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OBSERVATION

HOW TO USE AND CITE INTERNET RESOURCES, WITH SPECIAL ATTENTION TO RADIATION PROTECTION AND HEALTH PHYSICS WWW SITES

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This paper describes an Internet search for the phrases *radiation protection* and *health physics* using major search engines and discusses the search procedure and the related problems. Depending on the search engine used, the number of hits ranged from 10,000 to only 17. The author presents some of the most relevant Web sites for radiation protection and health physics, and gives their URLs. As expected, these are mainly the sites of major national and international organizations. The author discusses a model for citation of WWW resources and refers to Internet links where this issue has been elaborated in more detail. Numerous links to various institutions and Web resources are given as well.

Key words:
Health Physics, Internet, radiation protection, search engines

With the appearance of the World Wide Web (WWW) as the collection of multimedia resources, the Internet evolved into an unprecedented global phenomenon. The prospect of placing their research on the Internet, thereby increasing access to valuable databases, was specially attractive to scientists. The approximate number of Web sites increased from negligible 130 in June 1993, to 650,000 in January 1997 (1). According to investigations of *Matrix Information and Directory Services, Inc.* (2) in January 1997, there were some 57 million consumer Internet users worldwide. However, by January 2000, that number is expected to rise more than tenfold, i.e. to over 700 million users. This unprecedented growth causing increasing commercialization is one of the reasons that the Internet has evolved into a chaotic repository of information in which the ephemeral mixes with works of lasting importance. However, the Internet has become unavoidable as a research tool and valuable source of information in various scientific disciplines. This myriad of information on Internet poses the question as to how to find the right and relevant information. Fortunately, several so called *Search Engines* are available on-line. In addition, search strategies have been discussed on numerous WWW sites (3, 4).

SEARCH ENGINES

Search engines are programs that search documents for specified keywords and return a list of the documents where the keywords were found. Although search engine is really a general class of programs, the term is often used to specifically describe systems like AltaVista and Lycos that enable users to search for documents on the World Wide Web and Usenet news groups. It should be noted that the popular Yahoo, combining human and high-tech search features, is a crossbreed between a subject directory and a search engine. Therefore Yahoo is the database that classifies sites by broad subject area.

The search engines/tools are used to perform topic or keyword searches. Many of these engines use programs usually referred to as spiders (but also webcrawlers, wanderers, robots or worms) which roam the Web, gather data and bring back resources, sorts, indexes and create a database out of them. Because most Web pages contain links to other pages, a spider can start almost anywhere. As soon as it sees a link to another page, it goes off and fetches it. Large search engines, like Alta Vista, have many spiders working in parallel. The names or logotypes of some search engines are frequently metaphorically connected to spiders. For example Lycos comes from *Lycosidae*, a cosmopolitan family of relatively large active ground spiders that catch their prey by pursuit, rather than in a Web. Also, Inktomi (predecessor of HotBot) is the name of a mythological spider of the Plains Indians, who is known for bringing culture to the people.

Another program, called an indexer, then reads these documents and creates an index based on the words contained in document. Each search engine uses a proprietary algorithm to create its indices so that, ideally, only meaningful results are returned for each query. However, the search results frequently contain references to irrelevant Web sites while leaving out others that hold important material as a search engine displays first the URLs for the documents that mention a search term most frequently. The list of search results ("hits") frequently displays 10 items a page, but the best are as likely to appear on the 10th page as on the first. The usefulness of any search depends not only on the quality of the search engine, but on the skill of the user.

The major search engines vary in the size of their databases, the frequency of update, and the search options they offer. For this reason, the same search performed in several databases may turn up with dramatically different results for each database. Therefore, experienced Internet users (i.e. "searchers") have a bookmark with a sub-heading called Search Engines, with up to twenty or more to use.

SEARCHING THE INTERNET FOR RADIATION PROTECTION AND HEALTH PHYSICS

To illustrate this, the search was performed on several major search engines for phrases *radiation protection* and *health physics* (an interdisciplinary science and its application, for the radiation protection of humans and the environment that com-

bines the elements of physics, biology, chemistry, statistics and electronic instrumentation to provide information that can be used to protect individuals from the effects of radiation). The results are presented in Table 1.

It should be noted that CROSS (Croatia Search Service) is an automated engine that provides a way to search documents that are available on the public information services in Croatia only.

Very popular Deja News Search Engine at <**http://www.dejanews.com/**> contains over 15,000 Usenet discussion newsgroups. It can help locate the newsgroup where participants talk about a specified topic. However, it was not included in search, since it performs Usenet, rather than WWW search.

Table 1 *Number of search results for phrases "radiation protection" and "health physics" for the search performed on June 5, 1997 using several major search engines (displayed in alphabetical order)*

Search Engine	URL	Radiation Protection	Health Physics
Altavista	<**http://www.altavista.com**>	~10,000	~7,000
CROSS	<**http://cross.carnet.hr/index_en.html**>	66	10
Excite	<**http://www.excite.com**>	7,270	1,720
Goto.com	<**http://www.goto.com/**>	18	17
HotBot	<**http://www.hotbot.com**>	9,606	6,183
Infoseek	<**http://www.infoseek.com**>	5,768	3,764
Lycos	<**http://lycos.cs.cmu.edu**>	238	46
Magellan	<**http://www.mckinley.com/**>	1,470	1,300
Open Text	<**http://index.opentext.net/**>	981	804
Webcrawler	<**http://www.webcrawler.com**>	1,382	3,101

Note:
Goto.com recently evolved from the WWWW, the World Wide Web Worm, the first HTML search engine on Internet. However, this survey has been performed on WWWW.

Assuming that it takes only a couple of minutes to visit a single site and to see whether it contains relevant information, it would take several weeks to examine all the sites returned in the above search exercise. Of course, the greater number of keywords would lead to "more targeted" results. The search was performed to locate and identify the major WWW sites dealing with radiation protection and health physics. As expected, these are mainly the sites of major national and international organizations. However, one of the most relevant sites for radiation protection and health physics is *Radiation and Health Physics Home Page* at <**http://www.sph.umich.edu/group/eih/UMSCHPS/**>. The fact that this site was not among the top hits returned by some search engines after performing search using the phrases *radiation protection* and *health physics* is yet another illustration how search results can be biased.

SOME SITES DEALING WITH RADIATION PROTECTION / HEALTH PHYSICS

This paper presents (in alphabetical order) some of the sites relevant for radiation protection and health physics, covering most of the major international organizations that have their WWW sites. The list was meant to be only illustrative. Namely, as can be seen from Table 1, thousands of the sites had to be excluded. However, the numerous links to sites listed below would enable virtually everybody to find relevant information. Furthermore, most of these sites provide site search engines for keyword search that would further ease the process of finding the required information.

Agency for Toxic Substances and Disease Registry (ATSDR)
<http://atsdr1.atsdr.cdc.gov:8080/>

This site has a variety of information on toxic substances (including the radioactive ones) as well as a detailed listing of Minimal Risk Levels for a number of toxic substances and a list and description of the "ATSDR/EPA Top 20 Hazardous Substances". Excellent ToxFAQs (Frequently Asked Questions). A site search engine is available.

Federal Emergency Management Agency (FEMA)
<http://www.fema.gov/>

The Federal Emergency Management Agency is an independent agency of the US federal government, reporting to the President. Since its founding in 1979, FEMA's mission has been to reduce loss of life and property and protect nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery. It is an excellent site with numerous awards including *Top 5% Web Site*, and *Net Guide Gold Site*. A site search engine is available. For radiation protection purposes, emergency preparedness procedures in the case of radiological/nuclear emergency are especially interesting.

Hypertext Data base: Chernobyl and its consequences (Project "Polyn")
<http://polyn.net.kiae.su/polyn/manifest.html>

This is hypertext database describing an accident at Chernobyl Nuclear Power Plant. Although not an official publication, it is extensive and useful. As a platform for this database, an official version of events published in 1992 (5) has been used as well as materials of Chernobyl Kurchatov Institute Expedition and a number of publications in scientific press and mass media.

International Atomic Energy Agency (IAEA)
<http://www.iaea.or.at>

WorldAtom© is the International Atomic Energy Agency's public information Internet service on the World Wide Web. Documents provided on this site are for information

purposes only and are not official records. It is one of the most informative sites about nuclear energy, including radiation protection aspects. For example, it contains information on IAEA press releases, IAEA annual report, nuclear power status, nuclear safeguards, IAEA image database, information circulars, nuclear law/conventions, nuclear information-INIS, Chernobyl conference, IAEA Bulletin, IAEA news briefs, etc. For documents on IAEA, a Public Web Server is also provided with a search engine powered by Excite.

International Radiation Protection Association (IRPA)
<http://www.tue.nl/sbd/irpa/irpahome.htm>

IRPA is the world-wide international association consisting of individual members of an affiliated national or regional Associate Society. IRPA has now more than 16,000 individual members in 37 associated societies which are active in 42 different countries. The primary purpose of IRPA is to provide a medium whereby those engaged in radiation protection activities in all countries may communicate more readily with each other and, through this process, advance radiation protection in many parts of the world. This site provides substantial information on IRPA's activities, including IRPA's 10th congress in Hiroshima. On its Austrian site, IRPA hosts two major international organizations: International Commission on Radiation Units and Measurements (ICRU), and International Commission on Radiological Protection (ICRP).

International Commission on Radiation Units and Measurements (ICRU)
<http://www.irpa.at/irpa/icru.htm>

The International Commission on Radiation Units and Measurements (ICRU) was established in 1925 by the International Congress of Radiology. From the very start its principal objective has been the development of internationally acceptable recommendations regarding

- quantities and units of radiation and radioactivity;
- procedures suitable for the measurement and application of these quantities in diagnostic radiology, radiation therapy, radiation biology, and industrial situations;
- physical data needed in the application of these procedures, the use of which tends to assure uniformity in reporting.

The ICRU endeavors to collect and evaluate the latest data and information pertinent to the problems of radiation measurement and dosimetry, and to recommend in its publications the most acceptable values and techniques for current use.

International Commission on Radiological Protection (ICRP)
<http://www.irpa.at/irpa/icrp.htm>

The International X-ray and Radium Protection Committee was established in 1928. In 1950, in line with the more general application of ionizing radiation and radioactive materials, the Committee was renamed to the International Commission on Radiological Protection (ICRP). It has a long-established link with the International Society of Radiology. The purposes of the ICRP are to advance the science of radiological protection for the public benefit, particularly by providing recommendations on all aspects of radiation protection. In preparing its recommendations, ICRP considers the

fundamental principles and quantitative bases upon which radiation protection measures can be established, while leaving to the various national protection bodies the responsibility of formulating the specific advice, codes of practice, or regulations that are best suited for the needs of their individual countries.

National Council on Radiation Protection and Measurements (NCRP)
<http://www.ncrp.com/>

The National Council on Radiation Protection and Measurements (NCRP) has been active in the areas of radiation protection and measurements since its beginning as "The Advisory Committee on X-Ray and Radium Protection" in 1929. It was originally established to represent all national radiological organizations in the United States as a scientific entity and essentially to serve as the United States national analog of the ICRP. The NCRP originally operated as an informal association of scientists seeking to make available information and recommendations on radiation protection and measurements. The NCRP initiated the first recommendation specifying a maximum permissible level of exposure. Due to the vast increase in the use of radiation that took place in the 1940s and 1950s, it was recognized that continuation of the informal mode of operation was inappropriate. As a result, the NCRP was reorganized and chartered by the USA Congress in 1964 as the National Council on Radiation Protection and Measurements.

Nuclear Regulatory Commission (NRC)
<http://www.nrc.gov/>

The primary mission at the NRC is to ensure that public health and safety are protected in many different peaceful uses of nuclear energy. NRC was established by the USA Congress as an independent agency in January 1975 with passing of the Energy Reorganization Act of 1974. The NRC was given a mandate to take over responsibility for regulating various commercial, industrial, academic, and medical uses of nuclear energy from the former Atomic Energy Commission. For example, NRC regulates over 100 commercial nuclear power plants which provide more than 20% of the electricity production in the USA. The NRC also regulates such things as nuclear materials used in the diagnosis and treatment of cancer, in sterilizing instruments, in smoke detectors, and in gauges used to detect explosives in luggage at airports. On these Web pages, the NRC's activities can be explored in more detail. Search engine for the site is available.

OECD Nuclear Energy Agency (OECD/NEA)
<http://www.nea.fr/>

The OECD Nuclear Energy Agency (NEA) was established on February 1, 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on April 20, 1972, when Japan became its first non-European full Member. NEA membership today consists of all European Member countries of OECD as well as Australia, Canada, Japan, the Republic of Korea, Mexico and the United States. The Commission of the European Communities takes part in the Agency's activities. The primary objective of NEA is to promote cooperation between governments of the

member countries in advancing the development of nuclear power as a safe, environmentally acceptable and economically justified energy source. NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has concluded a Co-operation Agreement, as well as with other international organizations in the nuclear field. The site accommodates discussions on topics such as nuclear safety, radioactive waste management, radiation protection, nuclear law, nuclear science, as well as a library. Numerous links to nuclear institutions in NEA member countries are provided.

Radiation and Health Physics Home Page
<http://www.sph.umich.edu/group/eih/UMSCHPS/>

This WWW HomePage contains information and links related to radiation. It has been written for three distinct groups: the general public, students and the health physics community at large. Hundreds of files and links to other relevant sites are provided. The radiation and Health Physics Home Page is rated *Top 5% Web Site*, *Net Guide Gold Site* and *Rail Stops on The Science Expedition*. The site provides a keyword search (with AltaVista).

Radiation Effects Research Foundation (RERF)
<http://www.rerf.or.jp/eigo/experhp/rerfhome.htm>

RERF is a cooperative Japan-US Research Organization that conducts research and studies on various aspects of the radiation effects on man with a view toward contributing to the maintenance of the health and welfare of atomic-bomb survivors and to the enhancement of the health for all mankind. The Radiation Effects Research Foundation (formerly the Atomic Bomb Casualty Commission) was established in April 1975 as a private, nonprofit Japanese foundation. It s supported equally by the Government of Japan through the Ministry of Health and Welfare and the Government of the United States through the National Academy of Sciences under contract with the Department of Energy.

The Health Physics Society
<http://www2.hps.org/hps/>

The Health Physics Society is a professional organization dedicated to the development, dissemination, and application of both the scientific knowledge of and the practical means for radiation protection. The objective of the Society is the protection of people and environment from unnecessary exposure to radiation. The Society's concerns are understanding, evaluation, and control of the risks from radiation exposure relative to the benefits derived.

The Uranium Institute
<http://www.uilondon.org/>

The Uranium Institute as an International Association for Nuclear Energy is an independent, non-governmental, global organization that serves to offer a forum for research and debate on economic, technical and political issues affecting the peaceful

use of nuclear energy. The Institute has some 78 international members (with links to their sites) who come from all stages of the nuclear fuel cycle. The Uranium Institute site provides valuable information on nuclear industry, uranium (production, origin), discussions on the consequences of the Chernobyl accident, comprehensive glossary, links to other Nuclear Industry WWW sites, etc.

United States Department of Energy (DOE)
<http://apollo.osti.gov/html/home.html>

The Department of Energy is entrusted to contribute to the welfare of the USA nation by providing the technical information, scientific and educational foundation for technology, policy and institutional leadership necessary to achieve efficiency in the energy use, diversity in energy sources, a more productive and competitive economy, improved environmental quality and a secure national defense. As at least 1/5 of the electricity in the USA is produced by nuclear power, considerable attention is paid to nuclear issues.

United States Environmental Protection Agency (EPA)
<http://www.epa.gov/>

This site includes a large amount of information related to toxic substances and the environment. Of particular interest is <**http://www.epa.gov/radiation**>, a site that is anchor for information on EPA's activities that protect the public health and environment from the effects of ionizing radiation. The Radiation Protection Division (RPD) is EPA's office responsible for carrying out this mission. RPD accomplishes this goal by developing standards/guidance/criteria to:

- Protect the public and the environment from radiation exposure
- Clean up radioactively contaminated sites
- Identify and evaluate new radiation sources to determine any public health significance and to
- Participate in Federal radiological emergency preparedness and response activities.

It is a fine site with valuable information and even some software dealing with radiation protection.

World Health Organization (WHO)
<http://www.who.ch/>

The Constitution of World Health Organization was adopted on July 22, 1946 by the International Health Conference which was convened by the Economic and Social Council and held in New York. WHO came into being on April 7, 1948 when the 26th United Nations member ratified its Constitution. The objective of WHO is the attainment of the highest possible level of health by all peoples. Excellent site, rated *Top 5% Web Site*, and *Magellan 3 Star Site* with numerous valuable information and links. A search engine (powered by Excite) for keywords search through WHO Web Information is included.

WWW Virtual Library: Nuclear Engineering
<http://neutrino.nuc.berkeley.edu/NEadm.html>

The site provides hundreds of nuclear/radiation links and documents dealing with nuclear engineering radiation protection, nuclear data and related information, nuclear energy production and radioactive waste management, health physics, radiation protection, shielding, standards, radiation applications, etc. It is an excellent site, worth visiting.

HOW TO CITE INTERNET RESOURCES

With so many valuable resources available on the Internet, the question is how to cite them either on one's own WWW pages or in papers. Information services that could be cited are:

- WWW Sites (World Wide Web)
- GOPHER Sites
- FTP (File Transfer Protocol) Sites
- Telnet Sites
- Synchronous Communications (MOOs, MUDs, IRC, etc.)
- E-mail, Listserv, and News list Citations

Most commonly, though, one would cite WWW resources. According to *Walker* (6), to cite files available for viewing/downloading via the World Wide Web, the author's name (if known) should be given, as well as the full title of the work in quotation marks, the title of the complete work if applicable in italics, the full *http* address, and the date of visit. Here is an example:

Franić, Z. "How to cite Internet in Bibliography?" (In Croatian). 6 June 1997.
http://mimi.imi.hr/~franic/citcation.html
(8 October 1997)

However, as discussed in elsewhere (7–9), Walker avoids the problem of showing extraneous periods in document citations simply by leaving them out, using white space alone to separate the electronic address from other bibliographic elements. This eliminative approach is not possible with other troublesome characters such as spaces and slashes. The Internet standard for URL delimitation uses angle brackets (10). If angle-bracket delimitation became the accepted standard, it would be possible to use periods "as usual" in printed citations to separate bibliographic elements. That is, using this approach (8), Walker's citation model might look like this:

Franić, Z. "How to cite Internet in Bibliography?" (In Croatian). 6 June 1997.
<http://mimi.imi.hr/~franic/citation.html>
(8 October 1997)

Appearing to satisfy the demands of the scholarly citation, the above model suggests that one might replicate its style without difficulty as it presents its information eco-

nomically and conveys important data in a readable fashion. The date of visit is very important since it shows that the cited document was accessible at least at the moment of citation. It should be noted that several problems and ambiguities associated with citing electronic sources remain, some of which are frequently changing URL's, distinguishing between Internet addresses and command sequences, distinguishing between dates of publication and dates of user access, providing for the "openness" of many Internet pathways to the same (authentic) source, problem of secondary citation in Science Citation Index etc. Some of these are elaborated elsewhere (8, 11). In addition, those references provide models for information services other than World Wide Web.

CONCLUDING REMARKS

The search performed on the subjects of Radiation Protection and Health Physics illustrates the importance of the Internet, particularly World Wide Web as a source of valuable information and as a tool for further dissemination of that information. However, just as any library is only as good as the catalog that lists its books, the World Wide Web is only as useful as the search engines that service it. Unfortunately, search engines cover less than a half of the pages available on the Web. Namely, it is virtually impossible to afford enough hardware to index the whole Web. Therefore, in performing searches on more specific topics, at least several search engines should be used.

Once the desired information is found, there is the issue of the information's persistence on the Internet since the average time a page of text remains unchanged on the Web is estimated to be 75 days only, while a substantial percentage changes every 10 days or less (12). Another problem is how to standardize the citation style of the material that has been found on Internet. It seems that the combination of models proposed by *Walker* (6) and *Harnack and Kleppinger* (8) could become the standard. The future will probably bring the issue as to how to tackle Internet references in the Science Citation Index.

REFERENCES

1. *Lynch C.* "Searching the Internet". Scientific American, 1997;276(3):44–8.
2. *Quarterman J.S.* "1997 Users and Hosts of the Internet and the Matrix". 1997.<http://www3.mids.org/mn/701/pr9701.html>
(8 Oct 1997)
3. *Brake D. A.* "Webmaster's Voice" 1997. <http://www.newscientist.com/keysites/voice/voice.html>
(8 Oct 1997)
4. *The Gateway Development Committee.* "General Resources for All Subjects. Useful Sources for Information in a Search Strategy Format". 10 April 1997.

<http://gateway.lib.ohio-state.edu/bib/general.html>
(8 Oct 1997)

5. *Mervin S., Balonov M. (eds.)* The Chernobyl Papers, Vol.1, Doses to Population and Early Health Effects Studies. Research Enterprises, Richland, WA, 1993.
6. *Walker R. J.* "MLA-Style Citations of Electronic Sources". 8 Sep. 1996.
<http://www.cas.usf.edu/english/walker/mla.html>
(8 Oct 1997)
7. *Harnack A, Kleppinger E.* "Online! A Reference Guide to Using Internet Sources". 26 Jan. 1997.
<http://www.smpcollege.com/online-4styles~help/>
(8 Oct 1997)
8. *Harnack A, Kleppinger E.* "Beyond the MLA Handbook: Documenting Electronic Sources on the Internet". 25. Nov. 1996.
<http://falcon.eku.edu/honors/beyond-mla/>
(8 Oct 1997)
9. *Hoemann G.H.* "Electronic Style – Elements of Citation. Lkd. Electronic Style Page", at "Continue" and "Citation Elements." 3 Nov. 1995.
<http://funnelweb.utcc.utk.edu/~hoemann/style.html>
(8 Oct 1997)
10. *Berners-Lee T.* Uniform Resource Locators (URL). Dec. 1994.
<ftp://ds.internic.net/rfc/rfc1738.txt>.
(8 Oct 1997)
11. *Franić Z.* How to cite Internet in Bibliography? NeT, 1996;12:20–2. (In Croatian)
Also available on line:
Franić Z. "Kako citirati Internet u bibliografiji?" 6. June 1997.
<http://mimi.imi.hr/~franic/citation.html>
(8 Oct 1997)
12. *Chankhunthod A, Danzig P.B, Neerdaels C., Schwartz M.F., Worrell K.J.* "A Hierarchical Internet Object Cache". 6. November 1995.
<http://excalibur.usc.edu/cache-html/cache.html>
(8 Oct 1997)

Sažetak

KAKO SE KORISTITI I CITIRATI INTERNET-POSLUŽITELJE S POSEBNIM OSVRTOM NA ZAŠTITU OD ZRAČENJA I *HEALTH PHYSICS*

Pretražen je Internet s pomoću većih pretražnika, s pomoću fraza *zaštita od zračenja* i *health physics*. Raspravljena je procedura pretraživanja kao i neki problemi. Ovisno o uporabljenom pretražniku, rezultati su se kretali od 10.000 do svega 17. Prikazani su neki od poslužitelja, zajedno s njihovim URL-ovima, relevantnih za zaštitu od zračenja i *health physics*. Očekivano, to su poslužitelji većih nacionalnih i internacionalnih organizacija. Raspravljen je model za citiranje materijala na WWW-poslužiteljima, te su dani i linkovi na Internet poslužitelje na kojima je to podrobnije elaborirano.

Ključne riječi:
Internet,health physics, pretražnik, zaštita od zračenja

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