situation

At a company, dust is treated with an electrostatic filter.

- Inlet concentration: 900 mg/m_0^3.
- Emission value limit in the permit: 5 mg/m_0^3.
- Flue gas flow rate: 50,000 m_0^3/hour.

Step 1. Determination of failure emission

As mentioned in the introduction, the monitoring methodology in the NeR is based on the increase of an emission when an emission abatement technique or process-integrated measure fails and on the harmfulness of this emission. The increase in the emission upon failure of a emission abatement technique or process-integrated measure is expressed as a failure emission. The failure emission (in g/hour) is the difference between the untreated mass flow and the permitted mass flow (see Figure 1).

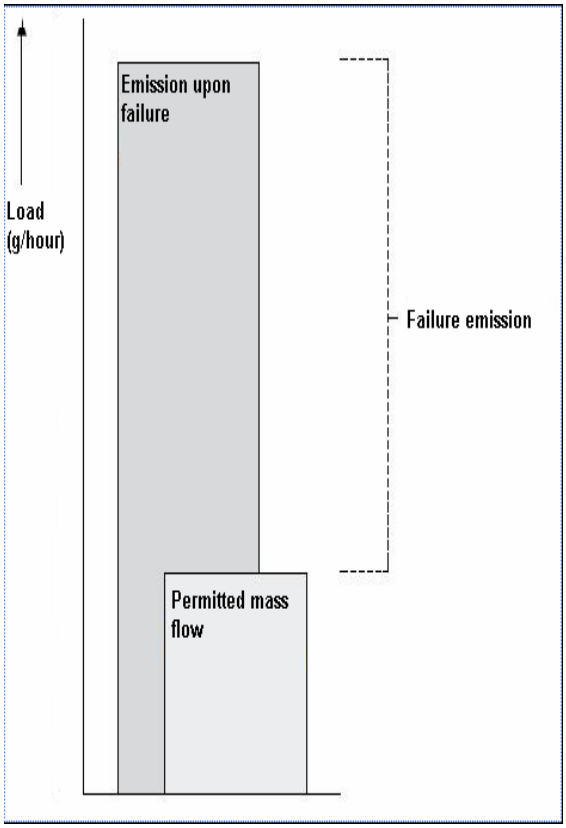

Figure 1. Failure emission

Failure emission = untreated mass flow (emission upon failure) - permitted mass flow

The permitted mass flow is the emission (in g/hour) that on the basis of the emission limit value is permitted. This is determined by multiplying the licensed emission concentration by the flow rate.

The untreated mass flow is the emission (in g/hour) that occurs when the available

emission abatement technique or process-integrated measure fails.

If the untreated mass flow is unknown, as with new facilities, it can be determined by estimation, for example on the basis of a mass balance or on the basis of the purification efficiency specified by the supplier. It may occur that the emission, upon failure of a technique, is smaller than 100%, for example, because only a part of the technique fails, several techniques or measures are applied one after the other, or because the failure, due to automatic shutdown of the process, cannot demonstrably last for a whole hour. In that case, the competent authority, in consultation with the operator, determines which emission must be used as the untreated mass flow.

Example a – Determining failure emission

- The failure takes at least one hour and the process does not switch off automatically.
- The untreated mass flow is: 0.9 [g/m_0^3] x 50 000 [m_0^3/h] = 45 000 g/hour
- The permitted mass flow is: 0.005 [g/m_0^3] x 50 000 [m_0^3/h] = 250 g/hour
- Interference emission is: 45 000 – 250 = 44 750 g/hour

Example b – Determining failure emission

- The failure takes up to 6 minutes. The process shuts down automatically because there is a loss of voltage.
- The untreated mass flow is: 0.9 [g/m_0^3] x 50 000 [m_0^3/h] = 45 000 g/hour
- The permitted mass flow is: 0.005 [g/m_0^3] x 50 000 [m_0^3/h] = 250 g/hour
- Failure emission is: 4 500 – 250 == 4 250 g/hour

Step 2. Determining the mass flow check value

The harmfulness of an emission is referred to in the NeR as mass flow check value. The harmfulness of the emission that additionally occurs when a emission abatement technique or process-integrated measures fails, is also expressed in the mass flow check value. Through the classification of the NeR, the mass flow check value of the emitted substance(s) can be determined.

The mass flow check value is shown in Table 1 per substance class.

Table 1 Mass flow check value

Category	Class	Mass flow check value (g/u)
MVP	Substances subject to compulsory minimisation	
	ERS	20 mg TEQ/jr
	MVP1	0.15
	MVP2	2.50
S	Dust	200
sA	Inorganic particulate compounds	
	sA.1	0.25
	sA.2	2.50
	sA.3	10
gA	Inorganic gaseous or vaporous compounds	
	gA.1	2.50
	gA.2	15
	gA.3	150
	gA.4	2000
	gA.5	2000
sO	Particulate organic compounds	see S
gO	Organic gaseous or vaporous compounds	
	gO.1	100
	gO.2	500
	gO.3	500

Example – Determining mass flow check value

The mass flow check value for dust is 200 g/hour.

Emissions of several substances

In practice it is possible that several substances are emitted simultaneously. For each substance (or group of substances) for which an emission limit value is included in the permit, the monitoring regime is determined per source. Then, for each source, the most strict monitoring regime is applied.

For substances of categories MVP, sA and gO, the permit may include an emission limit value per class in connection with the cummulation provision, but also a limit value based on cumulative emissions of all classes within a category. An example: a limit value for gO1 + gO2. In this case, for determining the untreated mass flow, the substances of classes on which the cummulation provision is applied must be added (in the example: gO1 + gO2). For determining the permitted mass flow, the emission limit value can be used that is included in the permit. The mass flow check value is the mass flow check value of the highest class (i.e. the class with the highest mass flow check value, in the example gO2)

Step 3. Determining the failure factor F and the monitoring regime

By dividing the failure emission by the mass flow check value, the failure factor F is determined. The failure factor F is a indicator of the stringency of the failure of the emission abatement technique.

F = failure emission in (g/h) / mass flow check value (g/h)

On the basis of the failure factor F, the monitoring regime is determined and by that the stringency of the monitoring requirement (see Table 2).

There are five different monitoring regimes, numbered 0, 1, 2, 3 and 4 and increasing in stringency. For each monitoring regime, the potential monitoring types are indicated, namely use of emission-relevant parameters (ERPs, see further § 3.7.4), periodic measurements and continuous measurements (§ 3.7.5). Monitoring regime 4 contains several possible monitoring types, from which the most suitable should be chosen in consultation with the operator. For each monitoring regime, it is indicated whether and how often measurements must at least be taken and/or which ERPs must at least be continuously monitored; it is possible to use monitoring types from a higher regime.

Table 2. Monitoring regimes

Monitoring regime	F	Possible monitoring type
0	F < 3	ERPs cat. B
1	3 < F < 30	Single measurement + ERPs cat. B
2	30 < F < 300	Measurement 1x every 3 years + ERPs cat. B
3	300 < F < 3000	Measurement 1x per year + ERPs cat. B In case of strong fluctuations: monitoring regime 4
4	F > 3000	Continuous measurement or ERPs cat. A or measurement 2x per year + ERPs cat. B

** For the classification if ERPs in category A and B, see §3.7.4*

Monitoring emissions of substances subject to compulsory minimisation

If the permit with regard to substances subject to compulsory minimisation includes emission limit values, monitoring regime 4 applies.

Example – Determining failure factor F

F = failure emission in (g/hour) / mass flow check value (g/hour) = 44,750 / 200 = 224

A failure factor of F = 224 leads to monitoring regime 2 (measurement 1x every 3 years and continuous monitoring of ERPs category B)

Step 4. Specification of monitoring requirements

In step 3, the monitoring regime is determined and it has become clear what the possible monitoring types are. On this basis, it can be determined which monitoring requirements are included in the permit. Of course, these can be directly derived from Table 2. There are, however, situations conceivable where this is departed from. This consideration must be made by the competent authority in consultation with the operator.

Reasons why the monitoring requirements may be more tolerant or more strict than are listed in Table 2:

- If use is made of proven reliable techniques (in combination with the presence of a proper inspection and maintenance system or an environmental management system) it may be considered to alleviate the monitoring requirement. Especially in existing situations, the proven reliability may be involved in the determination of the monitoring regime.
- A measurement based on growing insight into the extent of the emissions may be a reason for adjusting the defined monitoring type and frequency.
- If the measurement history indicates that the installation has been operating for years without deviation, the number of compulsory measurements can be limited. Conversely, the measurement regime can be made stricter when the measurement history repeatedly shows that the installation has exceeded the emission limit values.

- An intensification of the monitoring requirement may be reasonable if there is insufficient insight into the fluctuations in the process. Conversely, little or no fluctuations may be a reason for alleviating the monitoring obligation.
- For some processes (e.g. fluctuating or discontinuous processes) the carying out measurements or on the other hand the use of ERPs may prove technically impossible.
- In case of a very strong relationship between category B ERPs and the emission (see also § 3.7.4) it may be decided to decrease the frequency of the measurements.

Measurement requirements without emission abatement technique

There are production processes in which no emission abatement technique is present (due to low concentrations), but the mass flow check value is nevertheless exceeded for certain substances (due to high flows). This may, for example, be the case in foundries and batch processes. If, in this situation, an emission limit value is included in the permit, it should also be monitored according to the NeR methodology. Since the failure emission is lacking, monitoring regime 0 applies in this situation (only monitoring ERPs).

In this situation, the competent authority may also deviate from the NeR methodology. By including relevant information in the selection of monitoring type and frequency, such as information about the process, there is room for a tailored approach. This could mean that a measurement obligation is still imposed.

Example – Specifying the monitoring requirements

The monitoring type and frequency specified in the permit:

- Measurement 1x every 3 years and continuous monitoring of ERPs category B.

Monitoring requirements and the permit

It is important to record the monitoring requirements, i.e. the monitoring type and frequency, in the permit (see also § 3.7.1 – Legal framework). When prescribing the ERPs or measurements it is therefore important to lay down a number of other aspects in the permit or in a monitoring plan. The use of ERPs will include the relationships between the ERPs and the emission and the method of registration. This is further elaborated in 3.7.4. In the measurements, the measuring method, the measurement site and the quality of the measuring body and equipment are of interest, among other things. This is further elaborated in § 3.7.5. Finally, the permit should record the manner in which the results on the basis of the measurements and on the basis of the ERPs are assessed. This is further elaborated in § 3.7.6.

Monitoring odour emissions

To monitor the permit requirements with respect to odour, refer to § 2.9 and § 3.6 of the NeR. When monitoring odour requirements (in many cases it involves the presence of an emission abatement technique) ERPs can often be used.

Monitoring requirements in other legislation

The various laws and regulations on air emissions also include monitoring regimes. These are not, or not directly based on the size and harmfulness of emissions upon failure, such as in the NeR, but on a type of plant, power and/or fuel, such as in Decree on Emission Limits for Combustion Plants and Decree on Waste Incineration , or on the size of the load, as in PRTR framework.

The corresponding monitoring types and frequencies are laid down in the decree and/or the associated regulations. Most decrees refer to both measurements and ERPs as possible monitoring types. The BREF Monitoring also mentions the mass balance, calculations and emission factors. The applied measurement frequencies vary.

3.7.3 Exceptional emissions

This section does not apply if the exclusion provision of the NeR applies to the untreated emission. Exceptional emissions are incidental emissions due to special circumstances, such as, for example, maintenance, cleaning, malfunctions and start and stop procedures that occur rarely. To avoid the potential of increased emissions from exceptional emissions as much as possible, the following points should be incorporated in the permit requirements:

1. The emissions due to non-standard operations must be limited as much as reasonably possible. In case of malfunctions, the basic principle is to stop as quickly as possible if it appears that the emission abatement technique fails, to the extent that is possible, for example, for

security or environmental reasons. The shutdown of installed emission abatement techniques may only be allowed when:

- the maintenance of emission abatement techniques, which cannot occur during regular stops and required to ensure the proper functioning of the emission abatement technique;
- malfunctions in the emission abatement technique for the shortest possible period;
- malfunctions in the process that limits the functioning of the emission abatement technique.

Emission abatement techniques should, in principle, also be capable of limiting the discharge of emissions upon startup and shutdown. Only if the emissions and process conditions are very different from the emissions from regular operations and/or where safety is compromised may this be deviated from.

2. In case of emissions resulting from non-standard operations, it is important to keep a record of the causes. Measures to prevent repetition of failures should reasonably be taken, such as, for example, in the context of the inspection and maintenance plan (more frequent inspections, preventive maintenance).

The following points 3 to 5 only apply to companies with large emissions, paying attention to the relationship between the standard emission load and the emission upon failures. Instead of points 3 to 5, the competent authority may choose a plan approved by the competent authority on how the operator interacts with the failure emissions.

3. The competent authority must set a maximum on the duration of a continuous period of emissions resulting from exceptional operations. For this purpose, the competent authority includes a maximum number of consecutive hours in which exceptional emissions may occur.

4. The competent authority may set a maximum to either the total number of hours for exceptional emissions per year or a maximum to the total annual load due to the standard emissions plus the exceptional emissions.

5. Attention should be paid to monitoring the total annual load due to the standard emissions plus the exceptional emissions. One possible option is, for example, in this respect the double or modular implementation of the emission abatement technique. This will also avoid emissions during maintenance.

3.7.4 Monitoring by using ERPs

In § 3.7.2, it is described that several monitoring types are possible. One of the possible types of monitoring is the use of emission-relevant parameters (ERPs).

ERPs are measurable quantities in direct or indirect relationship with the emissions to be assessed. In the NeR, two types of ERPs are distinguished: ERPs that give a quantitative picture of the emission and ERPs that give an impression of the functioning of a technique/ process and hence an indication of the emission. This section discusses the two different types of ERPs and specific examples thereof. This section will also examine the effects of the use of ERPs in the permit and the use of ERPs in other laws and regulations.

Types of ERPs

Category A ERPs

These ERPs provide a reliable quantitative picture of the emission. After the relationship with the emission is well defined, these can simplify the measurements of a specific component or even completely replace it.

Examples of simplified measurements are the continuous measurement of "total VOC" in the flue gas flow instead of a specific volatile organic component, or a continuous dust measurement as a good measure of the concentration of heavy metals. In addition, in a flue gas flow with different components in a fixed ratio, a continuous measurement can be limited to a quantitative and easily measurable substance. The emissions are then derived from this reference substance on the basis of the ratio of factors. Such ratio factors must be specified at least twice a year by periodic measurements. If on the basis of specific process features it can be stated that the variation in the ratio factors is small, a lower frequency is sufficient. For the aspects that are important for reliable continuous measurements, refer to § 3.7.5.

An example of a category A ERP that can entirely replace a continuous measurement is the continuous monitoring of the raw material or fuel composition. On the basis of the raw material or fuel composition and the used quantity of raw materials or fuels, the concentration of certain components in the flue gas can be calculated. It is necessary

that the relationship between the ERP and the emission is shown by means of a measurement and that it is clearly identified and documented.

For a list of category A ERPs for various processes, refer to Table 3a and 3b. The results of category A ERPs can be used to determine whether the emission limit value is met.

Category B ERPs

These ERPs give an impression of the functioning of a technique/process and hence give an indication of the emission. It does not therefore concern the exact emission. Examples of such ERPs are the continuous monitoring of the temperature of an incinerator, the moisture content of a compost filter or the pressure drop of a dust filter. Category B ERPs should be continuously monitored. To obtain the best possible picture of the functioning of a technique/process, it is recommended to monitor all available category B ERPs for a technique. Table 3a and 3b give an overview of the relevant category B ERPs by flue gas treatment technology.

It is important to determine in advance what limit value the ERP may not exceed or within which range the ERP may proceed. This limit value or range may be determined using the specifications of the supplier or with the aid of periodic measurements resulting from monitoring regimes 1 through 4. These measurements serve not only for the determination of emissions, but can also serve for specifying the relationship between the ERPs and the emission. In that case, the measurements must be performed during the first test session under as many varied process conditions as possible.

If on the basis of the monitoring regime subsequent measurements must be performed (this applies from monitoring regime 2) the relationship between ERP and emission must also be checked during these subsequent measurements. In case of a very strong relationship between the ERPs and the emission it may be decided, in consultation with the operator, to lower the frequency of the measurements. In monitoring regime 0 there are no measurements. Because it concerns relatively small failure emissions, no control measurements are necessary for ERPs under this monitoring regime. In addition to maintenance and inspection, continuous monitoring of the ERPs is sufficient. For the aspects that are of importance for reliable measurements refer to § 3.7.5.

The results of category B ERPs are not used to assess whether the emission limit values are being complied with, but to assess whether the functioning of a technique/process or the flue gas conditions still meet predetermined criteria. The advantage of using category B ERPs is that continuous monitoring takes place and that an operator can take immediate action in case of any discrepancies.

A single category B ERP cannot replace measurements, but is used in addition to measurements. A suitable combination of category B ERPs can serve as a category A ERP when this combination has such a strong relationship with the emission limit value that by monitoring those ERPs it can established that the emission limit value is complied with.

In that case, a single measurement may suffice in the determining the relationship between the emission limit value and the combination of ERPs.

ERPs for various process and techniques

Table 3a and 3b give an overview of abatement technologies , components and available category A and category B ERPs according to the NeR. In specific situations, the competent authority, in consultation with the operator and possibly a measurement expert, may also determine other ERPs. When using category B ERPs, it is recommended to monitor all available ERPs for a technique in order to obtain the best possible picture of the functioning of a technique/process.

Monitoring the incinerator can serve as an example of a strong relationship between ERPs and the emissions. If the temperature and the CO content are continuously monitored, the process conditions do not vary and a reliable maintenance and inspection system are available, then there is a combination that leads to a strong relationship between ERPs and the emission. In such a case, it may be a reason to reduce the number of measurements to at least a single measurement.

Reporting and storing records

The competent authority must include in the permit that the operator must keep a record of the results of the ERPs in an organized manner, storing it in the facility until the next measurement takes place. For installations where only a single measurement takes place, this happens for one year. Discrepancies of the recorded values of the ERPs and actions performed by the operator

in response to this should be recorded in a log. The registrations must be stored in the company for 5 years.

In addition to storing the data in the installation, the operator must report certain information to the competent authority. For both category A and category B ERPs, it concerns data on the relationship between the ERP and the emission. In monitoring a reference substance (category A ERP) the ratio factors must also be reported.

Identifying and monitoring the relationship between ERPs and the emission takes place during the measurements resulting from the monitoring regime. The report to the competent authority on the use of ERPs will therefore often be part of the measurement report. The conditions on the measurement report are further described in § 3.7.5. The measurement reports must be stored for 5 years in the company.

ERPs and the permit

When prescribing ERPs, the permit should at least pay attention to:

- A description of the ERP or combination of ERPs.
- The monitoring frequency (continuous).
- The relationship between the emission and the ERP, the range in which the ERP may proceed or the value that the ERP may not exceed or fall short of (assessment criterion) and substantiation thereof.
- Recording and monitoring the relationship between ERP and the emission by measurements.
- Registration of the results of the ERP, any actions in response to this and the provision of data to the competent authority.

The method of assessing results should also be defined in the permit. This is elaborated in § 3.7.6.

It is possible that at the time of permit procedure it not yet clear which value or range must be linked to an ERP, for example because this information cannot be deduced from the specifications and the first measurement must still take place. In that case, the operator should elaborate this data in a monitoringplan.

Example – ERPs

For the electrostatic filter of the example, monitoring regime 2 applies. In the permit, it is recorded:

- which ERPs must be monitored: flue gas flow rate, electrical voltage and monitoring of proper operation of rapping mechanism;
- that ERPs must be continuously monitored;
- within which range or to which value the ERP may proceed;
- the discrepancies of the above-mentioned criteria and actions in response to this are recorded in a log;
- that the relationship between ERPs and emission should be checked 1x every 3 years by means of measurements;
- that the results of the ERPs must be registered and stored in the company for 5 years.

ERPs in other legislation

Also in other legislation ERPs are used as monitoring type. For example, Decree on Emission Limits for Combustion Plants and Decree on Trading in Emission Rights have the possibility of continuous emission determination by using relationships and/or models of the (measured) emission with continuously available process parameters (*Predictive Emission Monitoring System*, PEMS). ERPs are also mentioned as a possible monitoring type in the BREF Monitoring (so called surrogate parameters). Under the Decree on Waste Incineration, the use of ERPs or PEMS is not permitted.

Table 3a Abatement technologies associated with ERPs and components

Abatement technologies	**ERP Category**	**Compo-nents**
Thermal incineration	A: 1, 2 B: 6, 7, 8, 9, 26	VOC, odour
Catalytic incineration	A: 1, 2 B: 6, 7, 8, 9, 27	VOC, odour
Adsorption	A: 1 B: 6, 7, 9, 10, 11, 12	VOC, odour
Absorption	A: 1 B: 7, 9, 13, 14, 15, 24, 28	VOC, odour
Biological cleaning	A: 1 B: 6, 7, 9, 14, 15, 16, 17, 18, 19	VOC, odour
Deep cooling	A: 1 B: 6, 7, 13	VOC
Membrane separation	A: 1 B: 7, 9, 10	VOC
Cyclone	A: - B: 7, 9, 20, 29, 30, 31	Dust/ aerosols
Dust filter	A: - B: 7, 9, 12, 21, 31	Dust/ aerosols
Electrostatic dust precipitator	A: - B: 7, 21, 22	Dust/ aerosols
Wet dust separator	A: - B: 7, 9, 12,13	Dust/aerosols
Deep bed filter	A: - B: 7, 9, 10	Dust/ aerosols
Ceramic filter	A: - B: 7, 9, 12, 10	Dust/ aerosols
Dry flue gas cleaning	A: - B: 7, 12, 23	Inorganic substances
Wet scrubber	A: - B: 7, 9, 13, 24	Inorganic substances
Odour control using ozone	A: - B: 7, 22, 25	Odour
DeNO_X SCR	A: - B: 7, 32, 33	NO_X
Environemntal. manag. system	A: 3, 4, 5 - B: 34	Various

Table 3b ERPs for monitoring flue gas treatment techniques

Category A ERPs
1. Outlet total VOC concentration (e.g. FID, PID) 2. CO concentration 3. Raw material composition 4. Fuel composition (e.g. S-content coal/cokes oven gas) 5. Mass balance for monitoring a limit for hourly load (e.g. for chemical nickel plating bath)
Category B ERPs
6. Temperature combustion chamber / adsorption vessel / biofilter / coolant, etc. 7. Inlet flow rate of flue gas 8. Flow rate or consumption of fuel used for supplementary heating (usually gas) 9. Pressure drop of reactor, membrane 10. Operating time / useful life (of filter material) 11. Relative humidity of flue gas flow 12. Inlet flue gas temperature 13. Flow rate liquid circulation 14. Outlet flue gas temperature 15. pH of scrubbing liquid / biofilter / active sludge tank / buffer tank 16. Moisture content of biofilter 17. Inlet flue gas moisture content 18. Inlet dust concentration 19. Maximum temperature of the biofilter in the course of time 20. Good dust discharge from hopper 21. Verification of proper operation of the rapping mechanism 22. Electrical voltage or current on device 23. Value to be added in the case of dry matter (kg/hour) or suspension (m^3/hour) 24. Concentration of the reagent in the scrubbing liquid 25. Ozone concentration in flue gas from flue gas treatment 26. Switchover times of multi-bed catalytic reactor 27. Catalyst condition (age, aging, poisoning) 28. Concentration of the absorbed pollutant in the washing liquid 29. Level measurement 30. Weight measurement 31. Qualitative / indicative dust measurement 32. Measurement of dosing NH_3 33. Catalyst temperature
34. Production limitation (e.g. if production remains below value x, the emission remains below value v)

3.7.5 Monitoring by measurements

In § 3.7.2, it is described that several types of monitoring are possible. One of the possible types is the carrying out of measurements. Measurements are distinguished as periodic measurements and continuous measurements.

Based on the results of the measurements, the competent authority assesses whether the emission limit values are complied with. To achieve this, several aspects are important in carrying out the measurements. This section discusses the aspects that are important in carrying out periodic measurements and in carrying out continuous measurements, the measurements in the permit and the measurements in other laws and regulations.

The aspects that are discussed in this section, the competent authority may specify in the permit. Another possibility is that these aspects are elaborated in a monitoring plan by the operator, possibly in consultation with a measurement expert, and that this plan is approved by the competent authority. The operator is responsible for the carrying out of measurements in accordance with the requirements in the permit or in accordance with the monitoring plan.

More detailed information on the aspects discussed in this section are included in InfoMil publication Manual for measurements of air emissions.

This section is not about odour measurements; to that reference is made in section § 3.6.

Periodic measurements

Start of measurements

In case of requirement to periodic measurement, the competent authority must record in the permit that the first measurement should take place as soon as possible, but no later than 6 months after the emission limit value has come into effect.

In addition, it can be included in the permit that, in terms of enforcement, the operator must indicate when the measurements will

take place, how long in advance this must be reported (e.g. a week) and to whom.

Measurement site

It is important that, during the measurements, a representative sample is taken from the flue gas flow. Disturbances of the flue gas flow may lead to incorrect sampling. The requirements on the measurement site and on the measurement facilities are specified in a separate measurement standard (NEN-EN 15259).

The competent authority must include in the permit that the measurement site and the measurement facilities should, wherever possible, meet the relevant standard. The operator, possibly in consultation with the measurement expert, should work this out in a monitoring plan and must give effect to this. When measurements are taken at a measurement site that does not meet the standard, it must be stated in the measurement report.

Measuring methods

For the carrying out of the measurements, the operator (or the measuring body) should use standardized measuring methods. Standardized measuring methods are defined in measurement standards. The competent authority must lay down the obligation to use a specific measurement standard in the permit. This is the measurement standard prevailing at the time of the permit application. With the appearance of a new standard, the operator, in consultation with the competent authority and a measuring body, can decide to adopt this new standard.

For an overview of measurement standards for air emission measurements, refer to overview of standards placed on the InfoMil site (www.infomil.nl). The standards may be ordered from the Netherlands Standardisation Institute (NEN). The application of the standardized measuring methods may be deviated from if it is shown that the measuring method to be applied leads to comparable results as the standardized measuring method. *(For example using NEN 7778:2003 Environment – Equivalence of measuring methods).* In cases where no standardized measuring methods specifically tailored to the situation are available, it is possible to use other measuring methods.

Monitoring the reference parameters

The emission limit values on the basis of the NeR are concentration requirements (in mg/m_0^3) expressed at standard conditions. The latter means at 273 K, 101.3 kPa and related to dry flue gas. Based on the definition of the emission limit values at standard conditions, they are generic and independent of the specific flue gas conditions. In some cases, the limit values are additionally specified with a standard oxygen concentration.

The competent authority must include a provision in the permit stating that the measurement results must also be presented as expressed at standard conditions. For the conversion of the measurements results to standard conditions, certain reference parameters (temperature, pressure, moisture and/or oxygen content) must be known, depending on the measuring method. The operator, possibly in consultation with a measurement expert, elaborates the measurement of the relevant reference parameters in a monitoring plan using standardized measuring methods. *(For the formulas for conversion to standard pressure and temperature and for moisture correction and oxygen correction, see Section 5 InfoMil publication Manual for measurements of air emissions.)*

Quality assurance of measuring body

The quality of the performance of the individual measurements is to be ensured. This can be done through accreditation, wherein the measuring body is accredited for that periodic measurement. For less common components, an accreditation for the more general flue gas components suffices, such as for example NO_2, SO_2, dust, C_xH_y and O_2.

The Dutch Accreditation Council (RvA; http://www.rva.nl) is the Dutch accreditation body that manages an overview of the measuring bodies that are accredited. The accreditation includes a scope, stating for which type of measurement the accreditation is valid. A measuring body that is accredited by a foreign accreditation body (see http://www.european-accreditation.org/) is also allowed in the Netherlands.

The competent authority must elaborate the requirement to ensure the quality of the performance of periodic measurements in the permit.

Operating conditions during measurements

In the context of the NeR, the emission limit values relate to periods with the highest emissions, at normal operation. Therefore, the measurements must be carried at such operating conditions. It is not the intention

that measurements are carried out in failure situations, or during operation of all installations when this normally does not occur. Periods in which, due to stoppage of the process or other specific operating conditions, no emission takes place, should be ignored when sampling. (*Incidentally, failures are relatively more important as a source of emission. The E-PRTR Regulation therefore requires operator to report data on accidental emissions.*)

The competent authority must include a provision in the permit stating that the measurements are performed under normal operating conditions with the highest emissions. The operator, possibly in consultation with a measurement expert, elaborates these operating conditions in a monitoring plan.

Sampling duration and required number of sub-measurements

A periodic measurement consists standard of three sub-measurements or samples. The three sub-measurements must be performed during the periods with the highest emissions, at normal operation (see Operating conditions during measurements). If the history gives rise to this, it may be decided, by agreement between the competent authority and the operator, to carry out more sub-measurements.

The sampling duration for each sub-measurement takes half an hour, unless:

- a longer sampling period is to be used based on the measuring method;
- a longer sampling period is necessary for sampling the flue gases in a representative way, for example in the case of batch processes. If an emission limit value is recorded per batch, a sub-measurement can even take up to a full batch up to the time that, according to the permit, is used for assessing the emission limit value. It also applies here that sampling may not take place during periods that no emission occurs.
- a shorter sampling duration is required by working in charges shorter than half an hour.

The competent authority must record the required number of sub-measurements and the sampling duration in the permit or the operator should specify it in a monitoring plan.

Measurement uncertainty

Each measuring method (and measurement result) has a certain uncertainty. The measurement uncertainty is composed of sources of uncertainty in sampling, sample handling and analysis. The size of the measurement uncertainty can be derived from the relevant measurement standard or can be estimated by the measuring body that carries out the measurements. Table 4 contains a list of the maximum uncertainties to be used as a percentage of the emission limit value. These values include the possible conversion to standard conditions. (As a measure of the measurement uncertainty, the NeR uses the 95% confidence interval (95% CI). This means that the probabilitythat the true value is within this interval is 95%).

Table 4. Maximum measurement uncertainty as a percentage of the emission limit value

Component	**Measurement uncertainty [%]**
SO_2	20
NO_x	20
Dust	30
Total organic carbon	30
Other components*	40
Flow rate	20

*For odour, different values apply for the measurement uncertainty. See Section 3.6 of the NeR for information on measuring odour.

The competent authority may specify in the permit that the operator (or the measuring body) must determine the measurement uncertainty of the measurement. The value of the measurement uncertainty of a particular measurement result is important for the compliance assessment (see § 3.7.6) and must therefore be reported in a clear manner by the operator / measuring body. Instead of that, the above values may also be included in the permit.

Reporting and storage of measuring data

As described in § 3.7.1, the Dutch Environmental Protection Act (Wm) states that requirements must be attached to the permit concerning the provision of the measuring data to the competent authority. How this should occur, for example by sending the report or by keeping the report

available for inspection in the facility, and the period within which the data should be made available, must be specified in the permit.

The report should include all information that is necessary for the interpretation of the results. In the reporting on periodic measurements, it is important to show that the measurements were performed under normal operating conditions with the highest emissions. This requires the provision of information on the date and time of the measurements, as well as relevant data on the operation at the time of the measurements.

The competent authority must include in the permit that the operator should preserve the measuring results for 5 years. For installations where only a single measurement takes place, the measuring results must be preserved for the remaining lifetime of the installation.

Continuous measurements

Start of measurements

If a continuous measurement is prescribed, the monitoring starts immediately upon entry into force of the emission limit value, or after commissioning of the measuring system. For continuous measurements, there is a permanently installed measuring system (automated measuring system) at the company. This makes the operator itself the performer of the measurements.

If continuous measurement of a specific component is not possible for technical reasons, the possibility of continuous measurement of the substance class or category must be checked (see § 3.7.4).

Measurement site

See periodic measurements.

Measuring methods

See periodic measurements.

Monitoring the reference parameters

See periodic measurements.

For a continuous measurement requirement, the relevant reference parameters (temperature, pressure, moisture and/or oxygen content) must also be continuously monitored. This may be dispensed with when it appears that the respective parameters are constant, are unimportant for assessing the emission, can be determined in another way with sufficient certainty or cannot be measured continuously.

Quality assurance of automated measuring system

The measuring system (i.e. the system of sampling, sample handling and analysis) used to determine the concentrations in the flue gas continuously, must be checked and calibrated for an effective operation immediately after commissioning. This inspection is repeated at least once every 5 years and after any significant change in the process.

The calibration is composed of a comparison with an periodic measurement (using a standard reference method). This comparison is carried out by an accredited measuring body.

In addition to the five-year calibration, the measuring system must be checked at least once a year for effective operation. The operator constantly ensures the proper operation of the installed measuring equipment, including regular maintenance and regular tests by using test gases.

The above aspects of quality assurance are detailed in a European standard, which is implemented in the Netherlands: NEN-EN 14181. This standard does not prescribe a specific measurement principle, but gives procedures to ensure that the measuring results can meet a certain measurement uncertainty. NEN-EN 14181 has three Quality Assurance Levels (*QAL1, QAL 2 and QAl3)* and an Annual Surveillance Test *(AST). (For more information about NEN-EN 14181 see, for example, InfoMil practice sheet L40-7C Quality Assurance of automated measuring systems).* This guarantees the entire process from the selection of a suitable measuring system, calibration and validation of the measuring system after installation to the monitoring of the continuous proper functioning thereof. The uncertainty requirement against which the measuring system is tested is not contained in the standard itself, but must be specified in the permit. The uncertainty percentages in Table 4 are the basis of this.

Measurement uncertainty

See periodic measurements.

Processing, reporting and preservation of the measuring data

The operator determines per source a half-hour concentration for each successive half hour. To make the assessment easier for a large number of measuring results, the competent authority may specify in the permit that the half-hour averages, after conversion to the standard conditions and possibly standard oxygen percentage, may be classified by the operator in at least 20 concentration classes and stored as frequency distribution. The frequency distributions must be available at any given moment and recorded once a day. The measuring results of the continuous measurements must be preserved in the facility for 5 years.

The results of the continuous measurements are reported annually. See also periodic measurements. In reporting about continuous measurements, it is important that periods of startup and shutdown and other periods of exceptional operation are identified.

Measurements and the permit

As described in the introduction (§ 3.7.1 – Legal framework) and in § 3.7.2, the following points must be included in the permit of IPPC installations:

- Monitoring type
- Monitoring frequency
- Provision of measuring data

For non-IPPC installations, it is recommended to include the above points in the permit.

It is recommended in the permit also to pay attention to the following:

- Notification / start of measurements
- Measurement site
- Measuring method
- Quality assurance of measuring body (performing periodic measurements)
- Operating conditions during the measurements
- Sampling duration and number of sub-measurements
- Measurement uncertainty
- Quality assurance of automated measuring system
- Processing / registration of measuring data and reporting

The way the competent authority can record the above-mentioned points in the permit is already described in this section. Another possibility is to have the operator elaborate these points in a monitoring plan, possibly together with a measurement expert (see also § 3.7.1 – Legal framework). The monitoring plan must be submitted to the competent authority for approval. In this case, the permit sets out the issues that must be included in the monitoring plan and when the monitoring plan must be submitted.

Example – Monitoring requirements in the permit

The permit should include that:

- the periodic measurements are carried out as soon as possible, but no later than 6 months entry into force of the emission limit value;
- performing of the measurements is reported to the competent authority no later than 2 weeks prior to the date of implementation;
- the measurement site is arranged in accordance with NEN-EN 15259, which is elaborated in a monitoring plan;
- the periodic measurements are performed in accordance with NEN-EN 13284-1 by a measuring body with an accreditation for dust measurements;
- the operating conditions during the measurement are specified by the operator in a monitoring plan;
- the number of sub-measurements and sampling duration for a reliable measurement are specified by the operator in a monitoring plan;
- the measurement uncertainty is determined by the measuring body with a maximum of 30% of the emission limit value;
- the results of the periodic measurements, converted to standard conditions, are reported in a clear manner and stored until the next periodic measurement.

Monitoring versus enforcement

An operator that is obliged to carry out measurements may contract out their execution or have them executed by its own (accredited) measuring service. The Environmental Protection Act stipulates that data to verify the compliance with the permit may also come from the operator itself and hence requested for that purpose.

This means that the competent authority can enforce using the results of these measurements. In addition, the competent authority may perform the assessment measurements itself (or have them performed). Enforcement is also possible on the results of continuous measurements that

must be performed by the operator in accordance with the permit.

No enforcement can occur on measurements not included in the permit but which the operator voluntarily performs for the benefit of the operations.

Measurements in other legislation

Besides the NeR, other laws and regulations also impose monitoring requirements. Requirements relating to the carrying out of the measurements (measurement standard, accreditation, quality assurance of automated measuring system, averaging time, etc.) are partly specified in the decrees and partly in the associated ministerial regulations (see § 3.7.1 - Consistency with other legislation).

3.7.6 Compliance assessment

The final step in monitoring the emissions concerns the compliance assessment of the determined emissions by the competent authority. This section discusses the assessment of the recorded values of ERPs and the results of measurements, such as those provided by the operator or the measuring body. In addition, this section deals with the compliance and the permit and the compliance in other laws and regulations.

ERPs

In assessing the results of the ERPs, a distinction is made between the assessment of category A ERPs and the assessment of category B ERPs. Category A ERPs may, after the relationship with the emission has been well defined, entirely replace the measurement of a specific component or components. The assessment will therefore refer to that what is stated under "Continuous measurements".

In category B ERPs, it must be recorded in the permit (or in a monitoring plan) within what range the values of the ERP may proceed, or what values the ERP should not exceed or fall short of. These are the assessment criteria. With this type of ERPs, the competent authority does not therefore assess an emission limit value, but the recorded values are compared with these assessment criteria. If the assessment criteria are not complied with, it is an indication that the emission abatement technique is not functioning properly or that there are very different process conditions and that therefore the emission limit value is possibly exceeded.

Example – assessment of ERP

At a company, dust is treated with an electrostatic precipitator.

The flow rate of flue gas to be treated and the electrical voltage of the electrofilter should be monitored continuously as ERP. The values of the first ERP should be located between a and b m_0^3/s in accordance with the information from the supplier; the values of the second ERP between c and d Volt. The registered ERP values are compared to this.

Measurements

Periodic measurements

As described in § 3.7.5, a periodic measurement consists standard of three sub-measurements (samples). The results of the sub-measurements are averaged and this average is considered the result of the periodic measurement.

Before the competent authority assesses the compliance of the periodic measurement with the emission limit value, the measurement uncertainty (*see § 3.7.5 Monitoring by measurement, the texts on measurement uncertainty for periodic measurements*) must be subtracted from the measurment result. The measurement uncertainty is therefore interpreted in favour of the operator. If the result of the measurement, minus the measurement uncertainty of the measuring method, does not exceed the emission limit value, the emission limit value is complied with.

In practice, the measurement uncertainty is now often subtracted from all (three) sub-measurements. This is not correct because the average measurement uncertainty decreases upon increase of the number of sub-measurements. In a series of n sub-measurements, the average measuring result must be reduced by the value for the total measurement uncertainty divided by √n.

Example – Assessment of periodic measurement

At a company, dust is treated with an electrostatic precipitator. The dust emission limit value in the permit is 5 mg/m_0^3.

A periodic measurement was carried out with the following results:

Sub-measurement 1 = 5.6 mg/m_0^3

Sub-measurement 2 = 5.1 mg/m_0^3

Sub-measurement 3 = 4.7 mg/m_0^3

The result of the periodic measurement is the average = 5.1 mg/m_0^3

The measurement uncertainty of a dust measurement (see § 3.7.5) is 30% of the emission limit value = 0.3 x 5 = 1.5 mg/m_0^3.

At 3 sub-measurements, measurement uncertainty is 1.5/√3 = 0.9 mg/m_0^3.

The value for compliance assessment is therefore 5.1 – 0.9 = 4.2 mg/m_0^3. This is lower than 5 mg/m_0^3 and in doing so the emission limit value is complied with.

Continuous measurements

The results of the continuous measurements should be assessed in two different ways. For the continuous measurements, it applies that:

- each of the daily average concentrations should be lower than the emission limit value; and
- none of the half-hourly average concentrations may exceed twice the emission limit value.

Also for continuous measurements, it applies that the results of the measurements are assessed against the emission limit values after the measurement uncertainty has been deducted from it. Here, the total measurement uncertainty is used (see § 3.7.5 Monitoring by measurement, the texts on measurement uncertainty for periodic measurements). This therefore does not have to be divided by √n.

Compliance assessment and the permit

The permit for IPPC installations must lay down what procedure is used in the assessment of the information obtained with the provisions (see § 3.7.1 – Legal framework). The competent authority must therefore include the procedure of assessment in the permit:

- the measuring result that is assessed (e.g. after conversion, averaging and subtraction of the measurement uncertainty);
- the assessment criteria;
- when the emission limit value has been complied with.

For non-IPPC installations, it is recommended to include the above-mentioned points in the permit.

Compliance assessment in other legislation

For periodic measurements, the Solvents Decree, equal to the NeR, states that the average of all measurements should be lower than the emission limit value. The decree has, however, an additional requirement that all hourly average values should be less than 1.5 times the emission limit value.

The decrees regarding combustion emissions are stricter, because none of the measuring results that are part of a periodic measurement may exceed the emission limit value. However, there is (upon exceedance of the emission limit value by a sub-measurement) the possibility of yet determining, on the basis of a series of further measurements, whether the emission limit value is complied with.

For continuous measurements, there is in legislation a variety of assessment criteria. This is due to variations in the prescribed averaging time (from half an hour to a month), in the percentile values (from 95 to 100%), and in the multiplication factors for the emission limit value (between 1 and 2).