4th Imeko TC19 Symposium on Environmental Instrumentation and Measurements
Protecting Environment, Climate Changes and Pollution Control
June 3-4, 2013, Lecce, Italy

'SOME OPEN ISSUES IN ENVIRONMENTAL MONITORING OF IPPC PLANTS: AIR EMISSIONS MEASUREMENTS'.

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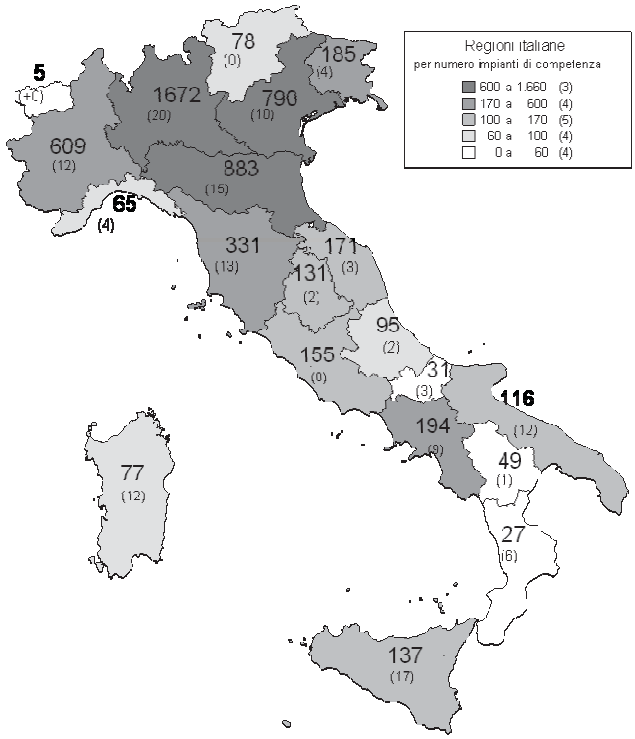
Abstract: This paper describes some 'open issues' coming from the application of the authorization decrees licensing IPPC Plants in Italy at national level that have to respect monitoring and control procedures – as prescribed – in terms of air emissions measurements.
The release of IPPC operational licensees, in fact, has given place to hundreds of new technical situations in these Plants where pollution is now under control, where monitoring and reporting must now be developed.
These questions, on the other side, can be considered as giving also new opportunities for research and development for new methodologies and studies in order to reach results able to solve them.
Kinds of these new techniques – as technologies and managerial procedures - can help to solve these problems in order to support better application of IPPC permits and besides also some preliminary comments and suggestions needed to match this new deal.

Keywords: environmental integrated permits, air pollution emissions, BAT, monitoring, measurements, control, instrumentation.

1. IPPC PLANTS UNDER NATIONAL OPERATIONAL LICENSING

In Italy, IPPC Permit is one typology of licensing authorization released into the environmental protection field to prevent and control pollution as an 'integrated authorization', allowing operation of industrial activities with specified production's characteristics and dimensions, both at national level and at regional level.
The list of categories of these specific industrial activities[1] is regulated by the Italian Law n. 152/2006 and s.m.i. (ex Italian Law n. 59/2005 and s.m.i.) that adopts and endorses the Directive n. 96/61/EC and s.m.i. (Directive 2008/1/EC and s.m.i.) concerning integrated pollution prevention and control (actually recast in the Directive 2010/75/EU).



In Italy IPPC activities under operational licensing are located in all Regions, where are operating about 5.800 plants, 161 of this are called "strategic" that means that they need National permits[2] - 114 of which are old, 41

[1] These activities are normally developed inside industrial plants designed and built following preliminary SEA-EIA permits, if needed (if listed inside EIA-SEA regulations).

[2] Other Plants are managed for authorization at Regional level, even if most of Italian Regions, particularly those with more than 300 IPPC Plants, delegate fully or partly these permit procedures to Provinces (Piemonte, Lombardia, Veneto, Trentino Alto Adige, Liguria, Emilia Romagna, Toscana, Lazio, Sardegna).

new already authorized, and 6 new under authorization at December 2012[3] - as 15 Crude Oil Refineries, 33 Large Chemical Plants, 2 Integrated Foundries, 111 Large Combustion Thermo-Electrical Plants and Offshore Plants.

These IPPC Permits[4] are released by the Competent Authority, and namely by:

1. IMELS for activities of national interest;
2. other Authority designed by the Region or Province for other activities

By its regulations, ISPRA provides technical and scientific support to the Italian Ministry for the Environment, Land and Sea (IMELS), and also in coordination of environmental inspections, monitoring and assessments, by the Italian Law n. 152/2006 and s.m.i. in a joint procedure for IPPC permits' releases.

According to EU Directive 96/61/CE and following codes (Directive 2008/1/CE and Directive 2010/75/UE) production activities under operational licensing permits are listed in Attachment VIII to Part II of Italian Decree n. 152/06 and following integrations, and particularly, in Attachment XII to Part II of Decree 152/06, while others activities remain under regional and provincial licensing.

Quantitatively, on 7 august 2011 about 177 plants were under national licensing (see Table 1).

STATUS	IPPC PLANTS (national)
Licensed	98
Waiting for licensee publication	39
Technical analysis completed	22
Technical analysis performing	18
TOTAL	**177**

Table 1. Results of IPPC licensing activities at 7 august 2011.

From an environmental point of view, the release of IPPC licensees in Italy has brought a reduction of pollution released around IPPC Plants by means of adoption of new technologies, showing that it's possible to have a better environmental quality.

Particularly, for only air emission at the stacks, the situation in Italy is showed in Table 2, following indications given at 7 august 2011 for macro pollutants as SOx, NOx, CO and Dust, as a result of BAT application as described in Brefs for medium values for similar IPPC Plants[5].

In order to achieve these results, some limits values has been prescribed[6] for pollutant substances and noise, supplying further dispositions to warrantee soil and groundwater protection, proper waste management, emissions prevention and controls with parameters, frequencies, methods, evaluation procedures, reporting, maintenance in different operational conditions.

[3] Updated to 2012 by MATTM. The categories of these specific industrial IPPC activities of national interest are:

1. crude oil Refineries (excluding those producing only lube), gasification and liquefaction plants with more than 500 tons/day of coal or oil shale;
2. thermal power Plants with more than 300 MWt of thermal power;
3. integrated Steelworks for first fusion of cast iron and steel;
4. a series of Chemical Plants with annual total production capacity superior to a minimum included between 100 and 300 millions of kg, depending on the specific class of product;
5. all other Plants under EIA that are fully localised on sea.

[4] The 'Decree of IPPC Permit' released is a formal authorization signed by the Competent Authority and contains:

1. An introduction with references to Directives, Laws, Owner's Request and all administrative documentation related to the authorization procedure;
2. The Decree's dispositive, with the description of what is authorized to the requesting Owner of the IPPC activity and at which conditions;
3. Some articles, referring to or containing:

- Emission limits and prescriptions for operation
- Other prescriptions
- Monitoring, inspection and control
- Duration and updating of the IPPC Permit
- Tariffs
- Authorizations substituted
- Final dispositions

[5] For example, for Crude Oil Refineries, to means values proposed for air emissions at the stacks (50° percentile of EU Refineries in t/Mt of oil, as well as SOx = 550, NOx = 270, CO = 50, Dust = 30.

[6] In accordance with general principles and respecting environmental quality norms (see art. 6 comma 16 and art. 29-septies of Italian Decree 152/06).

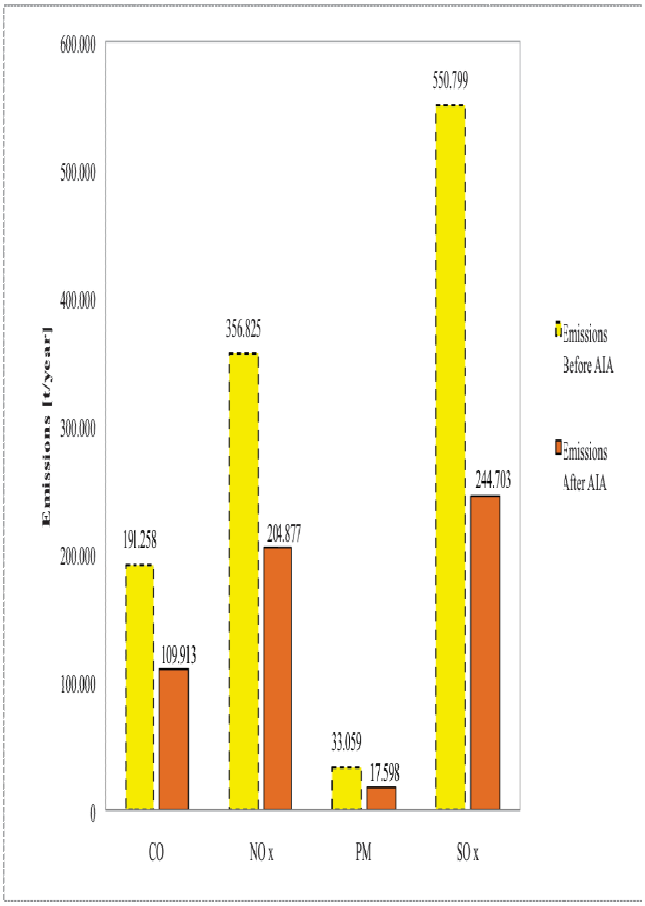


Table 2. Air pollution abatement in Italy from IPPC licensing activities at 7 august 2011.

3. MONITORING AND CONTROL PLAN

IPPC Permits[7], among other information, contain a description of the activities, a comparison with the applicable 'Best Available Techniques', a set of emission limits values and of specific prescriptions, as well as a '**Monitoring and Control Plan'** for each authorized installation, in which pollutants releases in the environment are controlled by measurements of selected parameters and frequencies with appropriate methodologies.

There are 3 main types of industrial monitoring:

1. Emission monitoring: monitoring of industrial emissions at source, i.e. monitoring releases from the plant to the environment.
2. Process monitoring: monitoring the physical and chemical parameters (e.g. pressure, temperature, stream flow rate) of the process in order to confirm, using process control and optimisation techniques, that the plant performance is within the range considered appropriate for its correct operation.
3. Impact monitoring: monitoring pollutant levels within the environments of the plant and its area of influence, and the effects on ecosystems.

The IPPC Permit plans and performs an integrated prevention and control set in the exact point of pollution ('at source'), that means that pollutants are declared, detected and controlled in the emission points of the industrial activities, as well as of all the entire industrial plant's operation.

This means authorization of plants' operation controlling natural resources' usage and proper deployment, emissions and discharges in the environment, inside predefined limit values and prescriptions, adopting a predefined monitoring framework, as self-controls on selected parameters, frequencies and methodologies, with a periodic reporting and planned inspections.

Preparation by ISPRA of a 'Monitoring and Control Plan', defines so:

1. selected parameters and frequencies for self-controls to be performed by the industrial plant's Operator;
2. predefined methodologies for above mentioned IPPC Plant self-controls;
3. contents, timing and modalities for periodic (annual) reporting for IMELS information;
4. and first planning of inspections, with parts to be inspected and different environmental aspects, to be performed by ISPRA, ARPA and APPA during the IPPC permit's period of validity (5, 6 or 8 years, depending of EMS adopted, if any).

In this way, control and monitoring activities are performed all over the Italian Country, by means of a joint collaboration among IMELS (Competent Authority), ISPRA (National Control Authority) and ARPA-APPA (Local Control Authorities).

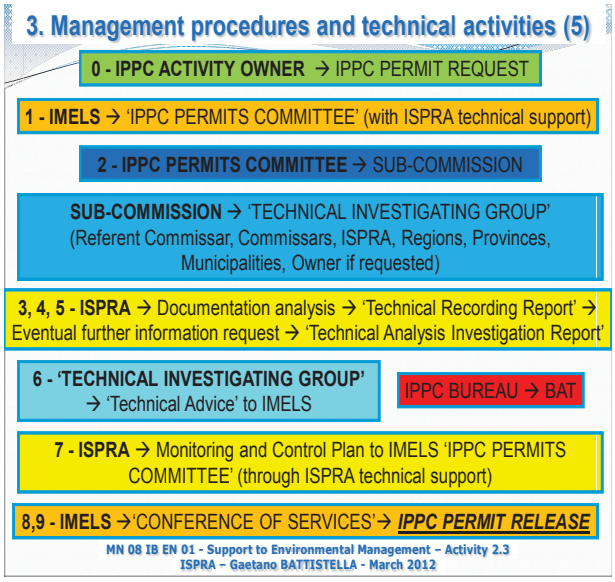


Table 3. Italian IPPC licensing activities procedure (at national level)

[7] Issue of the 'IPPC Permit' by IMELS, contains the approved 'Technical Advice' and the 'Monitoring and Control Plan' for the specific industrial plant operation and starting of these activities (for more information see also ISPRA web portal at the URL http://www.isprambiente.gov.it)

In this Italian procedure[8] to release IPPC Permits, ISPRA is also on charge of performing the requested comparisons of environmental parameters with the applicable '**Best Available Techniques' (BAT)** - contained inside available published BAT Reference (Bref) documents – in order to evaluate and to propose to the 'Technical Investigating Group' of the IMELS Committee appropriate proposals for limit values, prescriptions and recommendations to be adopted in the 'Technical Advice', to be approved.
In this way, also a virtual process is started, in order to compare IPPC activities and plants' performances in term of 'resource efficiency', trying to optimize the analyzed processes and to reduce their emissions limits.

4. MONITORING AND CONTROL ACTIVITIES 'OPEN ISSUES'.

At the moment, this authorization procedure has been recently concluded both at national than at regional level without delays and the permits released are in the management phase of their first application and endorsement by Operators, and this means that some interesting 'open issues' – as well as 'technical problems/questions to be solved' - come up to technical attention of both Competent Authorities (IMELS) and Control and Monitoring Institutions (ISPRA, ARPA/APPA), waiting for solutions and/or dedicated research.
About the control and monitoring of these pollutants, among others, there are a lot of specific situations in which for the first time - or 'officially' for the first time - some measuring procedures must be applied in terms of methodologies, instruments, skills and quality that needs to be analyzed to find possible solutions and give reliable answers.
Particularly, Attachment X to Part II of DLgs 152/06 defines the list of main pollutants to be monitored, if pertinent, with reference to air emissions and water discharges (see following table) for IPPC Plants under operational licensee.

AIR	WATER
SO_x; NO_x; CO; COV, Metals, Dust, Asbestos, Chloride, Fluoride, Arsenic, Cyanides, Carcinogenic / mutagenic substances, PCDD-PCDF	Organic halogenated, Organic phosphoric compounds, organic stannic substances, Carcinogenic / mutagenic substances, Hydrocarbons persistent and organic toxic persistent and bio accumulative substances, Cyanides, Metals, Arsenic, Biocides and Pesticides, Suspension materials, Eutrophic substances, Oxygen unbalanced substances

Table 4: list of main pollutants to be monitored, if pertinent, with reference to air emissions and water discharges[9]

Attachments to Part 3 of Italian Decree 152/06 list minimum emissions values (relevance thresholds) and maximum emissions values (limit values) and related prescriptions (continuous monitoring, process parameters to monitor, measurements' norms, continuous monitoring control procedures, conformity criteria for measurements, etc.) for pollutant substances emitted in atmosphere[10] at the stacks and specific indications for some substances (as dusts, VOC, NOx, SOx, etc.) and for some types of plants.
Besides, other useful references for monitoring are given in 'Reference Document on the General Principles of Monitoring' (July 2003), published by European IPPC Bureau, that addresses monitoring requirements of industrial emissions at source, and helps to promote comparability and reliability of monitoring data, even if process monitoring and impact monitoring of the quality of the environment are not covered. This document, where appropriate, refers to available CEN standards in the field of monitoring (see list in Annex 2).

[8] All information about IPPC Permit releases activities are available through a dedicated Website inside the IMELS Web Portal at the URL http://aia.minambiente.it/
This Website is available for public consultation for free and also by means of selected passwords for Experts involved in the analysis and evaluation activities for the IPPC Permit release.
Other support tools are used by Experts involved in the analysis and evaluation activities, as internal website or databases for data management and updating of all the IPPC Permit release's procedures during and after their performance.
A specific attention must be paid to the availability also of some external Website as the European IPPC Bureau Website for Bref publication of contents of BAT (Best Available Techniques) at the URL http://eippcb.jrc.es/

[9] At the moment, a part of pH and Temperature, controls and measurements performed are not in continuous and no specific considerations are possible, but this will probably change in the next future.
Other pollutants and – of course - 'open issues' can be easily found for monitoring of other pollutions from IPPC Plants, as well as for waste management, noise, odours, etc.

[10] Attachment 5 to Part 3 of Italian Decree 152/06 and s.m.i. lists some modalities to perform analysis with parameters to be controlled in water discharges (sampling, reference methods, yearly number of samplings, maximum number of samples not conforming, time for sampling, etc.).

5. AIR EMISSIONS MONITORING AND CONTROL 'OPEN ISSUES'

In the field of air emission control and monitoring, a first possible short list of 'open issues' to work with for a solution, refers to the following one.

1. Languages, which are different between 'emission monitoring and control' and 'impact monitoring' results presentation and communication (as parameters vs. indicators), in terms of internal emissions as inside the IPPC plant and external fallout as outside the IPPC plant.
In this case different situations match together, even if referring to the same IPPC Plant and its air pollution, one using measurements of 'environmental parameters' and the other using descriptions by 'environmental indicators'.
These 'impact indicators' have been developed historically before starting of IPPC licensing with other different purposes as limiting pollution around the territory and not always describing pollution that can be matched and reduced starting from analysis of data coming from emission monitoring and control at source.
In some cases, besides, also the order of magnitude is different, so that for some pollutants – as for example CO - the comparison with maximum air emission limit values at the stacks assigned to IPPC Plants shows that there is a huge difference in quantity that cannot underline the environmental problem of the derived pollution, as CO is a macro pollutant as SOx, NOx and Dust.

2. Modeling, for computing, evaluation and verification of conformity to IPPC criteria and goals (air pollutants' concentrations inferior to environmental quality standards fixed by norms) and comparison with air pollution emissions measures at the stack and for fallout measures on the soil outside of the IPPC Plant.
This is a very complex question – today not so much mathematician but more ecological - that should be correctly match using a 'bottom-up approach' starting from tolerability values of the ecosystem till arriving to resilience values of the territory in which an IPPC plant is going to be licensed to be comprehensive of its specific topics.
When this values are know, probably it becomes more easy to verify the needed conformity at the end of the licensing assigning appropriate selected limit values, also using modeling methodologies verifiable by some appropriate quality measurements, avoiding or reducing the ecological risk, because built as verified to be 'inside' the ecological footprint of the site.

3. Analytical measurements methods, sometimes missing (not available in all cases) for continuous monitoring and control of some specific pollutants (not for every of them as metals, PAH, etc.). In many cases continuous monitoring has been prescribed in IPPC Permits, but in some cases no methods are available for these measures – certified ones – of some specific pollutant released into the environment. There is a need to identify new methods as well as to certify those available and already used, if any, in order to supply qualified data.
On this question, a first review of IPPC Plants fully licensed, especially 'Refineries' and 'Chemical Plants' more than 'Large Combustion Plants', shows that there are some pollutants emitted at the stacks that are not yet possible to be monitored in continuous due to the lack of certified method of measurements.
In fact, at the moment, are available such types of methods just for some continuous measurements of pollutants and/or parameters, such as those showed in the following table.

POLLUTANT / PARAMETR	METHOD
Dusts	UNI EN 13284-1:2003
CO	UNI EN 15058:2006
NOx	UNI EN 14792:2006
SO_2	UNI EN 147912006
HCl	UNI EN 14791:2006
COT	UNI EN 1911 1-2-3:2010
Oxigen (O_2)	UNI EN14789:2006
Umidity (H_2O)	UNI EN 14790:2006
T - P	UNI 10169:2001

Other pollutants or parameters have not yet the availability of methods for continuous measurements, such as Ammoniac NH_3, Hydrogen Sulfide H_2S, Acetaldehyde C_2H_4O, VOC, PCDD, PCDF, PCB, CVM, DCE, Pb, Cd, C_6H_6, HF, Formaldehyde CH_2O, Propionic Aldheyde C_3H_6O, Methanol CH4O, Butanol $C_4H_{10}O$, Methyl isobutyl ketone, Cumene C_9H_{12}, Propanol $CH_3CH_2CH_2OH$, Metiletilchetone, Methyl propyl ketone $CH_3COC_2H_5$, Ethanol acetone, Cloride Cl_2, and their total sum amounts.
In some of these listed cases there are - already available - some methods never certified and internationally recognized, but used by Operators since many years, without any quality accreditation.
In other cases neither such 'under minimum quality level' is available, and this is really a problem that needs to be urgently solved, before going into different steps of testing them, such as quality procedures of automatic measurements system (SME), as defined by UNI EN 14181 (QUAL1, QUAL2, QUAL3, ASTM), to acquire valuable and useful data.

4. Measurements instruments and equipments, for their installations and maintenance for continuous monitoring sometimes have problems sometimes impossible to be solved. Installation and operation for IPPC plant layouts, characteristics and specific situations, where is prescribed to perform continuous monitoring and control, can identify unavailable instrumental measurements for different problems, as

physical availability, gas erosion, thermal situations, etc.
On this issue, for example, there are some research already active in University of Cagliari for a prototype of instrument able to perform continuous monitoring of Dusts, where erosion of this pollutant is the problem to solved by means of specific design of the instrument, availability of a 'calm room', adoption of specific deflectors in order to reduce combustion fumes speed at the stack for successful abatement of this phenomena, etc.
Other studies are developing to measure H_2S which is very soluble in water and is difficult to be measured in continuous, even if it's required as prescribed in IPPC Permits in some cases.
Also the measurement of Temperature of the flame at the flares is under development of specific research, because it's a very important parameter to be determined in order to assure a complete combustion of burning of ejected gas.
Finally, VOC measurements are at the moment under research and development of new equipments and instruments able to detect them in continuous monitoring for conveyed emissions as well as in other specific situation for not conveyed emissions.

5. Methods certification, – also for new alternative ones - for specific cases in which it's possible to find measurements' methods that are already available, but no certification procedure is available.
In these cases a new prototype procedure could/should be designed, tested and established in order to cope with the needed goals.

6. Long term monitoring (dioxins and furans), that is a specific question due to the presence, if any, of PCDD/F that must be detected among other measurements of chimneys characterized by a high level of dust (i.e. sinter process in the Iron and Steel Production).
This monitoring stems from evaluating the mass flows of emissions of dioxins and furans in systems with high variability of process and require a sampling period of 15-30 days, and then more than 6-8 hours provided by the UNI-EN 1948:2006, the only currently existing and specific for discontinuous sampling of dioxins and furans.
Currently these systems have been adopted in some systems (ILVA in Taranto - Italy, of Voest Alpine in Linz - Germany) only at the experimental level and require further technical and operational.

7. Critical component, in terms of appropriate definition of limit values to maximum threshold losses of air fugitive emissions, needed in the case of maintenance plans identification for LDAR program or similar plans of interventions, especially in the case of pollutant substances different from volatile organic compounds (VOCs).
In these cases (VOCs) the maximum threshold losses that identify the critical components are normally expressed in ppm of CH_4 (following indications derived from EPA Stds) and then these new maximum threshold losses might/should be changed in another expression referred to another % of a specific (toxic) substances (to be defined).

8. Measurement and evaluation, for air diffused emissions, of PAH, VOC or other pollutant substances dangerous to humans and the environment. In some cases (presence of explosive substances, flammable, carcinogenic, toxic and mutagen) is required to integrate LDAR program with local monitoring prototype. A network of fixed stations and placed in the perimeter and/or surrounding the plants that originate these emissions finalized and detect, in the shortest possible time, critical concentrations and to reconstruct the profiles emission of these pollutants.

6. CONCLUSIONS

From the discussion of these proposed 'open issues', that comes out from operational experience of licensing of IPPC Plants at national level, it's expected that new solutions could be found by means of appropriate studies and finalized researches and innovation, as it's already happening in some cases.
In fact, it's interest of Operators of the Plants, but also of Institutions and of Researchers to guarantee environmental quality for everybody.
In this way, these researches could have quick applications of their results, because of their need in monitoring and control of operation of IPPC Plants.

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