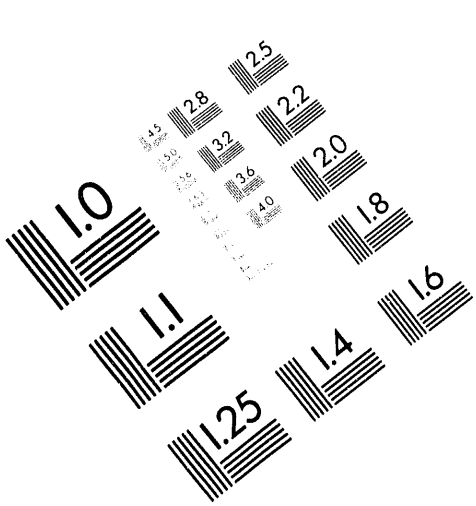

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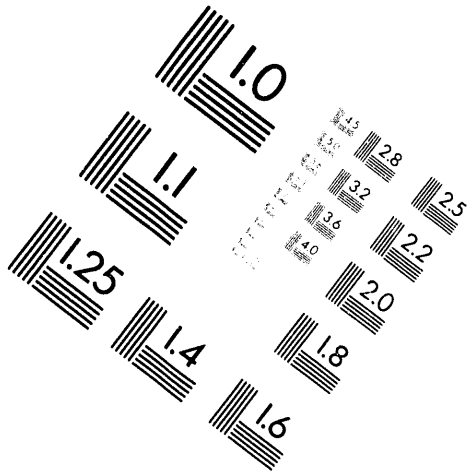

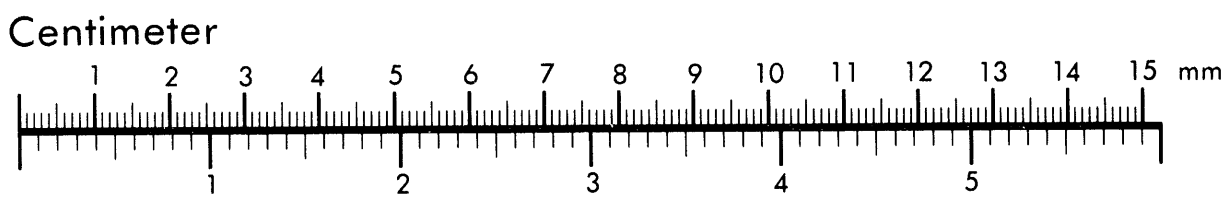

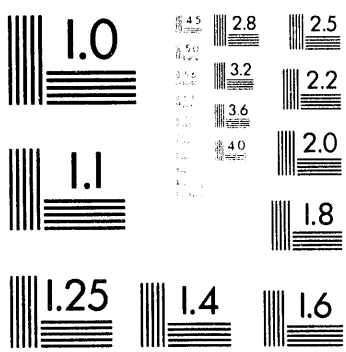

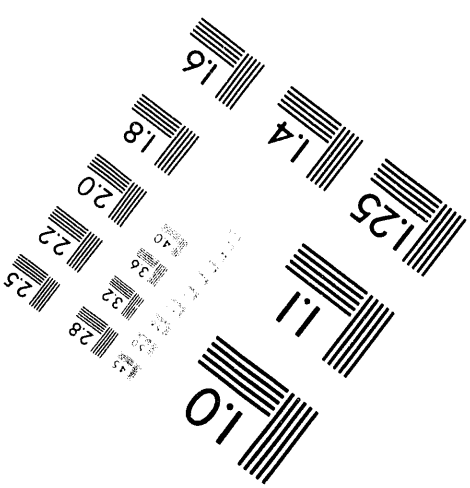

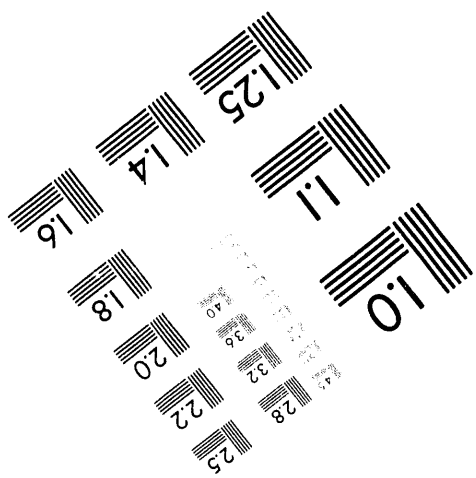

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SCOPE-RADTEST: Radioactivity From Nuclear Test Explosions

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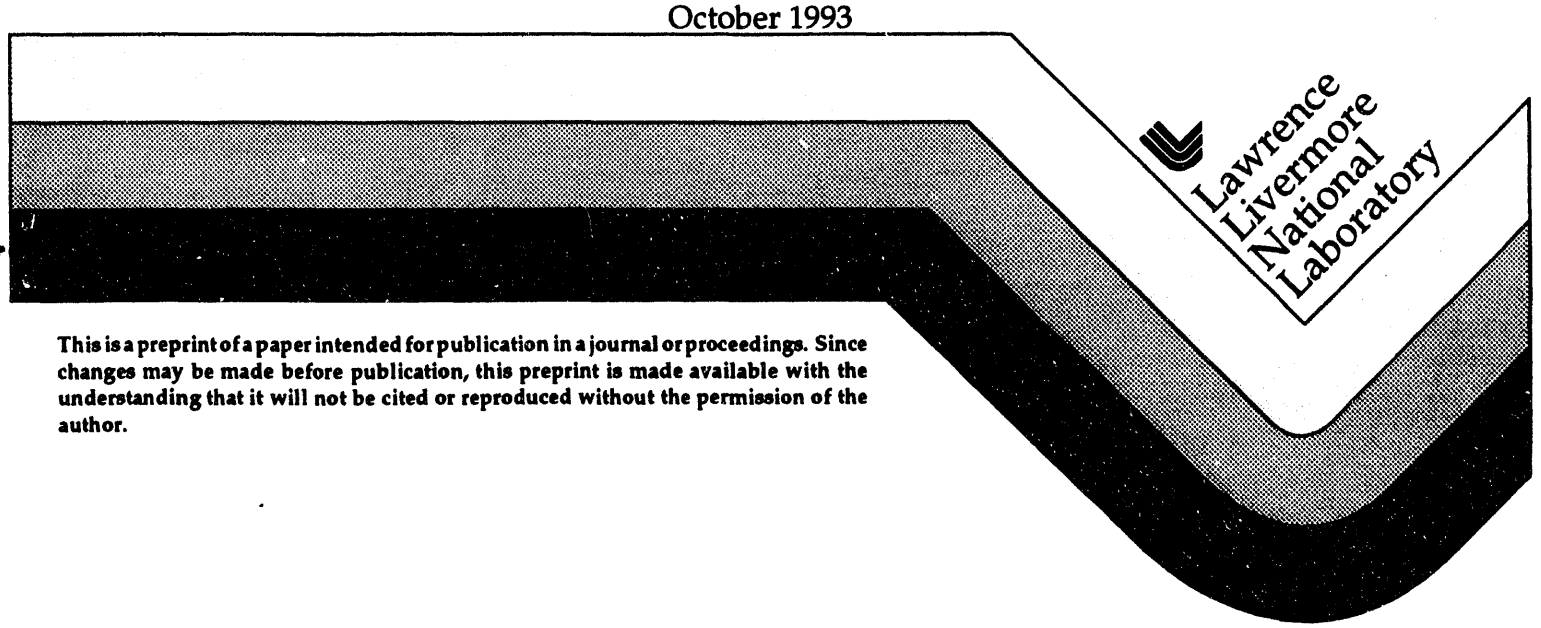

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ABSTRACT

The SCOPE-RADTEST program consists of an international collaborative study involving Russia, the U.S.A., China, and Kazakhstan. It will focus on the releases of radioactivity that resulted from nuclear test explosions that have taken place at various test sites around the world for peaceful and military purposes.

RADTEST will focus on these principal tasks:

(1) *To inventory data on measurements of radionuclide deposition densities, and identify gaps in these data.*

(2) *To compare old and develop new models of radioactive transport to better understand the deposition densities of radionuclides both on and near the nuclear test sites, including areas downwind where potentially significant episodes of fallout have occurred (such as the Altaj Region of Russia).*

(3) *To study the migration of the radionuclides through the biosphere, including all pathways to humans.* This will include the study of the effects on other biota that have impacts on humans. The main focus will be to characterize the nature and magnitude of the dose to humans. This will include dose reconstructions from past events, and also an increased capability for dose prediction from possible future accidental or deliberate explosions.

(4) *To analyze the data on the effects of these doses (including low doses) on human health.*

The test sites to be studied would include the Nevada Test Site (USA), South Pacific Islands (USA), Novaja Zemla (Russia), Semipalatinsk (Kazakhstan) and Luc Bu Pu (Lop Nor) (China). Tests at these sites include most of the total of nuclear explosions that have been conducted. Other sites, (including the sites of the U.K. and France), as appropriate, may also be included where tests were conducted for peaceful or military purposes.

The RADTEST project will result in a new and unique international data base that integrates, correlates and extends the existing national data bases. This will provide new opportunities to validate existing models, to construct new ones, and to help assess remediation and restoration needs. The first RADTEST international workshop will be held 10-14 January 1994 at the IAEA in Vienna.

RADTEST: RADIOACTIVITY FROM NUCLEAR TEST EXPLOSIONS

A study of the transport, deposition, and human health effects of the radioactive fallout resulting from nuclear test explosions.

PROJECT DESCRIPTION:

The RADTEST program will consist of an international collaborative study involving Russia, U.S.A., China, Kazakhstan, France, and the U.K. It will focus on the releases of radioactivity that resulted from nuclear test explosions that have taken place at various test sites around the world for peaceful and military purposes. The test sites to be studied would include the Nevada Test Site (USA), South Pacific Islands (USA), Novaja Zemla (Russia), Semipalatinsk (Kazakhstan) and Luc Bu Pu (Lop Nor) (China). Tests at these sites include most of the total of nuclear explosions that have been conducted. Other sites, (including those for non–military tests), as appropriate, may also be included where tests were conducted. RADTEST was officially adopted as a project of ICSU–SCOPE (International Council of Scientific Unions –Scientific Committee on Problems of the Environment) in April 1993.

RADTEST will focus on these principal tasks:

(1) *To assess the existing data on deposition densities of radionuclides both on and near the nuclear test sites, including areas downwind where potentially significant episodes of fallout have occurred (such as the Altaj Region of Russia).*

(2) *To examine the migration of the radionuclides through the biosphere, including all pathways to humans. This will include the study of the effects on other biota that have impacts on humans. The main focus will be to characterize the nature and magnitude of the dose to humans. This will include dose reconstructions from past events, and also an increased capability for dose prediction from possible future accidental or deliberate explosions.*

(3) *To analyze the data on the effects of these doses (including low doses) on human health. The Altaj Region of Russia, downwind from Semipalatinsk, will be an important area of focus.*

(4) *To compare existing national models and develop new models of radioactive transport to better understand the movement of these radionuclides.*

(5) *To establish a new and unique international data base that integrates, correlates and extends the existing national data bases on nuclear test radioactive contamination. This will provide new opportunities to validate models, construct new ones, and to help assess remediation and restoration needs.*

The RADTEST project will provide:

- a current inventory of radioactivity on or near the test sites to help in planning possible remediation and restoration efforts
- an up–to–date dose reconstruction from past events
- a comparison of new data on potential human health effects with other studies such as those of the Hiroshima and Nagasaki explosions. The new data are in a much lower and potentially important dose and dose–rate domain. The Altaj Region of Siberia provides a unique data base and opportunity for this, as recent reports indicate significant doses and health effects in this area
- new opportunities to compare and validate existing models of radiation transport and migration
- opportunities to construct new models
- an international data base including old data from existing national repositories, as well as new data that were previously restricted but will be made available in a transportable format.
- an improved capability for risk assessment from possible future test explosions or accidents
- an element of verification in a possible future comprehensive nuclear test ban (CTB) regime
- "bridge–building" between national communities of nuclear scientists that have not previously been in contact, by establishing working relations, collaborations and trust.

RATIONALE:

With the ending of the cold war between the West and the former Soviet Union, and an encouraging atmosphere in China for increasing collaborations with the rest of the world's scientific and technical communities, a unique opportunity now exists for an international collaborative study on the fallout from nuclear tests. This subject has never before been jointly studied by the countries that were involved with most of the nuclear test explosions. These countries include Russia, Kazakhstan, U.S.A., China, France, and the U.K. There is now a new willingness to share data on nuclear tests, much of which has heretofore not been available in the open literature.

The yield of nuclear test explosions in the past has totaled about 550 megatons of TNT explosive energy equivalent, of which about 40% came from nuclear fission. Table 1 displays the number of tests, and estimated yield, of the atmospheric tests conducted by each testing country. Eighty percent of these tests and 90% of the yield were conducted by the USA and the USSR.[1] Table 2 displays a comparison of the sizes of radioactive releases from nuclear test explosions and nuclear reactor accidents. It is clear that the radionuclides produced by these nuclear weapons tests comprise by far the largest source of man-made radioactivity dispersed into the Earth's environment to date. Research and publication of studies concerned with global fallout has been extensive (for example, the excellent work by UNSCEAR and the WHO). However, studies of local fallout phenomenon have generally been carried out by the individual testing country, with the resulting data and knowledge being somewhat restricted in their dissemination. RADTEST for the first time will enable the nuclear scientists that were directly or indirectly involved with these tests to share previously restricted work involving data, models, and knowledge about the fate of the release of radionuclides and their possible human health effects.

A sampling of scientific subjects to be addressed may include:

- source term studies (fission products, induced activity, physical cloud rise phenomena and forms of release)
- differences due to local ground conditions.
- particle size and activity size distribution
- airborne fraction, aerosolized fraction, and respirable fraction
- local and intermediate timescale fallout deposition modeling
- transport properties of Pu, I, Cs, Sr through the biosphere
- radionuclide deposition inventory

- terrestrial, aquatic, and atmospheric transport
- bioaccumulation and its effects
- dose reconstruction
- health effects on humans (epidemiological data, low doses, risk coefficients, focus on Altaj)
- accident consequence analysis (including Pu dispersal)
- risk analysis of nuclear operations

FURTHER IMPLICATIONS

A subject of great interest in the world today is the possibility of achieving a comprehensive nuclear test ban (CTB). Temporary moratoriums on testing of nuclear weapons have recently been announced by some countries, and the U.S.A. has announced its intentions of undertaking only a limited number of tests through 1996 (relating to warhead safety issues), with a permanent ban to follow. Interest in reaching a CTB is currently very high (for example, see Lord Zuckerman's recent article in *Nature*, 4 Feb. 1993). It is expected that verification procedures will be a dominant issue in a CTB. RADTEST could provide one element in a comprehensive test ban verification regime. By documenting the inventory of radionuclides on or near test sites, it would be possible to detect changes due to a vented clandestine explosion.

An important objective of RADTEST relates to "bridge building." One cannot underestimate the potential importance of effective communication and collaboration of scientists who have been involved in studies of the radioactive fallout from nuclear tests. These communities of scientists, heretofore isolated from each other, can establish working relations, collaborations, and trust with each other. This can greatly facilitate scientific consensus, which is necessary in reaching and carrying out agreements on the political level. "Bridge building" truly is in the spirit of SCOPE.

BACKGROUND

Between 1983 and 1988, SCOPE–ICSU (Scientific Committee on Problems of the Environment – International Council of Scientific Unions) carried out a project "Environmental Consequence of Nuclear War" (ENUWAR), that resulted in the publication of SCOPE–28, perhaps the most cited of the SCOPE–sponsored studies. At the last meeting of ENUWAR in Moscow in 1988, following an emotionally moving visit to the site of the Chernobyl nuclear reactor accident, many of the

participants advocated a study of the fate of the released radioactivity, and suggested a new SCOPE project called "Biogeochemical Pathways of Artificial Radionuclides" (RADPATH). It has now been successfully finished with the publication of the book, "*Radioecology After Chernobyl:* SCOPE–50" *John–Wiley, Pub.*. 1993. Taking note that the scientific potential of the project had not fully been exhausted, experts at the Scientific Advisory Committee (SAC) RADPATH Meeting and the Fifth Conference, *"Geochemical Pathways of Artificial Radionuclides in the Biosphere"* (Pushchino, USSR, December, 1991) recommended that SCOPE continue activities in this field. This proposal was discussed by Russian, Chinese, and SCOPE representatives at the Eighth SCOPE General Assembly (Seville, Spain, January, 1992). The idea of a new project organization was supported.

In May of 1992, Prof. Charles Shapiro (USA) met in China with experts representing the China SCOPE National Committee and the China SCOPE–RADPATH Committee representing 24 institutions within China. These meetings resulted in a statement of agreements that expressed the interest and enthusiasm of China for participation in the proposed study. On the initiative of Prof. Shapiro and the Russian National SCOPE Committee, a meeting of a group of experts from Russia, USA and the Chinese Peoples' Republic was organized in Moscow during 5–7 November 1992. Meetings were held in the Computing Center for the Russian Academy of Sciences (RAS), the Institute for Global Climate and Ecology, the Presidium of the RAS, the Russian State Committee for Chernobyl (GOSKOMCHERNOBYL), and the Vernadsky Institute of Geochemistry and Analytical Chemistry. Twenty experts attended the Moscow meetings. At these meetings, it was decided to narrow the focus of the study to fallout from nuclear tests. A memorandum of understanding was drafted on the organization of a new SCOPE project "RADTEST". In April of 1993, the SCOPE Executive Committee meeting in Paris formally adopted RADTEST as an official SCOPE project.

PROJECT ORGANIZATION

The scientific and administrative organization of the RADTEST project will be directed by the RADTEST Executive Committee (EC) and monitored by the SCOPE EC. Each participating country will have a SCOPE-RADTEST National Chairman, who will be a member of the RADTEST EC, and who will take a major responsibility in helping to carry out the administrative and scientific aspects of the project within their country. These responsibilities will include helping select participating scientists

and institutions, overseeing the scientific work, helping to arrange and conduct workshops, and seeking local sponsorship for project activities. The national chairman will be assisted in this work by national vice-chairmen.

Possible members of the EC include:

Prof. Charles Shapiro (Chairman)
Dr. Alexej Ryaboshapko (SCOPE representative)
Dr. Yury Tsaturov (Russia National Chairman)
Prof. Mao Yongze (China National Chairman)
Dr. Lynn Anspaugh (U.S.A. National Chairman)
_____(U.K. National Chairman
_____(France National Chairman)
_____(Kazakhstan National Chairman)

Possible national vice-chairmen may include:

Prof. Colonel Anatoly Matuschenko (Russia-Novaya Zemla)
Dr. Yakov Shoichet (Russia-Altaj)
_____(China)
Dr. Owen Hoffman (U.S.A.)

The Scientific Advisory Committee (SAC) will consist of high level individuals (minister-level) who have an interest, commitment, and a willingness to provide occasional support to the RADTEST project. These individuals will provide overall guidance to ensure that the project successfully achieves its scientific, political, economic and social goals.

Possible members of the SAC include:

Prof. Sir Frederick Warner (Chairman)
Prof. Yuri Israel (Russia)
Acad. Valentin Koptyug (Russia)
Dr. Vasilli Vosnjek (Russia)
Minister Viktor Mikhailov (Russia)
Dr. Roger Batzel (U.S.A.)
_____(U.K.)
_____(France)
_____(Kazakhstan)
_____(China)

The International Union of Radioecologists (I.U.R.): (Dr. René Kirschmann; Secretary General) has indicated its interest in participating in the project on a technical level, with Dr. Lev Khitrov as the IUR–RADTEST representative in the C.I.S.

PROJECT WORK PLAN:

A four–year project duration is anticipated. This estimate is based upon an understanding of the complexities from the experience of the Nevada Test Site downwind dose reconstruction project, which has been ongoing for over ten years and is still in progress. The first year will include a gathering of materials on a national level and an assessment of what work has already been done, what are the gaps, and which gaps need filling.

The first international workshop is scheduled to be held at the IAEA in Vienna, Austria during 10–14 January, 1994. This first workshop, which is receiving its principle financial support from the NATO scientific and environmental affairs division, will address the questions "What is available, what do we need?, and how do we get there?"

The participants from the USA will present an overview of the U.S. nuclear test program, and describe the ORERP (Off–Site Radiation Exposure Review Project). This project sought to (1) collect, preserve, and disseminate historical data related to radioactive fallout and health effects from nuclear testing, and (2) reconstruct insofar as possible, the exposures to the off-site public from nuclear testing at the Nevada Test Site and doses to individuals resulting from these exposures. The goals, methods, and sample results of the ORERP will be presented.[3] Also, a summary of work done at the U.S. South Pacific test sites will be presented.

The Russian RADTEST group will present reports on previous studies relating to test explosions conducted at the Semipalatinsk and Novaja Zemla test sites as well as those conducted elsewhere that were part of their peaceful nuclear explosion program. These reports will include fallout deposition characteristics, ecological studies near test sites, possible low-level radioecological effects on humans, dose reconstruction techniques, and measures for rehabilitation of the contaminated areas. A report will also be given summarizing recent studies of health effects in the Altaj region of Siberia. The Chinese RADTEST group will discuss their work on local fallout codes, civilian exposures from tests at Luc Bu Pu (Lop Nor), uptakes of fallout by food crops, and health studies.

The second international workshop is planned for summer, 1994, and will probably have as one focus the Altaj Region of Siberia in Russia, downwind of Semipalatinsk. At an April 1993 Russian national conference held in the Altaj Region (Barnaul), 125

papers describing recent studies have indicated very significant doses from the early test explosions, and significant medical effects on large populations[4]. RADTEST has been invited to undertake careful and independent study of these reports.

It is anticipated that other workshops will follow in each principal country at intervals of about nine months. Each workshop will focus on that countries' test site(s) as well as on-going studies organized at previous workshops. The scientific work will be divided into commissions which can address specific topics. For example, (a) sources and atmospheric transport, (b) pathways to humans following deposition, and dose reconstruction, and (c) human health effects.

It is proposed to establish four data banks in order to facilitate the interchange and comparison of data and modeling capabilities, and to identify differences and gaps in the data and modeling capabilities. To facilitate their comparison, it is proposed to establish agreed-upon standards for the data and their transmission. The location of these data banks will probably include: one in San Francisco for the U.S.A., one in Moscow for the C.I.S., one in Beijing for China, and one in Essex for the U.K. and France.

TENTATIVE TIMETABLE (1 July 1993 to 30 June 1997):

July 1993	Commence program
October 1993	First meeting of EC
November 1993	National meetings to assess the existing national data sources and models
January 1994	First international workshop in Vienna to assess previous work, identify needs, organize and plan future work.
July 1994	Second workshop to focus on the Altaj Region of Russia, downwind of Semipalatinsk
January 1995	Third workshop to focus on a major country, visit test sites, carry on projects from previous workshops
October 1995	Fourth workshop, in a second country
July 1996	Fifth workshop, in a third country
January 1997	Final review and synthesis workshop
June 1997	Submission of final report manuscript to SCOPE.

ACCESSIBILITY OF DATA

It is recognized that the success of RADTEST will require the active participation of key scientists and institutions in the principal countries that have knowledge of and access to the relevant data.

(1) ***U.S.A.:*** Almost all of the data associated with the U.S. nuclear testing program is generally available, either in the open literature, or accessible from unclassified data banks or through individual scientists. There remain a small number of items of information that are still restricted in their distribution. However, these restrictions would not impede the successful achievement of RADTEST goals. Of course, all of the work and publications of SCOPE-RADTEST will be open and unclassified.

Specific scientists with knowledge and access to these data sets that have expressed a strong interest in the U.S.A. participation include: Dr. Lynn Anspaugh of the Lawrence Livermore National Laboratory (LLNL) who is a major participant in the ORERP 10 year dose reconstruction project associated with the Nevada Test Site. Also, Dr. William Robison, of LLNL, (South Pacific Islands test sites) Dr. Richard Henderson (LASL) and Dr. Roger Batzel (LLNL).

(2) ***Russia:*** Before the dissolution of the Soviet Union, information about Soviet tests were generally not available to the international community. The past few years have witnessed a general opening up of all kinds of previously restricted data. Enthusiasm for RADTEST in Russia is very high, as is demonstrated in the *Memorandum of Understanding* reached in organizational meetings held in Moscow 5–7 November 1992. Specific scientists who have expressed confidence in the accessibility of Soviet nuclear test site data, and who have agreed to participation in RADTEST, include: Dr. Yury Tsaturov (Deputy Chair of GOSCOMCHERNOBYL*), Prof. Colonel Anatoly Matushchenko (Russian Ministry of Defence), Academician Valentin Koptyug (Vice-Chair of SCOPE and Vice-Chair of the Russian Academy of Science), Prof. Yuri Izrael, Director of Inst. of Global Climate and Ecology, Dr. V.N. Michailov, Minister of Atomic Energy, and Dr. Vasille Vosnjak (Chair of GOSCOMCHERNOBYL*).

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* GOSCOMCHERNOBYL is the Russian State Committee for the protection of population and rehabilitation of regions affected by Chernobyl and other radiation catastrophes.

(3) ***China:*** The Chinese SCOPE committee, in a series of SCOPE–RADPATH-II (now RADTEST) organizational meetings held in Beijing during 6–10 May 1992, have also expressed enthusiasm for the project. Prof. Mao Yongze; Chair of China SCOPE RADPATH, Prof. Liu Jinui; Secretary General of SCOPE China, and Prof. Zhu Changshou; Vice chair of China SCOPE-RADPATH from the Ministry of Public Health, have indicated the accessibility of numerous studies concerning fallout from Chinese and former USSR nuclear tests on civilian areas.

(4) ***Kazakhstan:*** The inclusion of Kazakhstan in RADTEST (where Semipalatinsk is located) is desirable. Most of the Soviet nuclear tests took place at the Semipalatinsk Test Site. Kazakhstan governmental and scientific participation is currently being explored.

(5) ***France and the U.K.:*** The participation of scientists from these countries is highly desirable. Approaches have been made through the respective SCOPE National Committees.

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Table 1. Number and Estimated Yields of Atmospheric Nuclear Tests [1]

			Estimated Yield (Mt)	
Time Period	**Country**	**Number of Tests**	**Fission**	**Total**
1945 – 1962	USA	193	72.1	138.6
1949 – 1962	USSR	142	110.9	357.5
1952 – 1958	UK	21	10.6	16.7
1960 – 1974	France	45	10.9	11.9
1964 – 1980	China	22	12.7	20.7
	Total	**423***	**217.2**	**545.4**

Source: UNSCEAR 1982
* An UNSCEAR update now in progress revises this total to 520.

Table 2. A comparison of radioactive releases from atmospheric nuclear detonations and nuclear reactor accidents.

	Radioactivity released (PBq)[a]				
Nuclide	**Hiroshima**	**Weapon tests [2]**	**Chernobyl [2]**	**Kyshtym [5]**	**Windscale [2]**
^{137}Cs	0.1	1500	89	.01	0.044
^{134}Cs[b]	—	—	48	—	0.0011
^{90}Sr	0.085	1300	7.4	1.0	0.00022
^{133}Xe	140	2 000 000	4400	—	14
^{131}I	52	780 000	1300	—	0.59

[a] Decay corrected to three days after shutdown or detonation.
[b] ^{134}Cs is produced in reactors by neutron activation.

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