Vývoj a aktivity Virtuálního ústavu pro referenční materiály (VIRM):

Prostor pro setkávání všech uživatelů a výrobců RM

Jan Kučera

Ústav jaderné fyziky AV ČR, Řež

(Evropský) ústav pro referenční materiály

(Virtual Institute for Reference Materials)

EC-GROWTH Contract N^{O} G7RT-CT-2002-05104

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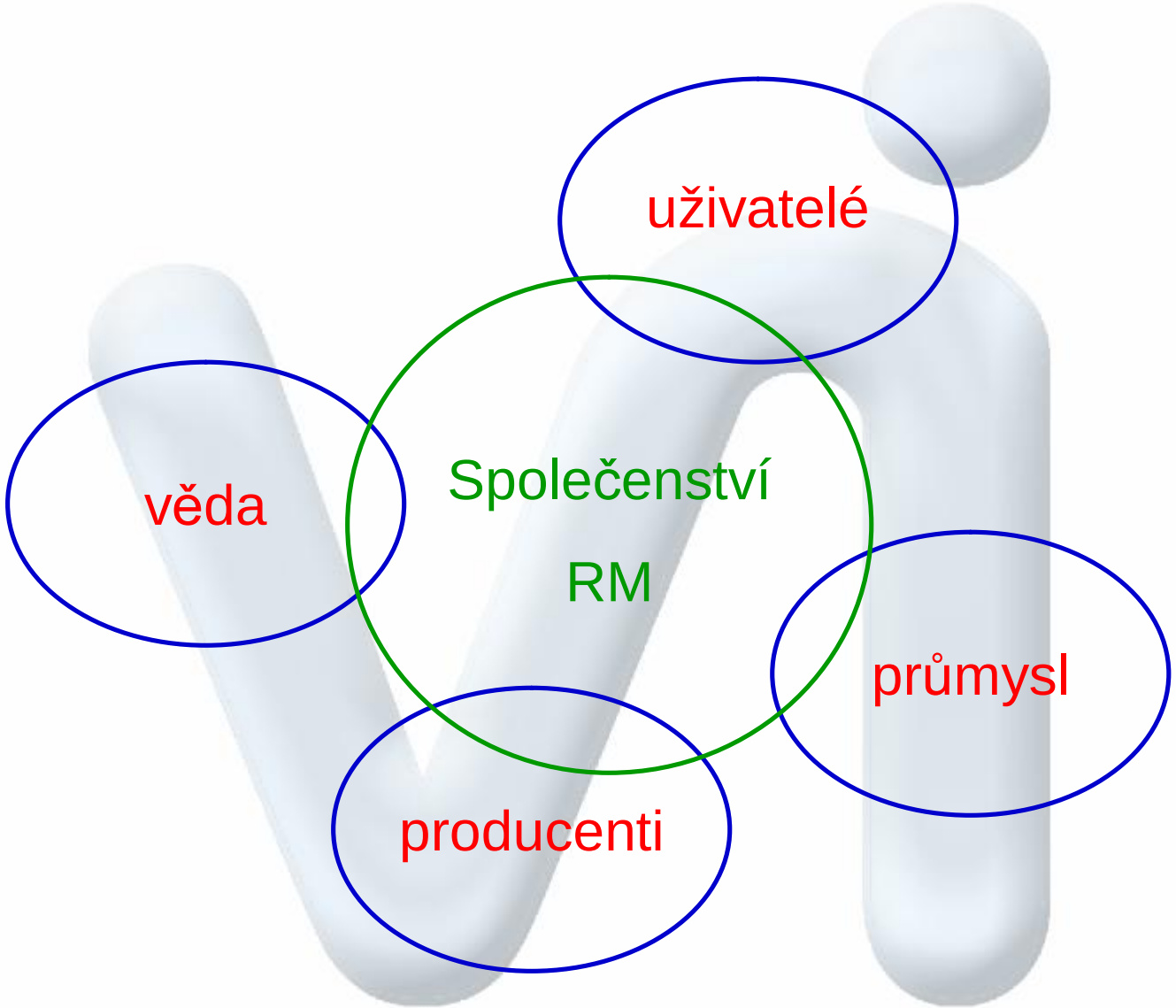

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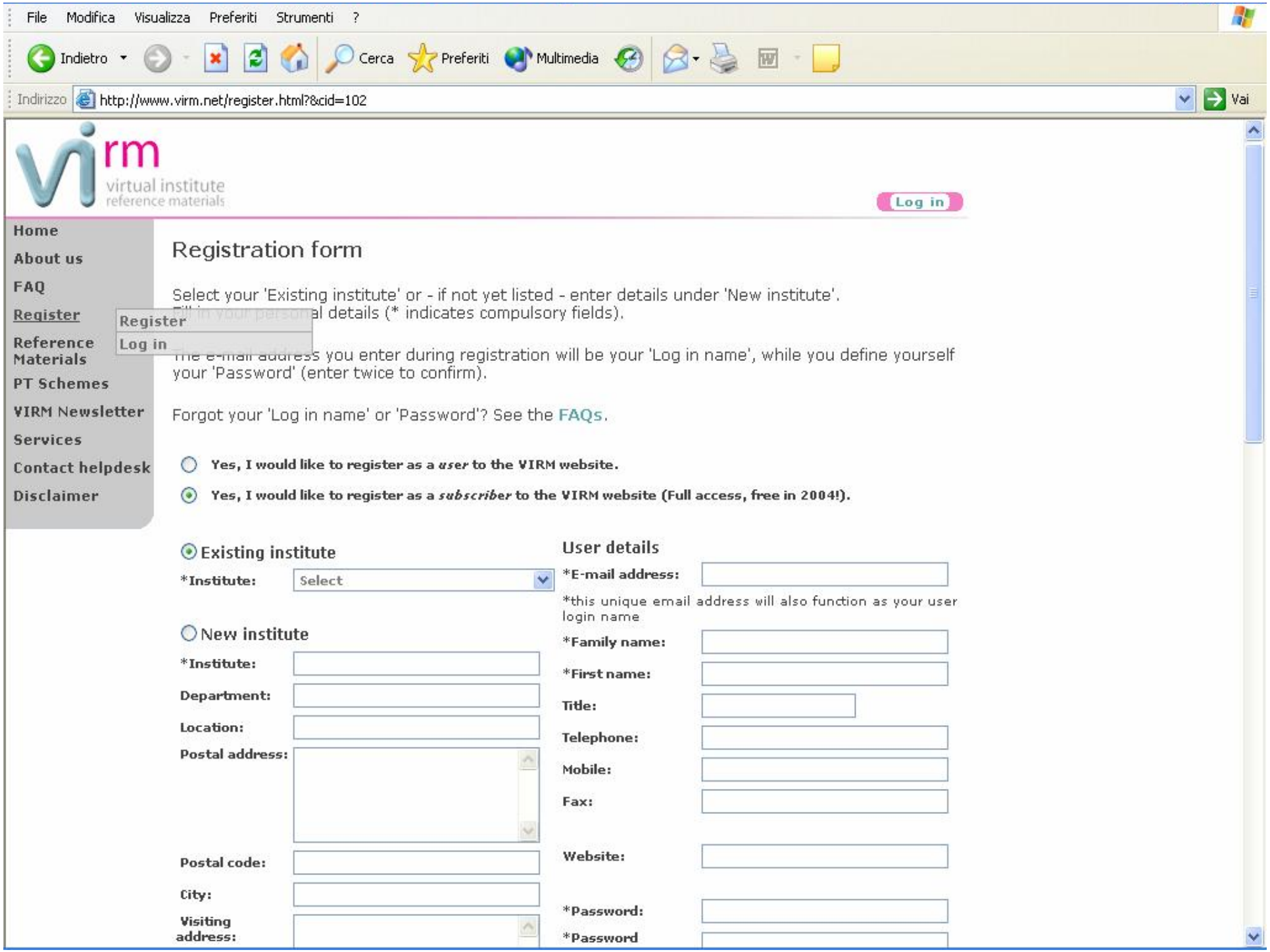
The project to develop the VIRM into a financial viable organisation and to become an independent legal entity started 1st January 2003 and the website and its data bases are currently under construction. Development of the data bases is an ongoing process.

Latest News: this site will be operational from 31 March 2004 onwards.

This project is supported by the European Community within the framework of the 5th Framework Research Programme (Contract: Growth G7RT-CT-2002-05104).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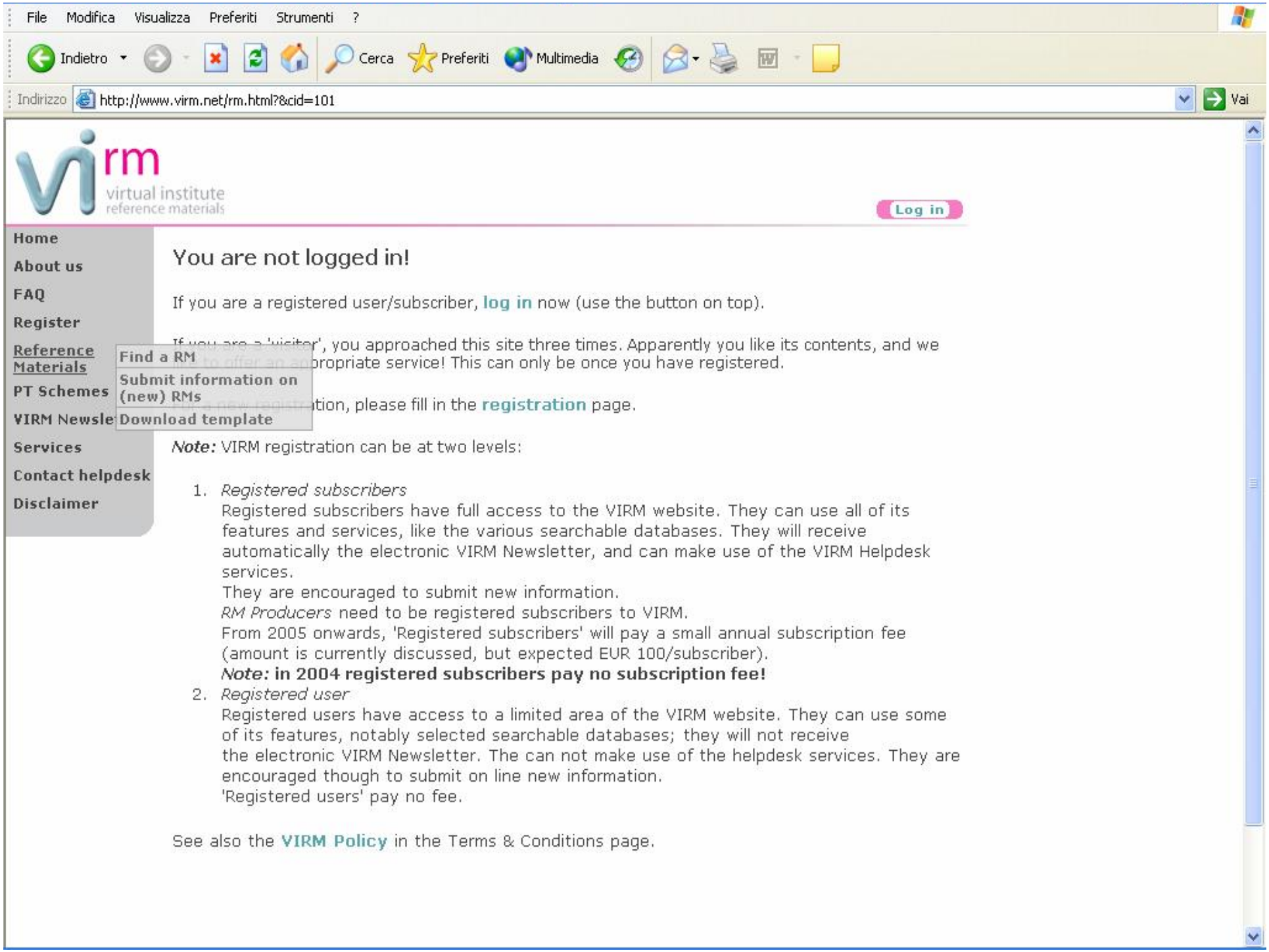
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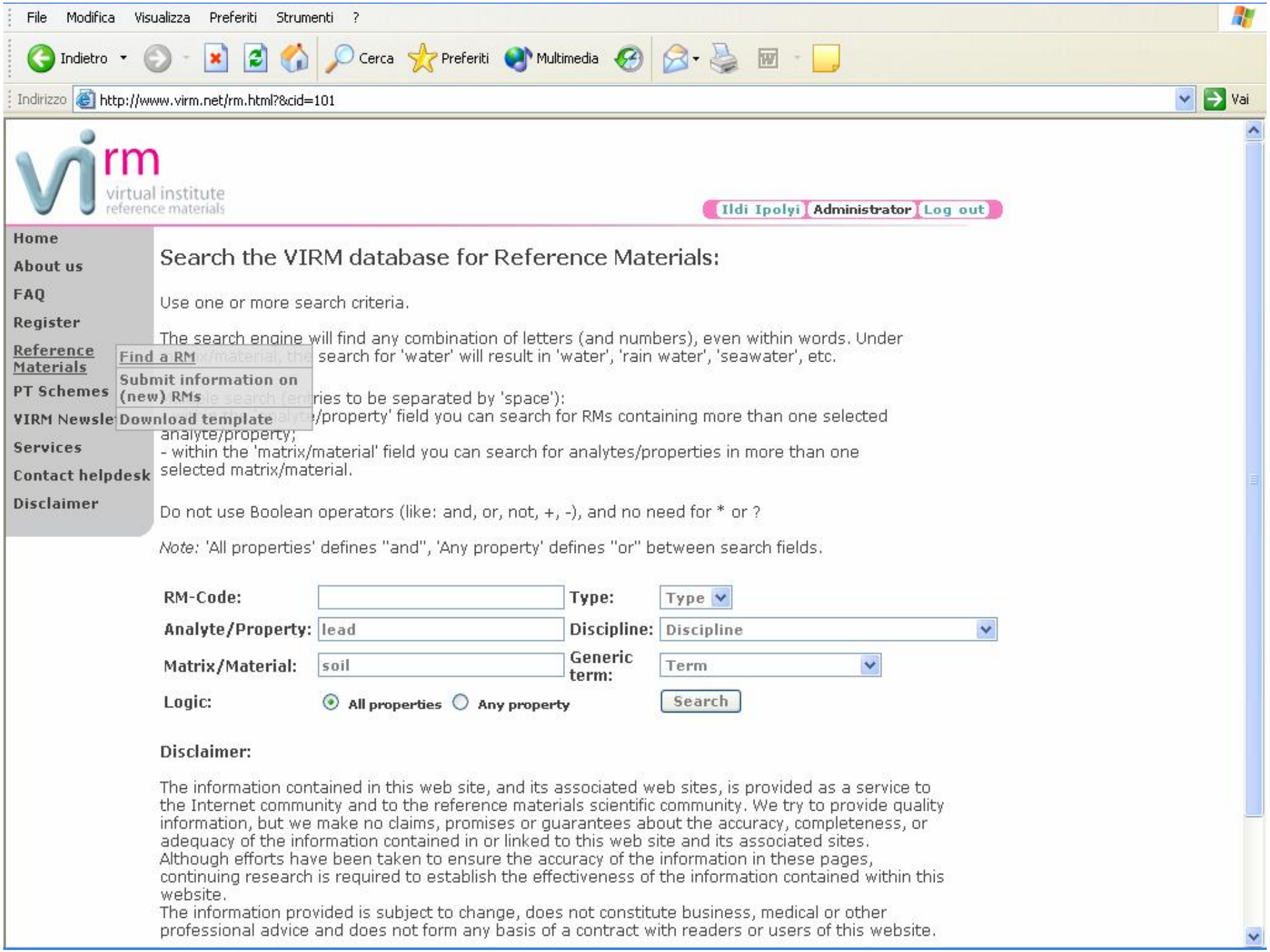
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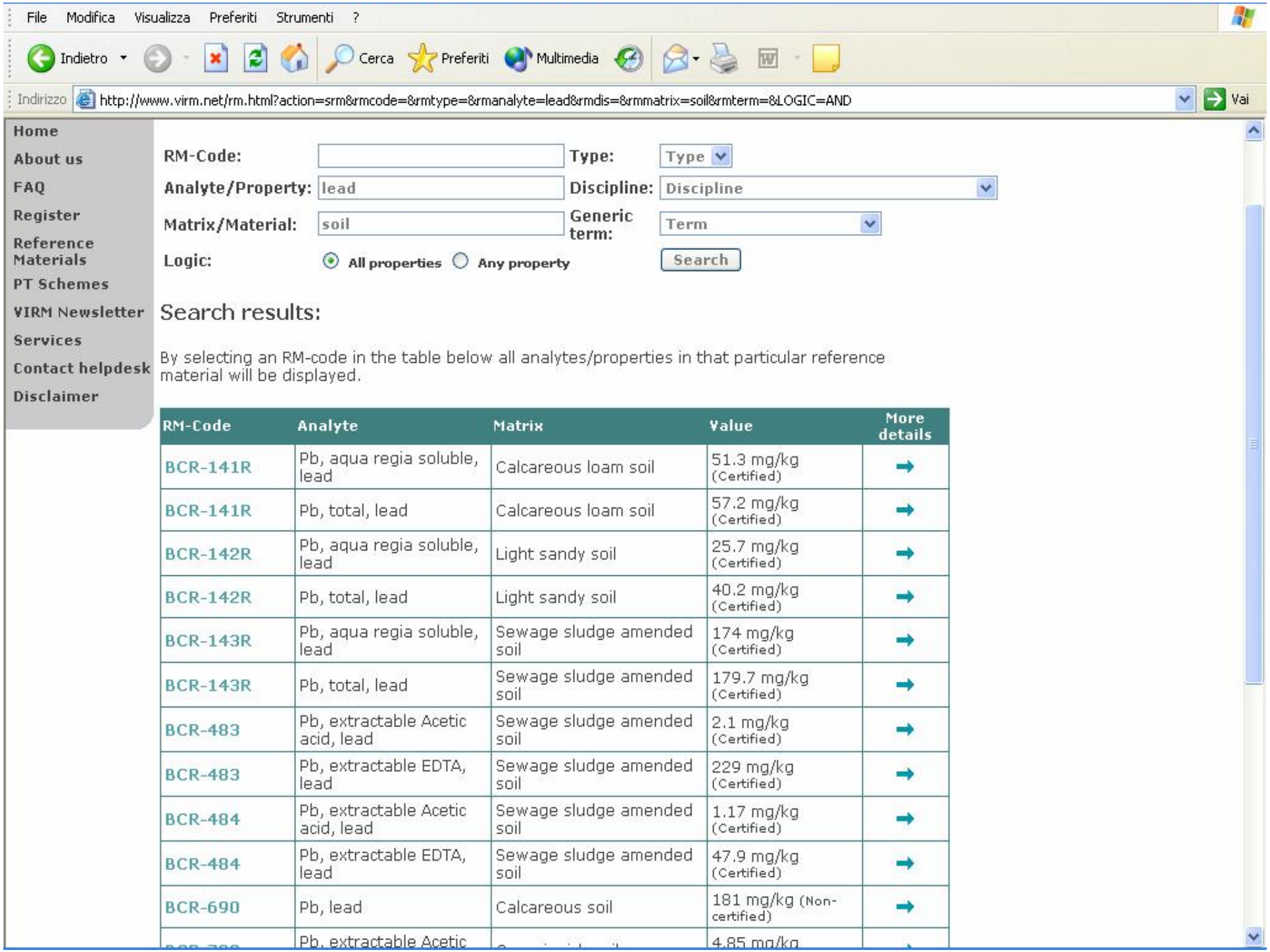
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By selecting an RM-code in the table below all analytes/properties in that particular reference material will be displayed.
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Analyte
Matrix
Value
More details
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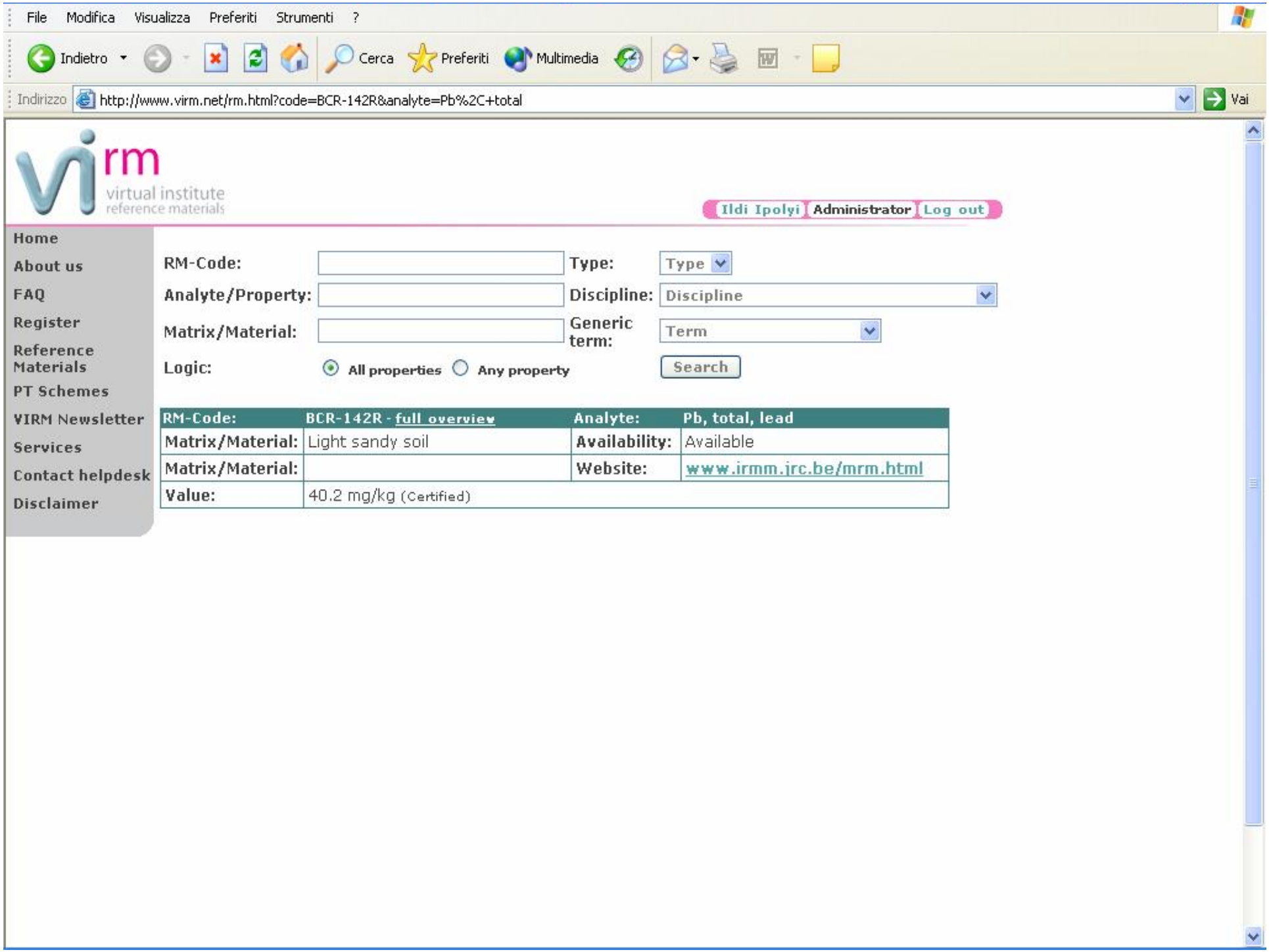
Pb, aqua regia soluble, lead
Calcareous loam soil
51.3 mg/kg (Certified)
BCR-141R
Pb, total, lead
Calcareous loam soil
57.2 mg/kg (Certified)
BCR-142R
Pb, aqua regia soluble, lead
Light sandy soil
25.7 mg/kg (Certified)
BCR-142R
Pb, total, lead
Light sandy soil
40.2 mg/kg (Certified)
BCR-143R
Pb, aqua regia soluble, lead
Sewage sludge amended soil
174 mg/kg (Certified)
BCR-143R
Pb, total, lead
Sewage sludge amended soil
179.7 mg/kg (Certified)
BCR-483
Pb, extractable Acetic acid, lead
Sewage sludge amended soil
2.1 mg/kg (Certified)
BCR-483
Pb, extractable EDTA, lead
Sewage sludge amended soil
229 mg/kg (Certified)
BCR-484
Pb, extractable Acetic acid, lead
Sewage sludge amended soil
1.17 mg/kg (Certified)
BCR-484
Pb, extractable EDTA, lead
Sewage sludge amended soil
47.9 mg/kg (Certified)
BCR-690
Pb, lead
Calcareous soil
181 mg/kg (Non-certified)
Pb, extractable Acetic
4.85 mg/kg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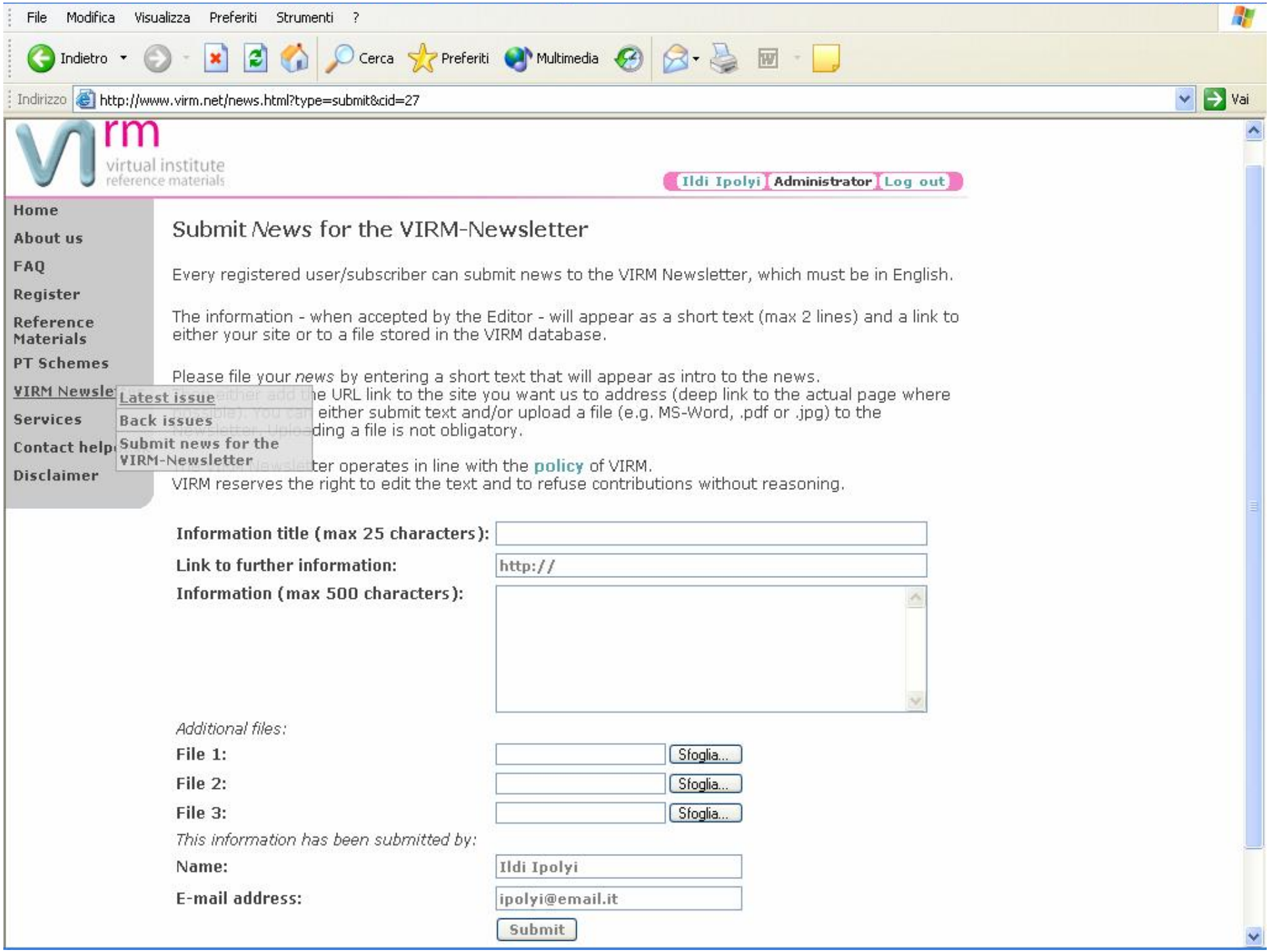
RM-Code: BCR-142R - full overview
Analyte: Pb, total, lead
Matrix/Material: Light sandy soil
Availability: Available
Matrix/Material:
Website: www.irmm.jrc.be/mrm.html
Value: 40.2 mg/kg (Certified)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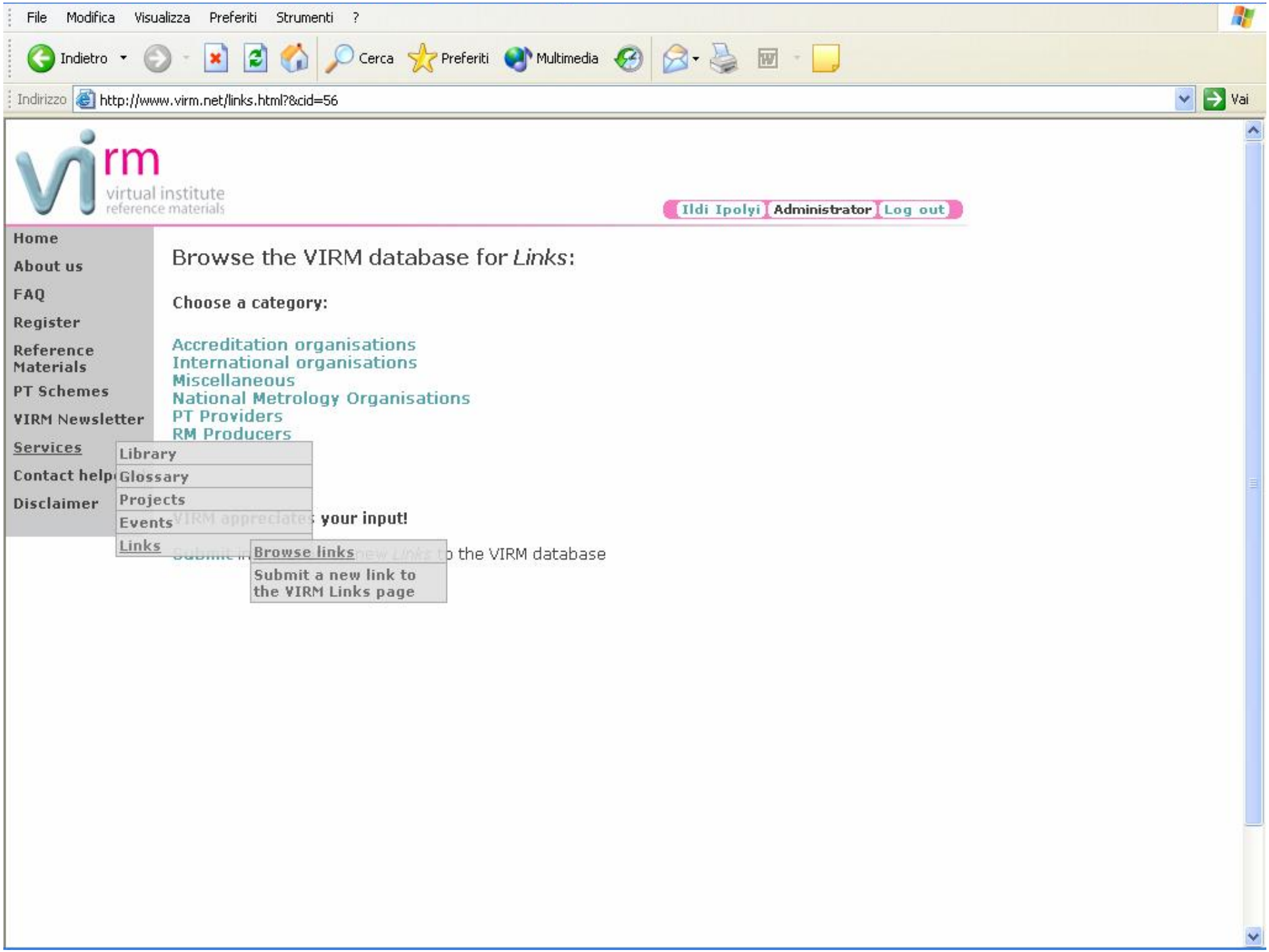
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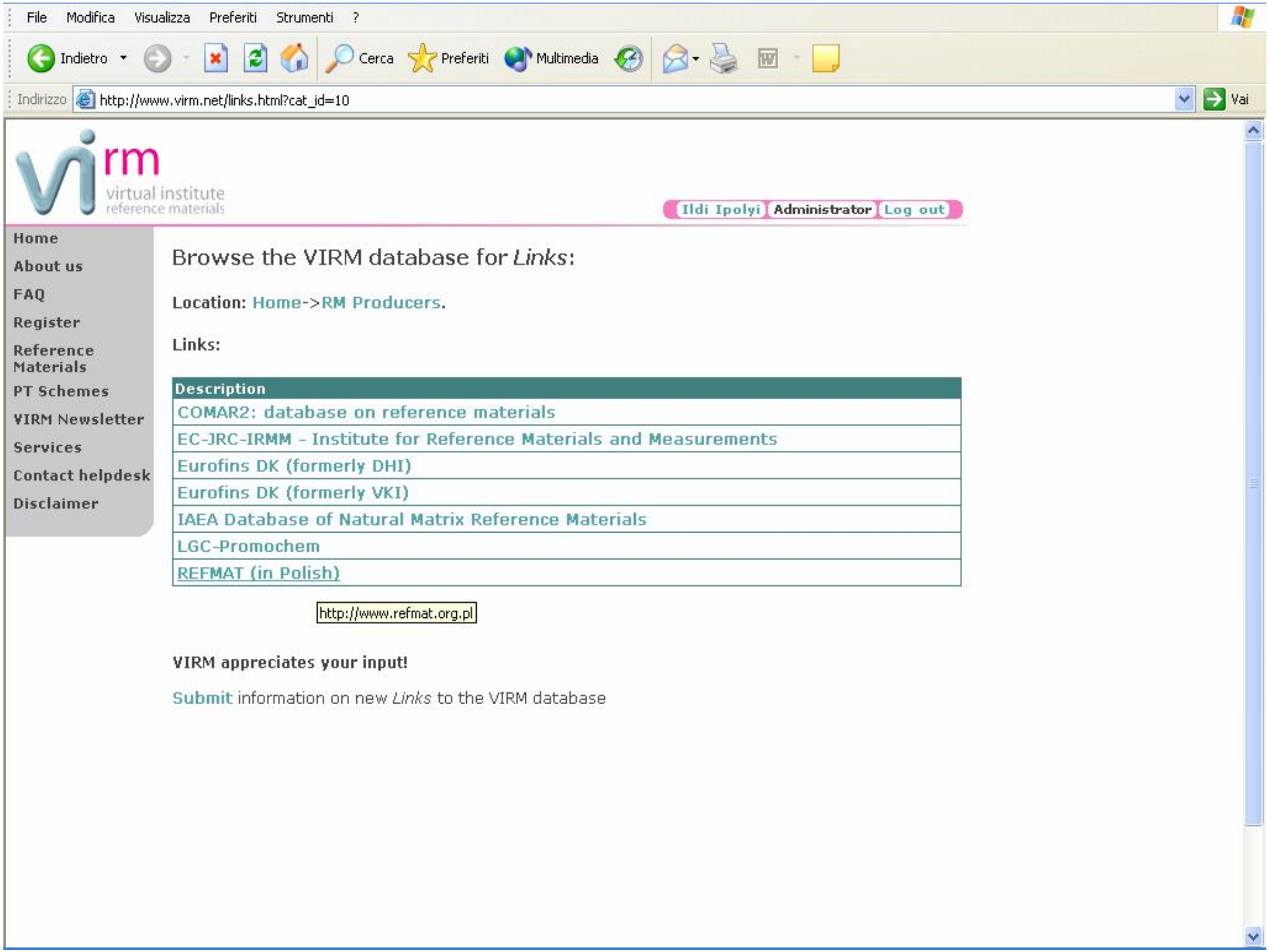
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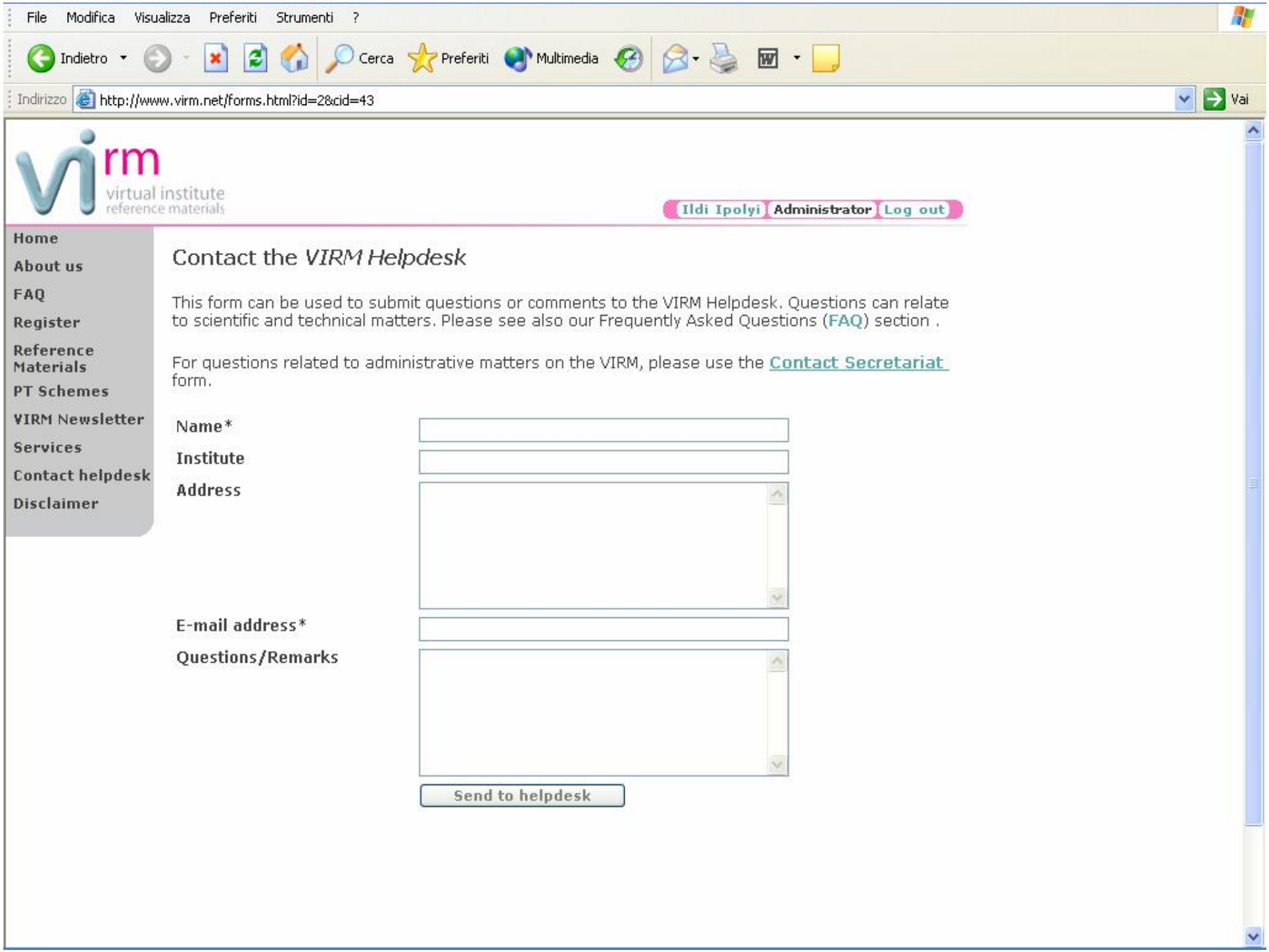
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Application Note 1

Comparison of a measurement result with the certified value

The comparison of a measurement result on a certified reference material with the certified value is explained. The method compares the difference between the certified and measured values with its uncertainty, i.e. the combined uncertainty of certified and measured value. Guidance on how to determine the standard uncertainties of certified values as well as standard uncertainties of measurement results is given.

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www.erm-crm.org

INTRODUCTION

One of the most frequent applications of certified reference materials is validation of measurement procedures. To achieve this, measurements on certified reference materials are performed and the results are compared with the certified values. This comparison is often described in a qualitative manner such as measurement results "agree", "agree well" or even "agree perfectly" with the certified values. However, a structured and quantitative approach exists that allows a statement of the evidence of any biase to be made.
This approach takes into account the certified value, the measurement result and their respective uncertainties. These uncertainties are subsequently combined and the expanded uncertainty is compared to the difference. This note will explain the procedure of the uncertainty estimation and the comparison of results with a certified value.

BASIC PRINCIPLES

After the measurement of a CRM the absolute difference between the mean measured value and the certified value can be calculated as

$$\Delta_m = |c_m - c_{CRM}|$$

Δ_m ..... absolute difference between mean measured value and certified value
c_m ..... mean measured value
c_{CRM} ..... certified value

Each measurement has an uncertainty u_m as described in the ISO Guide to the Expression of Uncertainty in Measurement (GUM) [1] and the Eurachem/CITAC Guide "Quantifying Uncertainty in Analytical Measurement" [2]. This means, any measurement result is only known within the limits of this uncertainty. Similarly, the certified value of a CRM is only known with a specified uncertainty u_{CRM} stated on the certificate. Uncertainties are usually expressed as standard deviations, but only the variances (the squared standard deviations) are additive. The uncertainty of Δ_m is u_Δ, that is calculated from the uncertainty of the certified value and the uncertainty of the measurement result according to

$$u_\Delta = \sqrt{u_m^2 + u_{CRM}^2}$$

u_Δ ..... combined uncertainty of result and certified value (= uncertainty of Δ_m)
u_m ..... uncertainty of the measurement result
u_{CRM} ..... uncertainty of the certified value

The expanded uncertainty U_Δ, corresponding to a confidence interval of approximately 95 %, is obtained by multiplication of u_Δ by a coverage factor (k), usually equal to 2.

$$U_\Delta = 2 \cdot u_\Delta$$

U_Δ ..... expanded uncertainty of difference between result and certified value

To evaluate method performance, Δ_m is compared with U_Δ: If $\Delta_m \le U_\Delta$ then there is no significant difference between the measurement result and the certified value.

DETERMINATION OF THE INDIVIDUAL UNCERTAINTIES

Uncertainty of the certified value

The expanded uncertainties U_{CRM} of each certified value are given on the certificate. Each ERM®-certificate also contains in a footnote an explanation of the derivation of the uncertainty (see Figs. 1 and 2). In most cases, the coverage factor is explicitly stated, (an example can be seen in Fig. 1). The standard uncertainty, u_{CRM}, of the certified value is obtained by dividing the stated expanded uncertainty by the coverage factor.
In some cases, the uncertainty is the 95 % confidence interval of the mean of laboratory means (for an example see Fig. 2). In this case, the t-factor for a 95 % confidence

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