


INERISmag

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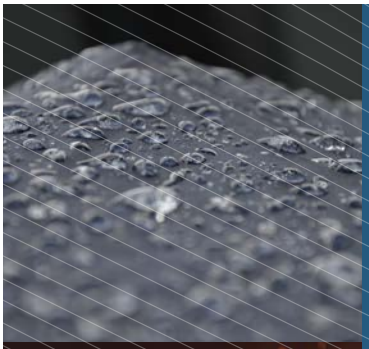
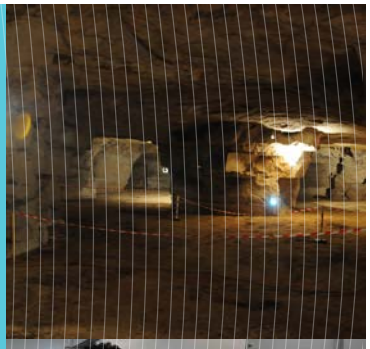
SCIENTIFIC AND PRACTICAL NEWS
OF RISK MANAGEMENT







LARGE EXPERIMENTAL FACILITIES: EXPERTISE AT FULL SCALE

BUSINESS SERVICES

CARRYING OUT TESTS AS CLOSE AS POSSIBLE TO FULL SCALE A TRUE ADDED VALUE

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INERIS

controlling risks for sustainable development










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BACKGROUND AND PERSPECTIVES
CHRONOLOGY

March 10, 1906, , the catastrophe of Courrières causes 1,099 victims. Two test stations will be installed to improve the personnel's safety.

1907 Creation of the Liévin site which will in particular work on coal dust.

1920 Creation of the Montluçon site: explosive shots allow to study inflammability of dusts and firedamp, and scientists also look into coal chemical treatment.

CERCHAR is created on **July 1, 1947**, a large central research establishment within National Coal Board.

Late 1990, CERCHAR was discontinued: by decree of December 7, 1990, a new body was created, the National Institute for Industrial Environment and Risks (INERIS), on the basis of the CERCHAR, which was reinforced by the arrival of teams from IRCHA.

INERIS celebrates its 20th anniversary **in 2010**

In 2012-2016, the Institute finalizes the modernization and the construction of large experimental platforms, all of which are unique in France, with some also being unique in Europe.

INERIS has cutting edge testing facilities, often unique in France, and that can be made available to its partners and clients. Among these, large facilities, allow for testing close to full scale, and are a key asset for the Institute.

Among traditional industrial activities and new technologies, industrial activities risks prevention on the environment, health and safety of people and goods, is a major challenge. The National Institute for the Industrial Environment and Risks (INERIS) has as its mission to contribute to this prevention. For this reason it carries out research programs, in particular related to risk cases phenomenology. The Institute's expertise covers a wide range of competencies that are dedicated to safety, whether looking into flammability and explosiveness of chemicals, long term behavior of industrial wastes or still yet the effects of chemical substances on complex ecosystems.

Meet the safety needs

Building on its historical background from the CERCHAR (French Research Center of National Coal Board) and from the IRCHA (National Institute of Applied Chemical Research), INERIS also looks to the future by renewing its historical platforms and by building new facilities so as to meet the evolution and increasing complexities in the field of safety needs. Its experimental approach goes from laboratory testing through to the implementation of unique large-scale testing facilities, feeds its multi-disciplinary expertise, in particular through the development or the assessment of computer models. However, what is the reason to test close to full scale conditions? And in which way does this methodology fit into current governmental concerns?

FOR MORE INFORMATION INERIS.FR


Mesocosms

CARRYING OUT TESTS AS CLOSE AS POSSIBLE TO FULL SCALE

A TRUE ADDED VALUE

Thanks to its facilities, INERIS is able to supply services not only based upon regulatory and theoretical expertise, but also on teams capable of designing the most representative tests to be able to cope with a given requirement or application.

Literature does not systematically propose data that enables to answer specific technical questions. In such cases, it is clearly possible to use a model that is based upon similar cases. However, full scale tests can give a more precise answer and make the developed models more reliable. Indeed, even if computer models become ever more successful, large scale testing remains necessary: indispensable to initially produce the data feeding the models and then, by means of testing, confirm the matching of the simulations with field reality.

The closest possible to real conditions

Stéphane Duplantier, Dangerous Phenomena and Resistance of Structures Division's manager within the Accidental Risks Directorate (DRA) explains: "laboratory testing can only take a portion of the parameters into account. For complex phenomena, such as the behavior of an electrochemical storage device (ie. battery) in abuse conditions, modeling or a part-by-part study will not bring about as complete an answer as the carrying out of full-scale testing would." Furthermore, on a laboratory scale, the dangerous phenomena are observed under so-called optimum conditions. Therefore, range of effects (and the range of safety) calculations based solely on data extrapolated from laboratory would result in extremely conservative models. That would make the land planning around industrial sites, the development of vehicles equipped with batteries etc., all the more difficult, based upon the fact of very large safety factors. The challenge is therefore to produce calculations as keen as possible.

EMISSION TEST BED

Objective: generate gaseous effluents simulating combustion or incineration smokes emitted by industrial installations.

- Unique in Europe
- Can accommodate up to twelve teams
- Used in the framework of the organization of the inter-laboratory tests entrusted to the Institute by the Ministry of Ecology

EXPLOSION DISPERSION PLATFORM

***Objective:** study of dangerous phenomena of an accidental origin.*

- Renovated in 2014
- Confined tests: galleries for destructive thermal tests on capacities, resistance of structures to overpressure...
- Open test platforms for safety equipment, new processes, phenomenology in the presence of obstacles...

Going beyond dangerous phenomena, substances' toxicity is also studied at full scale. So as to confirm or disprove the first observations obtained in the laboratory, experts rely upon mesocosms, which recreate artificial ecosystems. Twenty-meter-long channels to study long-term effects of chemical substances on aquatic environments in natural environmental conditions. "In a few months, we will achieve a point of equilibrium, and can then start out on 6 months of experiments: we introduce a chemical or exogenous environmental agent and we study its impact on the targeted species that are present," indicates Eric Thybaud, Dangers and impacts on living beings' Division manager within the Chronic Risks Directorate. In particular, the facility allowed us to study bisphenol A effects on communities of living organisms. Lastly, large-scale testing works as a validation of safety equipment and of tools for risk management. For example, the "ground movement" platform of Saint-Maximin, in the department of Oise, aims in particular to accommodate different innovative technologies for cavities risks management, such as stabilization or infilling, which industrial partners might want to implement for testing or validation purposes. Cornerstone of traditional subjects, large-scale tests now find a new application with emerging technologies. The experiments that INERIS can implement at full scale, or something approaching a 1:1 scale allows one to accompany the development of these new processes under safe conditions.

Montlaville facility, updated for increased effectiveness

On the explosion-dispersion platform of Montlaville, safety equipment effectiveness is particularely checked, such as the vents of hydrogen capacities under high pressure, small wall zones specifically weakened to be the first to burst and liberate a possible excess pressure and thereby protect the whole equipment and the environment.
The site, which includes two 150 meter-long galleries, a reminder of its mining history, and three platforms for the customized study of safety equipment in real-scale has just been fully renovated. It has benefitted from a complete infrastructure update (cabling between the test zones and the control rooms, roadways...).

The test bed, a unique device in Europe for particulate emissions

Since 1998, INERIS organizes inter-laboratory tests thanks to its emission test bed, which allows the simulation of gaseous effluents emanating from combustion or incineration installations. Furthermore, the installation has been validated in 2013 for particulate matrices generation. For this, no fewer than 180 total particulate samples, undertaken through the use of six in situ sampling systems that are activated simultaneously, allowed to demonstrate the homogeneity of dust concentrations in the bed. The test bed can therefore propose comparisons over the whole current gaseous and particulate compositions.
France is the unique country in Europe with such facility. It has the ability to generate real gaseous and particulate effluents, thereby allowing to have realistic information relating to the uncertainty of the measurement methods used by the test laboratories.

MESOCOSMS

***Objective:** reproduction of artificial ecosystems at a 1:1 scale for the long-term effects of pharmaceutical and chemical substances on aquatic environments.*

- Built in 1995
- 12 channels 20 m long and 80 cm deep
- Tests over several months in simplified ecosystem

"GROUND MOVEMENT" PLATFORM

***Objective:** evaluation of underground works stability.*

- Inaugurated in November 2012
- Located within the Parrain quarry in Saint-Maximin, (Oise)
- Study of the deformation and rupture mechanisms of the rockmass


Ardevie

TESTS
FOR ALL BUSINESS SECTORS

Whether it produces chemicals or builds battery integrated devices, Industry is required, by regulations, to ensure the safety of products and processes for employees, installations and the environment, and this at all stages of the product's life cycle. So as to characterize these risks and to determine the protections to be implemented, INERIS makes its testing capacity and its expertise available to producers, manufacturers and users.

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The Institute's teams' know-how, thanks to large scale tests, assures them specific expertise, in direct contact with the field. "In the event in which theoretical knowledge, bibliographical data and feedback are not sufficient to characterize a phenomenon or a range of products, industry could wish to resort to specific tests in realistic conditions. The platform specialists are able to help them in building an adapted test protocol that takes into account their questioning specificity and the current regulatory context," specifies Hafid Baroudi, Business Services and Certification (DSC) Director. This approach is particularly pertinent for complex physics

STEEVE PLATFORM

***Objective:** evaluation of the safety of electrochemical storage and their components at different stages of their life cycle.*

- Inaugurated in October 2012
- Abuse electrical tests (overcharge, short-circuits...); mechanical tests (pressure, shocks, falls, piercings, etc.); thermal tests (calorimetry, heat chambers, etc)
- Continuous gas analysis

INERIS was entrusted, through STEEVE, with the security aspect of the French network on the electrochemical storage of energy (RS2E).

FIRE PLATFORM

***Objective:** scrutiny of the behavior to fire of products.*

- Renovated in 2014
- Fire gallery, chambers of between 10 m³ and 80 m³, Fire Propagation Apparatus
- Test hall of 1 000 m³ for system fires having a heating capacity going up to 10 MW
- Smoke treatment system unique in France

ARDEVIE

***Objective:** recovery of waste and products having reached the end of their useful life.*

- Inaugurated in September 2007
- Technical assistance in the characterization and recovery of waste
- 400 m² of laboratories (storage, leaching, percolation, analyses, etc.)

phenomena, such as fires with decomposition products. Full scale testing also validates major modifications on existing safety equipment. Once the test completed, collected data are then used for model design, starting from which different accident scenarios can be simulated. The ability of these facilities to study large-scale equipment comes in support of the platforms dedicated to Atex certification (explosive atmospheres), for which INERIS is one of the few European recognized worldwide certifying bodies.

The fire gallery, a unique facility in France

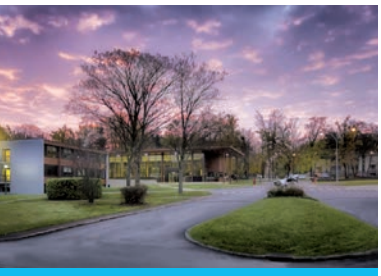
The fire gallery allows for the analysis of complex objects with important thermal and toxic potential, such as a pallet of chemicals or a car, in particular thanks to a new 1,000 m³ capacity test hall. This innovation, unique in France, is equipped with a modernized smoke-treatment system, also unique – they were delivered to the Institute in early 2014. This modernization triples the handled throughput and allows INERIS to produce fires twice as powerful, as well as more toxic, thanks to the toxic substances captured by successive filters.
Lastly, sound pollution and the volume of waste produced have sensibly been reduced in comparison to the previous system.

Testing products throughout their life cycle

Making use of the undertaking research projects on the safety of energy storage, as well as public authorities support service relating to the safety of electric vehicles, INERIS accompanies the sector's development with its STEEVE SECURITE platform, RS2E national network recognized. Batteries' safety is studied throughout their life cycle, from manufacture until end-life/recycling, by subjecting the products to extreme environmental stimuli (temperature, pressure, vibrations, electrical cycling). "These studies are undertaken either on demand ("partnership" research programs or specific industrial requirements), or according to a voluntary certification scheme, ELLICERT, defined together with the whole of the stakeholders (industry, experts, civil society)," explains François Rousseau, Substances and Processes' Division manager within the DRA. Recent extreme tests (overcharge, pressure, thermal stability tests or even altitude simulations) have been carried out on electrochemical cells that are to enter into the composition of a battery for an aviation application.

Another field in which "large-scale" expertise is fundamental is the long-term behavior of industrial waste. In order to recover products at the end of their useful life in all safety, the ARDEVIE platform accompanies industry in waste characterization and classification according to current regulations, in the development of clean and safe innovations in treatment sectors and in the environmental impacts evaluation of materials at the end of their useful life. In particular, ARDEVIE test bed can determine the behavior of several hundred kilograms of waste in realistic conditions and possible contaminants release (for example, the analysis over a long time period of water percolation on backfill under a roadbed).

INERIS
controlling risks for sustainable development



AN APPROACH AT THE HEART OF THE PRESENT GOVERNMENTAL CONCERNS

Rarefaction of fossil fuels, climate change and new technologies: the emerging needs in safety area are numerous, all signs of a productive industry. By modernising old platforms and by creating new ones, INERIS places itself in the dynamic approach that leads in innovation to benefit a clean and safe industrial development.

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Therefore, the Institute is endowed with a metrology of nanomaterials dedicated platform, aimed to the characterization of chemical substances potentials danger, and to industrial processes safety. S-NANO, which was presented in December 2014, includes laboratories which, amongst other things, allow safety parameters' study (flammability / explosiveness) and materials and products nanoparticles potential emission in the atmospheric air throughout their life cycle (manufacture, use, end of life). Available to the scientific partners of the Institute, it can also answer the industry's needs.

Very active in and around subjects tied to energy transition, the Institute has developed multidisciplinary competencies and cross-functional expertise. Its involvement in waste reclaiming at the end of its useful life has led INERIS to examine, in the framework of ecological transition roadmap for the 2013 Environmental Conference, the risks associated with the management of waste from two sectors, namely: lithium batteries and waste electrical and electronic equipment, also known as WEEE.

Beyond services to industry, large installations allow the Institute to offer a consolidated expertise to its partners as well as to public authorities, being able to meet tomorrow's challenges for the sake of our future society protection.

S-NANO PLATFORM

***Objective:** Characterization of risks tied to nanomaterials and their use throughout their life cycle.*

- Technical presentation on December 9, 2014
- 4 thematic laboratories:
  - characterization of the dangers
  - on site metrology and physic-chemical characterization of substances
  - danger over the course of the life cycle
  - management of waste

ABOUT INERIS

Established by the French Government in 1990 as the national competence centre for industrial safety and environmental protection, INERIS has developed expertise in the areas of chronic and hazardous risks.

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