MAIN ASPECTS OF THE FRENCH UNDERGROUND RESEARCH LABORATORY CONSTRUCTION

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ABSTRACT

On December 1998, the French Government authorized Andra to build an underground research laboratory in a deep argilite formation, located in eastern France. The decree for the application of this decision, published on August 3rd 1999, states that the “investigations and experiments in the underground laboratory are aimed at compiling the necessary data for the design, optimization, retrievability and safety of a potential radioactive waste repository” and that the permit to operate the underground laboratory is granted up to December 31st 2006.

Following a brief reminder of the main administrative and legal milestones of the French URL Project, this paper presents:

• the physical features of the URL (and the associated design criteria),
• the planning of construction works,
• the interface and the links with the scientific characterization activities,
• the various techniques involved in building surface and underground facilities.

It focuses on the stringent administrative rules, which Andra has to abide by, thus making the URL a unique "regulatory prototype".

A brief description of the contractual approach is finally considered and justified as well as the risk management policy approach.

It concludes by detailing the sociological environment encountered and how Andra is dealing with it.

INTRODUCTION

The Main administrative and Legal Milestones of the French URL Project

In accordance with the terms of the December 30, 1991 Law, the French Government authorized (on December 1998) Andra to build and operate an underground research laboratory in Eastern France (Meuse/Chaute-Marne departments). The formal decree was however issued on August 1999 and the first meeting of the local Public Information and Monitoring Committee (a mandatory and statutory step prior to construction start-up) was held on November 15, 1999. Then, operations were initiated by a 3-D seismic geophysical campaign as of November 16, 1999, and were carried-out until mid-December 1999.

Building activities could only take place as of mid-January 2000. It took thus 1 year to transform a political green light into a formal administrative clearance.
Besides, a "building license" decree, a "Water Act" decree and a "classified installation" decree had been granted (at department level) respectively on October 99 and March 98. When referring to the date at which Andra submitted it various administrative files (linked to the here above cited decrees), i.e. June 1997, one realizes it took 2 years and a half to transform an application act into a building action.

THE PHYSICAL FEATURES OF THE FRENCH URL

Location

Geographically, the URL is at the borders of two departments (South of the Meuse, North of the Haute-Marne) and two regions (Champagne-Ardennes and Lorraine) in Eastern France, in a relatively void countryside as per European Standards (8 inhabitants per sq.-km)

Geologically, the URL belongs to the eastern fringe of the Paris Basin, filled with a succession of sedimentary layers. The host formation is made of Argilites of the lower Callovo-Oxfordian era (middle and upper Jurassic). The layers are sub-horizontal with a slight dip (1 to 1.5° westward).

Pedologically, the URL site is installed on an open-space plateau, dedicated to wheat and colza farming. Arable earth thickness varies from 0.1 m (at the top of the hill) to 0.5 m (in the trough of small thalwegs). The Thitonian limestone is quite often outcropping.

Aerial view of URL site

Fig. 1. Aerial View of U.R.L. Site
Main dimensions

By all standards, the URL is a relatively small object, be it in terms of acreage (17 ha), surface extension (500 m x 700 m), depth (500 m) or in terms of underground cumulated drift length (1 100 m).

![Meuse / Haute-Marne underground research laboratory](image)

Fig. 2. Meuse/Haute-Marne Underground Research Laboratory

- The surface facilities are composed of technical and administrative buildings (about 6 000 m$^2$), as well as of roads, parking lots, water basins and earth removal deposit areas. The final aspect takes care (from an architectural point of view) of the "green image" (trees, lawns and miscellaneous plantations) Andra is endeavoring to provide, as an environment-dedicated national agency.
- The underground facilities include the following:
  - 2 shafts: an access (or main) shaft, dedicated to nominal translation of staff and materials/equipments and an auxiliary (secondary) shaft dedicated to ventilation and emergency exit. Their I.D. is respectively 5 and 4 meters. They go down to - 500 m, depth of the host formation.
  - Drifts (1 100 m), broken out in technical, experimental and exploratory drifts.

Design requirements

The URL project was designed from the very beginning as a scientific object (a qualification laboratory) and not as an industrial prototype (the premises of a potential repository)… As such, the global acreage of the laboratory and the shafts diameters are not compatible with an eventual re-use of the facilities for a future industrial exploitation. Andra is thus abiding by the December 1991 Law which forbids the introduction of radioactive wastes in the formation.
THE CONSTRUCTION WORKS SCHEDULE

As per the terms of the December 1991, the URL construction and exploitation clearance is granted up to the end of December 2006. The final report to the Government is due, however, on December 2005. Hence a very tight schedule has to be enforced by Andra in order to reach its scientific objectives.

One may wonder whether an amendment to the law will be necessary so as to allocate enough time to Andra scientists in order to demonstrate thoroughly the capacity of the host formation as a potential repository zone.

THE INTERFACE OF CONSTRUCTION WORKS WITH SCIENTIFIC CHARACTERISATION ACTIVITIES

From an operational and contractual point of view, the main challenge lies in the coactivity of science activities with building operations: two cultures, two scopes of interest are to be properly fitted.

The construction planning was thus established so as to make compatible the need of formation integrity (for the sake of thorough and unaltered scientific data acquisition) with building activities… As an instance, 3-D Geophysics was implemented prior to earth moving, monitoring boreholes were drilled and completed prior to shaft sinking start-up… The global critical path of operations is then a scientific, step by step, acquisition of all necessary knowledge which may preclude (or delay) the construction effort.

THE VARIOUS TECHNIQUES INVOLVED IN BUILDING SURFACE AND UNDERGROUND FACILITIES

Surface facilities

The surface facilities are of a very standard type and don't call for any comment, from a strictly technical point of view.

The real challenge lies in the number of contracts allotted for a relatively small overall budget (# U.S. $ 15 millions): more than 70 contractors are involved (for local sociological and political reasons need of integration), thus generating a great deal of technical coordination, either on workshop drawings or on site.

Underground facilities

Basically, the shaft sinking method is a classical mining technology (drill and blast). However, two major points create a complexity in the process:

- the need of adapting the sinking platform so as to allow permanent access of scientists either to the shaft wall or the shaft bottom
- the need of abiding by the Labour Code (and not the Mine Code), which calls for separate means of transportation for staff and personnal, be it in the construction mode or at stage of exploitation.

This second compelment was a cause of technical headache and definite cost increase (at time of bids and tenders) and is felt as a potential source of delay or contractual claims at time of work implementation. The contractor had to design, build and have certified a totally new machinery with no predecessors. As such the sinking devices and the final shaft equipments are regulatory prototypes (from a design point of view they are both a technical first and the "best answer" to the question: "what is administratively fit as per the Labour Code to work underground").
CONTRACTUAL APPROACH

3 main categories of contractors are present on site:

- the scientists "family",
- the mining "family",
- the surface building "family".

The third one called for lump sum contracts, the first one and second one called for a well balanced mix of turn key contracts and quantity contracts.

RISK MANAGEMENT POLICY APPROACH

To deal with the project complexity and its associated risks, 3 major nature of risks were identified:

- the scientific "bad luck", should "mother nature" surprise us more than anticipated : the step by step approach of the formation characterization and qualification is a reasonable warranty that no construction act will be carried out without a previous and reasonably thorough acquisition of scientific data which could not any longer be identified afterwards ;
- the technical risk, linked to the use of a technical/regulatory shaft sinking prototype : the terms of contract (performance bond, warranty bond,...) and the project budget structure are partial - but not complete - answers ;
- the political/sociological risks : the only issue for Andra is to deepen "its roots" (its integration within the environment), by multiplying its public and contractual relations with the neighborhood so as to become a net, positive contributor.

CONCLUSION

The Andra U.R.L. Project is confronted with a technical, scientific, planning and sociological challenge: motivation, awareness, humility, flexibility, public relations are the answers to reach the objectives assigned by the December 31ST 1991 law.