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December 18, 1997

DOE/NV/11076--T1

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Ref: DE-FC08-91NV11076
UNR # 1331-113-0351
DE-FC08-90NV10891
UNR # 1330-114-1170

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FFR 10 1998

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Dear Pamela:

This letter will serve as the necessary paperwork to closeout 91NV11076. The final report has already been delivered to you under separate notification.

Also, concerning 90NV10891:

I thought the letter you received was sufficient to close out 90NV10891. After further review of the cooperative agreement, I could not find where a final technical report was due. Please send me the paperwork for my files and I will try to find out why the report(s) were not delivered as required.

If you need anything else, just let me know.

Sincerely,

Jerald W. Best,
Manager

c: w\ltr_misce\mccann1

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Final Technical Report for DOE Grant 1331-113-0351**Title** International Development Workshops**Goals and Objectives**

The US Department of Energy (DOE) and the Nuclear Energy Agency of the Organization for Economic Cooperation and Development/Nuclear Energy Agency (OECD/NEA) began to act on their recognition of the importance of education in nuclear literacy, specifically in radioactive waste management (RWM), several years ago. The role of education to gain public confidence in nuclear energy and the disposal of radioactive waste was first discussed by the NEA in April of 1990 in the International High Level Radioactive Nuclear Waste Management Conference (IHLRNWMC) in Las Vegas.

To address this Goal for nuclear literacy, the US DOE, through the Information and Education Division of the Office of Civilian Radioactive Waste Management (OCRWM) and in cooperation with the OECD\NEA, organized an "International Workshop on Education in the Field of Radioactive Waste Management" in Engelberg, Switzerland in June of 1991. To this end, a grant to support nuclear literacy and RWM was written and funded by the OCRWM and the education division of the DOE Yucca Mountain Office in 1990.

Goal of the DOE Grant

The over-riding Goal of that workshop and the DOE grant was to find ways of raising the level of nuclear literacy in the general public through educational programs in radioactive waste management (RWM). The two Main Objectives of the workshop were: First, to contribute to an information base for education systems, on global aspects of radioactive waste management; and second, to achieve international consensus on the basic tools and methods required to develop the information base (1). These two objectives also became the principal objectives of the DOE International Workshops grant. In other words, the global and local (Nevada) objectives were one and the same.

Workshop Overviews and Accomplishments**International Workshops**

A primary outcome of the workshop was the recognition that most participating countries did not have well-organized educational strategies relating to high-level RWM. There was also no coherent over-arching scheme for existing curriculum materials in each countries RWM materials. It was felt that additional educational materials and approaches were needed if school age children are to become properly informed on issues relating to nuclear power and RWM. New materials must be aimed at experienced teachers, prospective teachers, and students, if teaching and learning are to be improved in RWM (2).

A year after the workshop in Switzerland, the International Alliance for Education in Radioactive Waste Management (IAERWM) was suggested with the mission of fostering national science literacy in radioactive waste management through international collaboration in education. The focus of the Alliance was education rather than public information, with the goal of putting education initiatives in a global context. The 12 original countries of the OECD\NEA and

Austria were invited to send participants to the first official IAERWM meeting which was held back to back with the International High-Level Radioactive Waste Management Conference in Las Vegas in April of 1992. Twenty participants attended representing eight countries (US, UK, Canada, France, Sweden, Spain, Switzerland, Austria). As a result of that meeting, the IAERWM was formalized and a plan to develop educational materials in RWM was accepted. Furthermore, all participants agreed that a necessary precursor for the development of new educational materials would be to gather existing materials into a catalogue of all international educational materials in radioactive waste management. The materials would include print, video and computer software, but not be limited to those materials. The meeting ended with the responsibilities for implementing the plan being delegated and the UK (NIREX) agreeing to host the first Alliance meeting in October of 1992 at Keswick, England.

The first Alliance Meeting was held in Keswick, England from October 12-15, 1992. UK Nirex hosted the meeting. The meeting included the following items: A presentation on the status of the International RWM materials catalogue; A trip to Sellafield including the information center, the Thorpe Reprocessing Plant, the high-level vitrification operation, the intermediate level waste storage facility, and the NIREX deep drilling program and bore holes; Presentations on the status of each attending countries's nuclear waste program (Finland, US, UK, Canada, France, The Netherlands, and Sweden); A presentation of the US DOE satellite downlink workshop on the secondary curriculum, "Science, Technology and America's Nuclear Waste"; The teacher evaluations of the satellite downlink workshop; and a presentation about the establishment of an IAERWM school e-mail network.

The second Alliance meeting was held in The Netherlands from September 6-10, 1993. In addition to the host, The Netherlands, other Alliance member countries who sent representatives included Belgium, Canada, France, Sweden, Switzerland, The UK, and the US. In that meeting a first draft of the catalogue of curriculum materials from each participating Alliance country was discussed. Attending members brought samples of RWM educational materials being used in their countries. Each country also gave an update on the status of its radioactive waste storage program. The problems of disseminating educational information to gain public acceptance for nuclear energy and the need to find a safe storage place for radioactive waste was discussed and the use of e-mail and the Internet, with the support of Yucca Mountain Project of the DOE, to share information within and between OECD\NEA countries was again broached.

In regard to educating the public about the need for storage of RW, each country gave the current status of its program. In The Netherlands, the public has apparently accepted low level waste storage and the storage program began in 1991. Conference participants were able to visit the interim storage facility at Borsele. In regard to disseminating educational materials, the curriculum materials from the UKs Nirex, "Safe for the Future,"

have been well received and are being used in many UK schools. A new program "The Technology of Radioactive Waste Disposal" is also available for a charge. None of the curriculum materials are sent to schools unless requested. Both the UK and Sweden showed new videos on waste disposal. The Swedish video on natural analogs, "Traces of the Future," was particularly interesting. France also showed a video produced in Japan to inform the public about HLW disposal. The Japanese video gave a good overview of many issues on nuclear power. In Canada, RWM is only part of the educational agenda and Canada suggested an integrated approach with nuclear literacy as only a part of developing science and math literacy in all students. Belgium developed a middle school student and teacher attitude survey on science and nuclear literacy. Current results indicate a general lack of interest in the subject. Plans are being made to target the general public. The US updated the use of the curriculum project, "Science, Society and America's Nuclear Waste," including the use of telecommunications and satellite downlinks to disseminate information about the program.

The third Alliance Meeting was held in Pinawa, Canada from May 8-10. Representatives from four Alliance countries and the OECD/NEA attended. The countries represented were Canada, Finland, the UK and the US.

The Conference began with a welcome by Jane Sargent of AECL. Ms. Sargent mentioned that four countries who had planned on attending opted out at the last minute due to a conflicting meeting in Europe. Those countries were Belgium, The Netherlands, Spain and Switzerland. Ms. Sargent suggested the need to build better connections between persons involved in education if the Alliance is to have better attendance from all 12 twelve countries.

Ms. Sargent's introductory remarks were followed by country updates on the status of each countries permanent radioactive waste storage program and each countries educational programs regarding the garnering of citizen support of long term underground storage.

Mr. de la Ferte of the OECD, showed a video that went back to the June '93 Oxford Conference and coordinated with a book called Teachers and Nuclear Energy. The intent of the OECD/NEA educational program is to place nuclear energy in the wider context of energy and the environment. Mr. de la Ferte also presented (1) information regarding an upcoming International OECD/NEA seminar on future information challenges in the field of radioactive waste management and (2) updates on OECD/NEA information on nuclear waste.

Veli-Matti of Finland presented a CD-ROM that can be used as an educational tool to support the need for nuclear energy as part of the total energy picture, especially in a country such as Finland whose geographic location and fluctuating energy needs make nuclear power ideal. The multimedia presentation of the disk shows Finnish expertise in nuclear power for generating electricity as well as nuclear waste disposal. He also presented information concerning the results of a poll regarding the public acceptance of a permanent nuclear waste site. The site will not be selected until the year 2,000 and in the meantime nuclear educational materials are being used in the schools to see if attitudes toward a

permanent site become more favorable.

John Hutchins of the UK gave an update of the status of the rock lab at the proposed nuclear repository at Selafield. He also described new materials designed for the nuclear education program and brought some samples for viewing. The new integrated materials on science and geography for 11-14 year old's; "Safe Today, Safe Tomorrow," is complete. The total educational program is built around the national curriculum and the framework on science, technology and geography. Materials are targeted to the teacher and directly at the national curriculum. There has been no polling of student attitudes before and after teaching the materials.

Ms. Sargent gave an update of the Canadian program. Of high interest was the reaction to the environmental impact statement (EIS) when it was put on the Internet. Many people downloaded it and it generated tremendous interest countrywide. The issues in education are natural analogs, risk perception, and materials being developed by Science North that will be put on CD-ROM.

US presentations were given by Max Powell of the Yucca Mountain Site Characterization Office, Effie Harle, a DOE consultant; and Ginger King, a private consultant. Their remarks covered the progress of the proposed nuclear waste repository at Yucca Mountain, Nevada; the rather extensive DOE educational programs and the status of the international curriculum brochure of educational materials on nuclear energy and RWM. At that time, the DOE Yucca Mountain Project was in the midst of setting up an educational information Homepage on RWM, to be accessed through the Yucca Mountain Site Characterization Office.

The second day of the program involved a visit to the Underground Research Laboratory (URL) and the Whiteshell Nuclear Research Establishment, both in south Eastern Manitoba. Two presentations regarding collaborative efforts of AECL in science education, including the Deep River Science Academy, were also presented.

As a result of Pinewa meeting, the emphasis of the educational materials changed from print and video to CD-ROM, the internet and the World Wide Web as the best and most interesting way to provide information about RWM to student. The third day of the program dealt with the possibility of using the Internet and some of its tools, e. g. gopher and the World Wide Web (WWW) to establish nuclear education links between the Alliance countries. After some introductory remarks about educational uses of the Internet, participants had a chance to use some of the Internet tools, including Gopher and the Web browser, Netscape. All participants agreed that the Internet would be an ideal way to provide access to educational materials on nuclear energy and radioactive waste management. First, a listing of the nuclear resources in the educational brochure could be placed on the Internet for teacher and student access and retrieval. A school with graphical user interface connectivity and a browser such as Netscape could actually download information like the multimedia presentation on the Finnish CD-ROM. To this end, the conference ended with agreement that each country should set up a Homepage for its

nuclear information agency to allow schools with Internet capability to access educational materials through that Homepage as well as set up links with schools in other Alliance countries.

The last meeting of the Alliance took place in February in Tucson, Arizona during the 1996 Waste Management Conference. The breakout meetings for the Alliance included representatives from Belgium, the OECD, The Netherlands, Spain, Sweden, the UK and US. Ginger King welcomed the Alliance members and Max Powell gave the opening remarks followed by Roy Post who gave an additional welcome to the foreign guests. Ginger King also gave a summary of the previous Alliance meeting in Pinewa, Canada. The afternoon breakout meetings started with each countries representative giving an update. The updates were completed in the morning of the next day.

After a talk by Jaques de la Ferte of OEDC a two hour workshop on how to use the Web to access and retrieve information on nuclear energy and RWM was given by Mike Robinson, Tim Hill and Richard Powell. The focus questions for the workshop were (a) how can the Web improve science teaching and (b) how can the International Alliance homepages promote nuclear literacy in students? Eight computer terminals with Web access were available to about 25 K-12 teachers from Arizona. The teachers were given a demonstration on how to access and retrieve information from the Nevada Science Project Web site which included the three links to the Homepages of the OECD in France, the DOE Yucca Mountain Office in Las Vegas and the AECL in Canada. All three sites were also bookmarked when the browser software was installed. Graduate students in engineering from the University of Arizona set up the computers and the GUI connections without any glitches. The teachers had four people to coach them on how to access the sites and download information.

Besides the Web, the representatives from the Alliance countries were available at various stations with their print materials spread out on tables in front of them. They showed their RWM educational materials to the teachers, including videotapes, and fielded any questions on how to use the materials. The teachers were able to take samples of the print materials with them and get the addresses for ordering other materials.

After the Tucson meetings, the International Alliance representatives went on to El Paso to spend the night and then drove by van the next day to the WIPP site in New Mexico where they all had a special tour of the site.

The meetings closed with a consensus that the establishment of Homepages in each Alliance country would be the best way to distribute educational information on nuclear energy and RWM. There was some talk of trying to get money for teacher training on how to use the Web, funding to get connected to web and training on how to set up a homepage in teacher classrooms. At this point Nevada may be the only site that has followed through on the teacher training and help in getting web capability in school classrooms. Funding for support came from the Yucca Mountain Project Office.

Nevada Accomplishments

In addition to what has gone on in the international arena some mention should be made of what the DOE International program

accomplished in science education in the State of Nevada. Because of the proposed site for high-level nuclear waste at Yucca Mountain, science education in Nevada that involves nuclear literacy became a political issue. Politics have to some degree restricted academic freedom in the schools, especially in Clark County. Over the three year period prior to 1995, the OCRWM supported science education in the State of Nevada with the purpose of helping both teachers and students become more nuclear literate. That support can be divided into two areas. The first area relates directly to the IAERWM. The second area is part of a statewide teacher training and science materials development project, the Nevada Science Project (NSP). Funding for the NSP was from the Yucca Mountain Project Office.

In regard to the IAERWM, the Departments of Curriculum and Instruction of the Universities of Nevada at Reno and Las Vegas committed time and resources to facilitate the US DOE's goals in the Alliance. Initially they focused on helping develop and then run the breakout sessions at the first and largest workshop in Engelberg, Switzerland. Later they focused more on the development and implementation of workshops in Nevada to provide teaching materials in RWM and promote more nuclear literacy in Clark County teachers. Workshop were held in April of 1992, '93 and '94. In spite of some opposition to the workshops they helped provide a free flow of information regarding the advantages as well as the disadvantages of nuclear power in Nevada. They provided a good source of information about nuclear energy in a state whose government has attempted to restrict any voice other than those who do not want Yucca Mountain sited for the nuclear waste repository.

In addition to the workshops, the NSP held two Summer Science Institutes that have included nuclear energy and nuclear waste management as major sections of the 60 hour programs. Both of these were carried out in Las Vegas and they reached 45 K-12 teachers from Clark County and other areas of the state. One of the workshops also developed a secondary curriculum in nuclear energy tailored to the needs of Nevada secondary teachers. A third 60 hour energy workshop will be held in the Summer of 1997 in Reno that will involve 15 K-12 teachers and provide some information about nuclear energy and RWM.

Three 15 hour workshops that included five hour sections on nuclear power and RWM were given in the rural sites of Elko, Winnemucca and Fallon. Those workshops reached 40-45 teachers in the Rural Alliance (the fifteen counties not including Clark and Washoe).

The most recent area that the NSP has been involved in is the training of teachers on how to use the Internet and set up homepages. With the use of Macintosh computers and money to buy modems and software (all donated by DOE through the efforts of Ginger King, formerly of OCRWM and Max Powell, Yucca Mountain Project Office), 33 middle school teachers were trained in how to use e-mail in 1992. Another 30 teachers were trained in summer workshops in 1993 and 1994 and 20 more were trained in the summers of 1995 and 1996. In the summer of 1997, 15 more teachers will

learn how to develop their own web pages. Most of the previously trained teachers are now on line with Nevada Schools Network (NSN). Over 1,000 teachers are in fact currently using NSN to send e-mail and access the Internet, at least on an occasional basis. A few now have Web access due to a small technical support grant by Yucca Mountain. They include seven schools in the Rural Alliance. Furthermore, the Yucca Mountain Project Office of the DOE paid for the file server at the UNR college of education to make NSN available to teachers. This last endeavor, one that the Yucca Mountain Project of the DOE continues to support, fits in with the former Bush Administration goal of establishing a coordinated government wide effort to improve science and mathematics education (3). Moreover, a major objective of the America 2000 strategy is to establish national electronic networks that link all American schools with other sites where learning occurs (4). Studies have shown that student performance in mathematics and science is enhanced by access to and experience with computers and various scientific equipment.

A growing number of Nevada teachers are now using the Internet to send e-mail messages internationally. A few lucky ones, thanks to DOE YMP in some cases, are using a graphical user interface (GUI) (5) to download graphics from networks such as the World Wide Web (WWW).

The End of the Alliance

Support for the International Alliance for Education in Radioactive Waste Management ended in September of 1996. The last accomplishment (really an application for nuclear education since the homepages would have been set up anyway) of the Alliance was the addition of Homepages from three information agencies (OECD, AECL and DOE) so teachers, students and the public at large can access their educational materials as well as links to many other sources of information on nuclear energy and RWM. With the addition of these homepages (there are now others in Sweden, Finland and other former Alliance countries) and their many links to other web sites, the need for print material on nuclear energy and RWM in each former Alliance country is needed less and less. Resources from every country can now be retrieved on the web. Internationally, the use of the web to disseminate information falls within the second goal of the original workshop in Switzerland, to achieve international consensus on the basic tools and methods for achieving an information base. At the time no one knew what technological possibilities would arise that would make obsolete the need for the handbook and other print materials. Still, it's nice to know that the Alliance was able to change with the times and make the best use of new technological innovations in communication that have applications to education.

Work in Nevada still goes on to help more teachers get on the Web and download educational materials on nuclear energy and RWM. More and more teachers now realize the potential of the Internet for improving classroom instruction. The World Wide Web (WWW or simply the Web) and file transfer protocol (ftp) have tremendous educational potential for keeping up with world events and

arranging international science experiments and the Yucca Mountain Project Office continues to support a limited number of schools that need help to get on the internet and use the Web. In the US, the stated US government goal of making access to the information highways more available to schools to help equalize access to education (6) continues to be furthered by the Yucca Mountain Project Office.

Final Remarks

In closing, it must be remembered that changing public attitudes that have become established and ingrained over many years of limited knowledge and perception is a long term process that involves providing new experiences in a favorable environment. The Triangle Coalition (Government, Industry and Education) of the International Alliance for Education in Radioactive Waste Management helped provide a favorable science learning environment for school children. That environment helped many students gain new knowledge and more favorable perceptions regarding the need for nuclear energy and the resulting need for permanent radioactive waste disposal. Establishing favorable science learning environments takes time and resources over an extended period before significant change can be measured but it also compliments the larger goal of promoting science literacy in all citizens by providing the knowledge, skills and values to create the changes in behavior needed for responsible citizenship in a technological society. It is very difficult to change a dominant social paradigm such as the one concerning RWM in Nevada but the grant for the International Alliance did help many Nevada students as well as students in other OECD/NEA countries see the need for a different social paradigm in RWM.

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