

## **RÉSUMÉ OF DR. J.P. GIROUD**

## **JEAN-PIERRE GIROUD**

**geotechnical engineering  
geosynthetics  
landfills, dams and liquid impoundments  
drainage systems  
soil reinforcement**

### **SUMMARY**

Civil engineer, Ph.D. in geotechnical engineering  
Former professor of geotechnical engineering  
Former Director of the Geotextiles and Geomembranes Group of Woodward-Clyde Consultants  
Co-founder and former Chairman of the Board of GeoSyntec Consultants  
Retired from GeoSyntec Consultants with the title of Chairman Emeritus (January 2001)  
Currently, independent consultant (from January 2001), operating under JP GIROUD, INC.  
Author of 7 books and over 350 papers  
Past President of the International Geosynthetics Society  
Past Chairman of the Technical Committee on Geosynthetics of the International Society for Soil Mechanics and Geotechnical Engineering  
Former Chairman of the Editorial Board of Geotextiles and Geomembranes (1984-1994)  
Chairman of the Editorial Board of Geosynthetics International (1994-)

### **EDUCATION**

Universite de Grenoble, France: Docteur es Sciences (PhD), 1974  
Universite de Grenoble, France: Licencie es Sciences, 1964  
Universite de Grenoble, France: Docteur en Mecanique des Sols, 1963  
Ecole Centrale des Arts et Manufactures de Paris: Diplome d'Ingenieur, 1961

### **PROFESSIONAL HISTORY**

Independent consultant, JP GIROUD, INC., 2001  
GeoSyntec Consultants; Chairman Emeritus, for life  
GeoSyntec Consultants; Co-founder, Technical Director, Chairman of the Board, 1983-2001  
Woodward-Clyde Consultants; Director of the Geotextiles and Geomembranes Group, 1978-1983  
Institut de Recherches Interdisciplinaires de Geologie et Mecanique (Universite de Grenoble, France); Deputy-Director, 1976-1978  
Institut Universitaire de Technologie de Grenoble; Professor of Geotechnical Engineering, 1971-1978  
Universite de Grenoble; Assistant Professor, Director of the Master's Degree Program of Geotechnical Engineering, 1965-1978  
Advisor at the Court of Justice of Grenoble (for geotechnical engineering), 1975-1978  
Expert Consultant to the Disaster Response Agency of the Provincial Government of Grenoble in the area of civil emergencies (landslides, rockfalls), 1975-1978

Ecole Nationale des Travaux Publics, Lyon, France; Professor of Geotechnical Engineering,  
1977-1978

## **SUMMARY OF PROFESSIONAL EXPERIENCE**

Dr. Giroud became an independent consultant (JP GIROUD, INC.) when he retired from GeoSyntec Consultants in January 2001. He has retained the title of “Chairman Emeritus” of GeoSyntec, but he is no longer employed by GeoSyntec. A former professor of geotechnical engineering (until 1978), Dr. Giroud became Director of the Geotextiles and Geomembranes Group of Woodward-Clyde Consultants in 1978. In 1983, he co-founded GeoSyntec Consultants, of which he was Chairman of the Board.

Dr. Giroud has been engaged in the practice of geotechnical engineering since 1962. He has conducted research on foundation design between 1963 and 1978, and research on geotextiles, geomembranes and other geosynthetics ever since 1969. Dr. Giroud has provided consulting services since 1963.

Dr. Giroud has designed projects or provided design assistance in the following areas: liner systems, drainage systems, leachate control and leakage detection systems for landfills, liquid impoundments, reservoirs, canals, dams, mine heap leach pads, oil secondary containment, and low-level radioactive waste containment facilities; cover systems for landfills and mine tailings; geotextile filters; geotextile- and geogrid-reinforced unpaved roads; geosynthetic-reinforced embankments on soft soil; geosynthetic-reinforced vertical walls and slopes; bank protection; geosynthetic drainage systems; landslide repair; shallow and deep foundations; concrete retaining walls and sheet-pile retaining structures; soil improvement using dynamic compaction.

Dr. Giroud has gained international reputation for his experience with geosynthetics. Dr. Giroud has done pioneering work in the field of geosynthetics since 1970, and is recognized throughout the world as a leading expert on geosynthetics. He coined the words “geotextile” and “geomembrane” in 1977, which started the geo-terminology used in geosynthetics engineering. He was instrumental in the formation of the International Geosynthetics Society (IGS), of which he was President until 1990. He is currently Chairman of the Editorial Board of *Geosynthetics International*, a journal he helped founding in 1994, and he was Chairman of the Editorial Board of *Geotextiles and Geomembranes* (1984-1994), a journal he helped founding in 1984. Dr. Giroud was chairman of the Second International Conference on Geotextiles (1982) and the International Conference on Geomembranes (1984). He served two terms as chairman of the Technical Committee on Geosynthetics of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE).

Dr. Giroud designed the first dam incorporating geotextiles, which was constructed in 1970. Dr. Giroud has developed many of the analytical methods used in geosynthetic engineering for geotextile filters, geosynthetic drainage systems, unpaved roads, geomembrane and composite liner leakage evaluation, leachate collection and leakage detection layers, liner system stability and reinforcement on slopes, reinforcement of liners and soil layers overlying voids, geomembrane stress and strain analysis, evaluation of the effects of temperature on geomembranes, connections between geomembranes and concrete structures, effect of wind on geomembranes, etc. Dr. Giroud

has published noted state-of-the-art reviews on granular and geotextile filters, the use of geosynthetics in environmental applications, the use of geosynthetics in dams, and the behavior of geomembranes.

Dr. Giroud, considered the “father of geosynthetic liner systems”, has developed many methods for the design of geosynthetic liner systems used for landfills and liquid impoundments (more than 60 papers on this topic), and he recently wrote three books published as special issues of *Geosynthetics International*: “Design of Geomembrane Applications” (285 pages), “Control of Liquid Migration Using Geosynthetics Liner Systems” (251 pages), and “Liquid Collection Systems” (320 pages). As a practicing engineer, Dr. Giroud has originated a number of geosynthetics applications such as: first nonwoven geotextile filter (1970), first geotextile in a dam (1970), first use of nonwoven geotextile as cushion for geomembrane (1971), first double liner with two geomembranes (1974), first entirely geosynthetic double liner system with two geomembranes and a geonet leakage detection system (1981). ). He also played a key role in the development of the technique of exposed geomembrane landfill covers (1995-1998). Since 1971, he has been involved in the design of more than 100 liner systems including liner systems for 30 waste disposal landfills and several dams. He has conducted performance analyses for approximately 30 liner systems. Dr. Giroud has been involved in the design or performance analysis of hundreds of projects incorporating geosynthetics, and has provided technical assistance for the development of a number of new geosynthetics.

Dr. Giroud also has extensive field experience. In the 1980 he began providing construction quality assurance for geomembrane liners. He played a key role in the development of modern geomembrane construction quality assurance (1983-1984). In 1980-1981 he designed the procedure for installing a geomembrane vertically in a 20-m deep rock cavity located 600 m underground; the operation was completed successfully. In 1987-1988, he designed and monitored the first full-scale field test to evaluate the stability of a geosynthetic landfill cover system.

Dr. Giroud has extensive experience with testing geosynthetics. He started testing geomembrane permeability in 1973 and geomembrane-soil friction in 1974 using a small shear box. In 1977, he participated in the development of a large shear/pullout box for geosynthetic interface shear strength evaluation. In the early 1980s he participated in the development of transmissivity testing for geonets and geocomposites. He has also provided technical assistance to more than twenty geosynthetic manufacturers, and he has published numerous studies on geosynthetic testing and specifications

Dr. Giroud is the author of one book, two book chapters, and more than 250 papers on geosynthetics, and the editor of a book of geosynthetics case histories. Dr. Giroud is also the author of a monumental Geosynthetics Bibliography (1721 pages, more than 10,000 references). In addition, he wrote four books and a hundred papers on other geotechnical engineering subjects. Dr. Giroud is currently completing the preparation of a 1000-page book “Lessons Learned from Failures Associated with Geosynthetics”.

Dr. Giroud has extensive experience in performing forensic analyses and providing expert testimony. His first participation in a court case dates back to 1962. The first failure analysis of a geomembrane lined facility by Dr. Giroud dates back to 1972. Since then, Dr. Giroud has investigated more than 30 failures of structures incorporating geosynthetics, including a number of geomembrane-lined landfills, landfill cover systems, liquid impoundments, leach pads, and dams,

and on landslides, retaining structures, and soil-reinforced structures. Dr. Giroud has given keynote lectures on geosynthetic failures at the conference “Foundation of Success: Lessons Learned from Failures” organized by the Colorado Section of the American Society of Civil Engineers (ASCE) (1992), at the French Conference on Geosynthetics (1993), at the 47<sup>th</sup> Annual Geotechnical Engineering Conference of the university of Minnesota (1999), where he was the “Kersten Lecturer”, at the University of Colorado at Boulder (1999), where he was the “Jack Hilf Memorial Lecturer”, the conference of the North American Geosynthetic Society, “Geosynthetics ’99”, the Second European Conference on Geosynthetics (2000), at the Three Gorges Dam, China, where he was the Nete Lecturer (2000). He delivered the very prestigious “Vienna Terzaghi Lecture” (2005), and he recently wrote the chapter on filter criteria in the Jubilee Volume commemorating the 75th anniversary of Terzaghi’s book “*Erdbaumechanik*”.

Dr. Giroud has provided consulting services and technical assistance in various parts of the world. He is an internationally recognized authority with extensive experience with international matters, including conflict resolution.

Dr. Giroud has taught training courses on geosynthetics for prestigious organizations such as the U.S. Environmental Protection Agency, the Federal Highway Administration, the U.S. Bureau of Reclamation, and the Association of State Dam Safety Officials. He has lectured worldwide on geosynthetics and has been keynote lecturer or session chairman at numerous conferences.

Dr. Giroud had a major influence on the development of the geosynthetics discipline: he started the geo-terminology when he coined the words *geotextile* and *geomembrane*; he was the driving force behind the formation of the International Geosynthetics Society; he helped founding the two journals of the geosynthetics discipline, *Geotextiles & Geomembranes* in 1984 (of which he was chairman 1984-1994) and *Geosynthetics International* in 1994 (of which he is chairman since 1994); he chaired the first International Conference on Geomembranes and the Second International Conference on Geotextiles; he published the first comprehensive list of mathematical and graphic symbols for the geosynthetics discipline (list adopted by the IGS and periodically updated); he published a monumental Geosynthetics Bibliography; he developed many of the methods used for the design of geosynthetics applications; etc. In 2002, he became Honorary Member of the IGS with the mention “Dr. Giroud is truly the father of the IGS and the geosynthetics industry”.

Dr. Giroud has received awards from the French Society of Engineers and Scientists (1972), the Industrial Fabrics Association International (1983), and the IGS (1994 and 2004). In 1994, the IGS has named its highest award “The Giroud Lecture”, “in recognition of the invaluable contributions of Dr. J.P. Giroud to the technical advancement of the geosynthetics discipline”. In 2005, Dr. Giroud has been awarded to status of “hero” of the Geo-Institute of the American Society of Civil Engineers (ASCE). Dr. Giroud has recently been invited to present the 2005-2006 Mercer Lecture series.

## **RESEARCH AND INNOVATIVE PRACTICE**

Dr. Giroud has developed design methods for:

- Determination of stresses and settlement in a variety of shallow foundation situations (three books published).

- Determination of the bearing capacity of foundations in a variety of situations such as slopes, inclined and eccentric loading, multilayer soil (one book published).
- Selection of the depth of soil exploration for foundation design, based on a risk analysis.
- Geotextile filter selection.
- Geotextile-reinforced and geogrid-reinforced unpaved roads.
- Determination of the required bursting resistance of geotextiles and geomembranes.
- Stability and differential movements of earth and concrete covers on geomembranes.
- Evaluation of rate of leakage through liners.
- Liner system leakage detection.
- Leachate collection layers.
- Leakage detection and collection layers.
- Geosynthetic-reinforced soil layer bridging voids or cavities.
- Anchor trenches for liner systems.
- Stability of liner systems on slopes.
- Analysis of stresses leading to geomembrane cracking.
- Design of structures connected with geomembranes.
- Design of tanks lined with geomembranes.
- Effect of wind on geomembranes.
- Fundamental relationship between opening size and physical characteristics of nonwoven geotextiles.
- Liquid migration in geosynthetic clay liners.

In the early 1980s, Dr. Giroud performed a theoretical analysis (published in 1984), which predicted that polyethylene geomembranes would fail in the field at low strains as a result of yield, even though they would only fail at high strains in conventional laboratory tests. This prediction, first received with skepticism, was verified in a number of polyethylene geomembrane liner failures and is now the basis for the determination of acceptable stresses and strains in polyethylene geomembranes used in landfills and other facilities.

Dr. Giroud has pioneered the following applications:

- First use of a nonwoven geotextile as a filter in a drainage system (1970).
- First use of a geotextile in a dam (1970).
- First use of a geotextile associated with a geomembrane (1971).
- First use of a geomembrane/clay composite liner in a dam (1973).
- First use of a double geomembrane liner (1974).
- First use of a geonet associated with two geomembranes to form an entirely synthetic double liner system (1981).

In addition, Dr. Giroud has developed many of the concepts used in geomembrane liners construction quality assurance, and he has been instrumental in the development of the use of synthetic drainage materials such as geonets in hazardous waste facilities in the United States and in the acceptance of this technique by the U.S. Environmental Protection Agency (EPA).

## **SPECIAL ASSIGNMENTS**

- 1974-1975-1976: Invited lecturer at Paris University for a Continuing Education Program on Foundation Engineering.
- 1974-1978: Director of Continuing Education programs on geotechnics and geotextiles at the University of Grenoble, France.
- 1972 and 1973: Missions to Poland to establish cooperation contract between Polish Universities and the University of Grenoble, France.
- 1974 and 1975: Missions to USSR to establish cooperation between French and Russian research centers.
- 1975: Mission to Great Britain to establish cooperation between French and British societies for Soil Mechanics and Foundation Engineering.
- 1977: Chairman of the French delegation to USSR on Foundation Engineering.
- 1978: Co-founder of the French Committee on Geotextiles.
- 1979: Member of the US team on Plastic Films for US-USSR joint studies.
- 1980-1982: Chairman of the Organizing Committee of the Second International Conference on Geotextiles (held in 1982).
- 1982-1983: Vice-chairman of the Interim Committee of the International Society on Geotextiles.
- 1982-1984: Chairman of the Organizing Committee of the International Conference on Geomembranes (held in 1984).
- 1983: General reporter at the Symposium on Waterproofing for Reservoirs, Dams and Canals, Paris.
- 1983-1985: Chairman of the Technical Committee on Geotextiles of the International Society for Soil Mechanics and Geotechnical Engineering.
- 1983-1986: Vice-president of the International Geotextile Society (now International Geosynthetics Society)(IGS).
- 1983-1986: Member of the Organizing Committee of the Third International Conference on Geotextiles (held in 1986).
- 1983-1993: Chairman of the Editorial Board of the Geotextiles and Geomembranes International Journal.
- 1983-1984: Member of the British Science and Engineering Research Council (SERC) board reviewing the cooperative research conducted by four British Universities on geogrids.
- 1985-1989: Chairman of the Technical Committee on Geotextiles and Geosynthetics of the International Society for Soil Mechanics and Geotechnical Engineering.
- 1986-1990: President of the International Geotextile Society (now International Geosynthetics Society) (IGS).
- 1990-1994: Member of the Organizing Committee of the Fifth International Conference on Geotextiles Geomembranes and Related Products (held in 1994).
- 1990-1994: Immediate Past-President/Officer of the International Geosynthetics Society (IGS).
- 1993-date: Member of the International Advisory Board for the International Landfill Symposium.
- 1994-date: Past-President of the International Geosynthetics Society (IGS), formerly International Geotextile Society.
- 1994-date: Chairman of the Editorial Board of Geosynthetics International.

1995-1998: Chairman of the International Advisory Board of the Sixth International Conference on Geosynthetics ( held in 1998)

1998-2002: Chairman of the International Advisory Board of the Seventh International Conference on Geosynthetics (held in 2002)

## **AFFILIATIONS**

American Society of Civil Engineers

- Member (1967 to date)

American Society for Testing and Materials

- Member of the Committee on Geosynthetics

International Geosynthetics Society (IGS)

- Vice-Chairman of the Interim Committee (1982-1983)
- Vice-President (1983-1986)
- President (1986-1990)
- Immediate Past-President (1990-1994)
- Council Member (1983-1994)
- Past-President (1994 to date)
- Honorary Member (2002)

International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE)

- Chairman of the Committee for the Coordination of Research of the French Society for Soil Mechanics and Foundation Engineering (1974-1976, and 1976-1978)
- Chairman of the Technical Committee on Geotextiles (1983-1985)
- Chairman of the Technical Committee on Geotextiles and Geosynthetics (1985-1989)

National Sanitation Foundation

- Liaison between NSF Joint Committee for Flexible Membrane Liners and ASTM (1981-1984).

North American Society on Geosynthetics (NAGS)

- Member (1987 to date)

Societe des Ingenieurs et Scientifiques de France

- Member (1965 to date)

## **MILITARY SERVICES**

From 11/63 through 02/65, Second Lieutenant in French Air Force

## **HONORS**

Annual award of the French Society of Civil Engineers for an engineer less than 35 years of age, 1972

Raoul Dutron Lecturer, ABEM (Association Belge pour l'Etude des Materiaux), 1977

President's Award of the Industrial Fabrics Association International (IFAI), 1983

International Geosynthetics Society Award, 1994

Grand Award of the PVC Geomembrane Institute, 1994

The International Geosynthetics Society has decided that, starting with the 6th International Conference on Geosynthetics, in 1998, the inaugural lecture of every International Conference on Geosynthetics will be called The Giroud Lecture "in recognition of the invaluable contributions of Dr. J.P. Giroud to the technical advancement of the geosynthetics discipline during the last 25 years", 1994

Kersten Lecturer, The University of Minnesota, St. Paul, 1999

Jack Hilf Memorial Lecturer, The University of Colorado, Boulder, 1999

First Nete Lecturer, China, 2000

Honorary Member of the IGS with the mention "Dr. Giroud is truly the father of the IGS and the geosynthetics industry", 2002

International Geosynthetics Society Award, 2004

Delivered the prestigious 2005 Vienna Terzaghi Lecture, Austria

Hero of the Geo-Institute of the American Society of Civil Engineers (ASCE), 2005.

Invited to present the 2005-2006 Mercer Lecture series.

## **PUBLICATIONS AND INTERVIEWS**

Dr. Giroud has authored or co-authored seven books and over 300 technical papers on subjects relating mostly to foundation design, geosynthetics, dams, and waste containment facilities. These papers have been published in various journals in the United States, France, the United Kingdom,

South Africa, Belgium, Germany, Switzerland, Morocco, Poland, Italy, etc. (see the list of publications). In 1993-1994, Dr. Giroud has published a monumental bibliography on geosynthetics (1721 pages). In 1995, he published a volume on “Design of Geomembrane Applications” (285 pages) as a special issue of *Geosynthetics International* marking his 25th year of commitment to geosynthetics. Dr. Giroud recently wrote two books published as special issues of *Geosynthetics International*: “Control of Liquid Migration Using Geosynthetics Liner Systems” (251 pages) and “Liquid Collection Systems” (320 pages).

Dr. Giroud was invited to write the inaugural paper for the first issues of Geotextiles and Geomembranes (1983) and the Geotechnical Fabrics Report (1984). He was interviewed for the first issue of Geosynthetic World (1990). Dr. Giroud was interviewed for the cover story by ENR (September 1981) and Civil Engineering ASCE (January 1989). He was also interviewed by The Civil Engineering Contractor (1978), Construction Equipment (May 1983), Modern Plastics (March 1989, International Construction (April 1989), and Geosynthetics World (1992, 1993).

Dr. Giroud has recently been invited to write the chapter on “filter criteria” in the book co-authored by prestigious authors for the 75<sup>th</sup> anniversary of the publication of *Erdbaumechnik* by Terzaghi. He received an IGS Award for this chapter.

## **TRAINING COURSES AND LECTURES**

Dr. Giroud has presented three series of courses on liner systems for waste containment facilities for the personnel of the U.S. Environmental Protection Agency (EPA) (1983-1986), and one series of eight courses on landfills for the EPA Region 4 (1994), as well as training courses for the Federal Highway Administration (FHWA) on geotextiles (1987-1991), the U.S. Bureau of Reclamation (1988), the Industrial Fabrics Association International (IFAI) on landfills (1985, 1987, 1989, 1991, 1993) and on liquid impoundments (1994), the University of Wisconsin (1985-1994), Lehigh University on landfills (1986-1989), local sections of the American Society of Civil Engineers (ASCE), the Dam Safety Section of the State of Montana Department of Natural Resources and Conservation (1989), the State of Michigan Department of Natural Resources (1991), the Association of State Dam Safety Officials (ASDSO) (1991), the University of Florida TREEO Center (1992, 1993, 1994), the Swedish Geotechnical Institute (SGI) on landfills (1994), and industrial companies such as IBM (1984), Waste Management (1984, 1988), and Dow Chemical (1989). Dr. Giroud has also lectured in several universities such as: Purdue, Duke, North Carolina State, Illinois Institute of Technology, Clemson, Ecole Polytechnique de Montreal, San Diego State University, University of Southern California, University of Alberta in Edmonton, University of Minnesota, University of Colorado at Boulder, etc. Dr. Giroud has presented over 100 lectures on foundation design, geotextiles and geomembranes, design of waste disposal facilities, etc., in all continents (North and South America, Western and Eastern Europe, North and South Africa, Middle East and Far East, China, Australia).

## **KEYNOTE LECTURES**

Dr. Giroud gave the opening lecture or an opening address at the First Canadian Symposium on Geotextiles (Calgary, 1980), the First Swiss Symposium on Geotextiles (Zurich, 1982), the session on water storage at the International Symposium on Plastic and Rubber Waterproofing in Civil

Engineering (Liege, 1977), the session on Civil Engineering at the Congress of the European Nonwoven Association (Amsterdam, 1978), the session on soil reinforcement at the ASCE conference and exhibition Geotech 81 (San Francisco, 1981), the Second International Conference on Geotextiles (Las Vegas, 1982), the International Conference on Geomembranes (Denver, 1984), the Third International Conference on Geotextiles (Vienna, 1986), the Post Vienna Conference on Geotextiles (Singapore, 1987), the First Indian Geotextiles Conference (Bombay, December 1988), the Fourth International Conference on Geotextiles, Geomembranes, and Related Products (The Hague, 1990), the Southeastern Conference on Dam Safety (Atlanta, 1992), the French Conference on Geosynthetics (Tours, 1993), the Fifth International Conference on Geotextiles, Geomembranes and Related Products (Singapore, 1994), and the North American Conference on Geosynthetics, Geosynthetics '99 (Boston, 1999).

Dr. Giroud presented a closing address at the following conferences: the Second International Conference on Geotextiles (Las Vegas, 1982), the International Conference on Geomembranes (Denver, 1984), the Third International Conference on Geotextiles (Vienna, 1986), the Post Vienna Conference on Geotextiles (Singapore, 1987), the International Geotechnical Symposium on Theory and Practice of Earth Reinforcement (Kyushu, 1988), the First Indian Geotextiles Conference (December 1988).

In 1987, Dr. Giroud presented a keynote address at Geosynthetics '87 (New Orleans), he presented a lecture at the Institution of Civil Engineers, in London, for the inaugural meeting of the U.K. Section of the International Geotextile Society, and he presented a state-of-the-art lecture on geosynthetics at the Post-Vienna Conference on Geotextiles (Singapore). In 1988, Dr. Giroud presented state-of-the-art lectures on geosynthetics at the 10th Seminario de Geotecnia of the Venezuelan Society of Soil Mechanics (Caracas) and the First Indian Geotextiles Conference (Bombay). In 1988, he was the keynote lecturer at the conference organized for the 10th anniversary of the French Committee of Geotextiles and Geomembranes (Paris). In 1991, Dr. Giroud presented state-of-the-art lectures on geosynthetics in dams to the U.S. Committee on Large Dams (USCOLD) and at the annual conference of the Association of State Dam Safety Officials. In 1992, he was guest speaker at a symposium of the American Society of Civil Engineers in Denver (Colorado), where he presented a lecture on lessons learned from geosynthetic failures. In 1993, Dr. Giroud was the keynote speaker at the French Conference on Geosynthetics in Tours (France) and a guest speaker at the Italian Conference on Geosynthetics in Bologna (Italy). In 1994 he was a guest speaker at the 8th International Conference on Computer Methods and Advances in Geomechanics in Morgantown, (West Virginia), and he gave the Special Lecture at the opening of the 5th International Conference on Geosynthetics, in Singapore. In 1996, Dr. Giroud was a lecturer at the 14th Distinguished Lecture Series of the University of California, Berkeley, on the occasion of the 1996 Graduation, and he was the keynote speaker at the international conference on filtration, GeoFilters 96, in Montreal (Canada). In 1999, Dr. Giroud delivered the "Kersten Lecture" at the 47<sup>th</sup> Geotechnical Engineering Conference at the University of Minnesota, and the "Jack Hilf Memorial Lecture" at the University of Colorado, at Boulder. In 2000, Dr. Giroud was the keynote speaker at the Second European Conference on Geosynthetics and the Fifth Chinese Conference on Geosynthetics. In 2002, Dr. Giroud was the keynote speaker at the Forum Geosynthetique 2002, in Saint Hyacinthe, Quebec. In 2003, Dr. Giroud was keynote speaker at the Geosynthetics 2003 Conference in Atlanta.

## **CONFERENCES**

In 1982, Dr. Giroud chaired the Second International Conference on Geotextiles. In 1983, Dr. Giroud was general reporter at the Symposium on Waterproofing for Reservoirs, Dams and Canals, held in Paris. In 1984, Dr. Giroud chaired the International Conference on Geomembranes and chaired the session on geotextiles at the Symposium on Plastic and Rubber Waterproofing in Civil Engineering in Liege, Belgium. In 1985, Dr. Giroud chaired the panel on Hazardous Waste Control and the Lining Industry at the Geotechnical Fabrics Conference in Cincinnati, and presented the state-of-the-art report on geotextiles at the 11th International Conference on Soil Mechanics and Foundation Engineering in San Francisco. In 1986, Dr. Giroud chaired the session on soil reinforcement at the Third International Conference on Geotextiles, in Vienna, Austria; in 1987 he chaired the first session devoted to special lectures of the Post Vienna Conference on Geotextiles, in Singapore; in 1988 he chaired the session on Tests and Materials at the International Geotechnical Symposium on the Theory and Practice of Earth Reinforcement, in Fukuoka-Kyushu, Japan; in 1989 he chaired the session on Reinforced Soil Slopes and Walls at the 12th International Conference on Soil Mechanics and Foundation Engineering, in Rio de Janeiro; in 1990 he chaired the session of the special lecture on soil reinforcement at the Fourth International Conference on Geotextiles, Geomembranes and Related Products in The Hague, and was general reporter on geosynthetics in waste disposal facilities at the same conference. In 1993, he co-chaired the workshop on quality assurance of lining systems at the 3rd International Landfill Conference in Sardinia (Italy). In 1994, he was an advisor to the organizing committee of the Fifth International Conference on Geotextiles, Geomembranes and Related Products and chaired the session on the Durability of Geotextiles and Geogrids. In 1995, Dr. Giroud chaired the workshop on Testing of Geosynthetic Materials for Landfill Liners and Covers at the 4th International Landfill Conference in Sardinia (Italy). Dr. Giroud has been chairman of the International Advisory Board of the Sixth International Conference on Geosynthetics (1998) and the Seventh International Conference on Geosynthetics (2002). Dr. Giroud chaired the panel discussion on environmental applications of geosynthetics at the 6th International Conference on Geosynthetics (Atlanta, 1998) and chaired the Special Session on Geomembranes in Landfills at the 7th International Conference on Geosynthetics (Nice, 2002).

## **REPRESENTATIVE ASSIGNMENTS**

### **J.P. GIROUD**

#### **PROJECT DESIGN**

- Design of foundations for a hospital, several tanks, factories and buildings and five supermarkets in the Grenoble area, France (1966-70).
- Site investigation, design and earthwork supervision of Valcros Dam, France, in which a geotextile was used for the first time in a dam (1969-70).
- Design of a series of reservoirs where geotextiles were associated for the first time with geomembrane liners (1971-73).
- Design of large cuttings including slope stability calculations for the Lyon-Grenoble Highway, France (1972).
- Evaluation of effects of geomembrane liner uplift by wind, Pontho, Reunion Island (1972).

- Design and monitoring of soil improvement using dynamic compaction, and foundation design, Les Marines de Cogolin, France (1972-73).
- Site investigations and design of Rhone-Progil Reservoir, which is a large water reservoir on a steep slope, with the first double geomembrane liner ever built, in Pont de Claix, France (1973-74).
- Site evaluation and design of the waterproof lining at Ain Djasser Irrigation Pond, Algeria (1974).
- Report on the design and monitoring of an experimental test section of Moscow-Riga Highway in USSR, where a geomembrane is used (1975).
- Design assistance and establishment of detailed specifications for the waterproof lining of Esfahan Canal, Iran, which was for many years the largest canal in the world lined with a geotextile-geomembrane system (1975-77).
- Landslide evaluation for the Grenoble-Gap Highway in France (1976).
- Design of foundations subjected to large horizontal forces, stadium of Villard de Lans, France (1976).
- Foundation design for Guest Palace Hotel at Taif, Saudi Arabia (1976).
- Design of geomembrane canal liner for the Balikh Irrigation Project, Syria, for the World Bank (1977).
- Design of the rehabilitation of the pile foundations of a multi-story building in Grenoble, France (1978).
- Specifications for the use of geotextiles at Howard Terminal, San Francisco Bay (1978).
- Design of pond lining and dike reinforcement at Beaumont, Texas (1978-79).
- Design of geotextile filter for a gabion bank protection, Vermilion River, Illinois (1980).
- Design of underground cavity lining for the Proton Decay Experiment, Lake Erie, Ohio (1980-82).
- Design of geotextile reinforced unpaved roads, Kuparuk, Alaska (1981).
- Design of geotextile reinforced dike, Barrow, Alaska (1981).
- Design of a geomembrane-lined liquid impoundment for sulfuric acid for a uranium mine, Arlit, Niger (1981).
- Review of the design of geogrid reinforced artificial sand islands to be built in the Beaufort Sea, Canada (1981).
- Design of geotextile drains for Tyrone Mine tailing dam, USA (1982).
- Review of design of geomembrane-lined Codole Dam, Corsica, France (1982).
- Review membrane selection and waterproofing design for roofs of Riyadh International Airport, Saudi Arabia (1982).
- Review of design of geomembrane-lined reservoirs with floating cover in Kirkuk, Iraq (1982).
- Design, geomembrane selection and quality assurance of NIES hazardous waste landfill, Wichita, Kansas (1982-83).
- Design of a geotextile vertical drain for Getty Plaza excavation, California (1983).
- Design of lining system for a hazardous waste landfill, Liberty County, Texas (1983).

- Conceptual design, review of detailed design and construction quality assurance of geomembrane installation for three reservoirs, including one with a double liner, in Aqaba, Jordan (1983-84).
- Review of the design of a geomembrane-lined tailing dam, Hemlo, Canada (1984).
- Design assistance, quality assurance, and full-scale slope stability of a hazardous waste landfill liner installation in Emelle, Alabama (1984).
- Assistance for design of a hazardous waste landfill closure including geomembrane, geonet and geotextile, Eastern Missouri (1984).
- Assistance for design of a hazardous waste landfill closure including passive gas ventilation, Missouri City, Missouri (1984).
- Conceptual design and detailed design of the geomembrane liner system for a one million square meter reservoir for pump-storage station, La Muela, Spain (1984-85).
- Review of conceptual design of a series of geomembrane-lined lagoons in Page, Arizona (1984-85).
- Review of design of a sanitary landfill, Fort Bend County, Texas (1985).
- Design assistance and quality assurance for a hazardous waste landfill, Baton Rouge, Louisiana (1985).
- Review of design of a proposed very large sanitary landfill, Morris County, New Jersey (1985).
- Review of design of a double lined hazardous waste landfill, Arlington, Oregon (1985).
- Review of design of a large geomembrane-lined dam and water reservoir for a pump-storage station, Kuriyama, Japan (1985).
- Design of the lining system for a large water reservoir, Djebel Zioua, Algeria (1985-86).
- Lining system design for landfill in Broward County, Florida (1985-86).
- Assistance for design of a hazardous waste landfill, McIntosh, Alabama (1986).
- Review of design of a hazardous liquid impoundment for a paper mill, Canton, North Carolina (1986).
- Review of the design of a sanitary landfill cover, Toronto, Canada (1986).
- Review of the design of a triple lining system for a hazardous waste landfill in Wright City, Missouri (1986).
- Review of the conceptual design of a hazardous waste landfill in Toronto, Canada (1986).
- Review of the design of a sanitary landfill lining system, Ottawa-Carleton, Canada (1986).
- Review of the conceptual design of a large reservoir in Salt Lake City, Utah (1986).
- Hazardous waste landfill design review and quality assurance plan, in Deer Park, Texas (1986).
- Design review of lined tailings disposal, Rock Springs, Wyoming (1986).
- Conceptual design of lining system for a landfill in St. Lucie County, Florida (1986).
- Conceptual design and reviews of the detailed design of a series of reinforced vertical walls and slopes a full-scale test, in Northbrook, Illinois (1987).
- Review of the conceptual design of the lining system for a municipal waste landfill in Foster County, Pennsylvania (1987).
- Review of the design of an ash landfill in Long Island, New York (1987).

- Review of the conceptual design and guidance for the detailed design of a lining system for heap leach pads for two different gold mines, near Lead, South Dakota (1988).
- Review of liner material selection for a municipal waste landfill, Gloucester County, New Jersey (1988).
- Assistance for geomembrane selection and specifications for a lined potable water reservoir with floating cover, Nassau, Bahamas (1988).
- Review of preliminary design of a municipal waste landfill, Cumberland, New Jersey (1988).
- Review of detailed design for a municipal waste landfill, West Palm Beach, Florida (1988).
- Conceptual design for the geomembrane liner system of a municipal waste landfill, Monroeville, Pennsylvania (1988).
- Preliminary design of the geomembrane liner system of a municipal waste landfill resting on existing waste, Long Island, New York (1988).
- Stability calculations for a geomembrane-lined ashfill, Long Island, New York (1988).
- Review of conceptual design of hazardous waste disposal landfill, Augusta, Michigan (1988).
- Conceptual design for an ashpond for a utility company, Binghamton, New York (1988).
- Evaluation of rate of leachate generation for a municipal landfill, Jacksonville, Florida (1988).
- Review of construction quality audit for mine heap leach pad and associated ponds, Lawrence County, South Dakota (1988).
- Conceptual design of the rehabilitation of brine ponds, Fresno, California (1989).
- Review of conceptual design and expert testimony for a municipal solid waste landfill, Edmonton, Canada (1989).
- Review of conceptual design of reinforced-soil sea wall, Point Loma, California (1989).
- Review of problems caused by vegetation growth to the geomembrane cap of a large municipal waste landfill, Fresh Kills, New York (1989).
- Review of the design of the heightening of an embankment dam, Middle Creek, Montana (1990).
- Conceptual design of an unpaved access road, Ecuador (1991).
- Review of design for remediation of polluted soil, Chavanay, France (1991).
- Design of geomembrane liner system for a large municipal solid waste landfill, Guaynabo, Puerto Rico (1991).
- Design of a removable geomembrane landfill cap for a landfill with waste mining/recycling, Collier County, Florida (1991).
- Review of design of a test pad for evaluating effectiveness of liquid collection in the cap of a sludge pond, Ohio (1992).
- Review of landfill design, Livermore, California (1992).
- Technical assistance for the use of geosynthetics at Los Angeles Harbor Pier 400, California (1993).
- Technical assistance for the design of Lopez Canyon Landfill, California (1993).
- Technical assistance for the selection and specification of geomembrane for a large water reservoir in Ismailia, Egypt (1993).

- Evaluation of long-term performance of a geomembrane liner for a low-level radioactive waste repository, Martinsville, Illinois (1993).
- Design assistance for very large geomembrane-lined ponds in Wilmington, North Carolina (1994).
- Evaluation of long-term performance of geomembrane liner and geosynthetic clay liner for a low level radioactive waste disposal facility, North Carolina (1994).
- Evaluation of geomembrane resistance to puncturing by stones for an ore leach pad, Hayden, California (1994).
- Participation in the conceptual design of a waste containment island for the Port Authority of New York and New Jersey (1994).
- Design assistance to Chem Nuclear Systems, Inc. for the development of “high-integrity vaults” for the storage of low-level radioactive waste (1994-1998).
- Design assistance for detailed design of a solid waste landfill, Calce, France (1995).
- Design assistance for wind effect on geomembrane-lined pond, Paris Airport, France (1995).
- Evaluation of the action of PCBs on HDPE geomembranes (1995).
- Development of design criteria and design methodology, design assistance and design review for low-level radioactive waste disposal landfill, Fernald, Ohio (1996).
- Liner system comparison, Tesoro tank farms, Alaska (1996).
- Design review for pond linings, Anne Arundel County, Maryland, USA (1997).
- Design assistance for pond liner associated with above ground tanks, for BP, Algeria (1997).
- Filter design assistance for two landfills, USA (1997).
- Design of 12 m deep excavation into waste to repair liner system in a landfill, Michigan (1997).
- Design of a long-term (300-year) monitoring plan for the cover geomembrane of a large mine tailings storage facility (1998).
- Review of the design of an exposed geomembrane cap for a large municipal solid waste landfill in Sussex County, Delaware (1998).
- Review of wind uplift calculations for an exposed geomembrane cap at Sabine Parish Landfill, Louisiana (1999).
- Review of design of use of geosynthetic clay liner encapsulated between two geomembranes for two landfills, Keystone and Commonwealth (2001).
- Member of the design team of Lachenaie Landfill Northern Extension, Montreal, Canada (2001).
- Design assistance for geomembrane-lined underground Kildare Motorway Bypass, Ireland (2001).
- Design assistance for Bryn Pica Landfill, UK (2001).
- Design assistance for flood retention structures rehabilitation concepts, Arizona (2002-2003).
- Filter design review, Lewis Road Landfill (2002).
- Design assistance for two large water reservoirs for pump-storage station, Afourer, Morocco (2003).
- Analysis of geomembrane resistance to soil cracking for the design of the rehabilitation of White Tanks flood control dam, Arizona (2004).

- Design assistance for bank protection rehabilitation, Manalapan, Florida (2004).
- Design review for a large geomembrane-lined water reservoir, Newark, Delaware (2004-2005).
- Design assistance for the closure of a solid waste landfill, Guam (2004-2005).

## **CONSTRUCTION QUALITY ASSURANCE**

- Earthwork and geotextile installation supervision at Valcros Dam, France, in which a geotextile was used for the first time in a dam (1969-70).
- Inspection of construction of two evaporation ponds for a uranium processing plant, Narbonne, France (1980).
- Preparation of guide specifications for geomembrane installation in hazardous waste disposal facilities, for the U.S. Environmental Protection Agency (USEPA), USA (1983).
- Construction quality assurance of NIES hazardous waste landfill, Wichita, Kansas (1983).
- Construction quality assurance of geomembrane installation for three reservoirs, including one with a double liner, in Aqaba, Jordan (1983-84).
- Preparation and revision of a construction quality assurance manual for geomembrane and geotextile installation for a major waste management firm, USA (1984-85).
- Supervision of construction quality assurance of a double lined hazardous waste landfill, Arlington, Oregon (1985).
- Review of "Construction Quality Assurance for Hazardous Waste Land Disposal Facilities", a Technical Guidance Document for the USEPA (1986).
- Participation in the preparation of the national guidelines on geomembrane construction quality assurance for the French environmental regulatory agency, ADEME (1996).
- Inspection of construction quality assurance for low-level radioactive waste disposal landfill, Fernald, Ohio (1996).

## **PERFORMANCE ANALYSIS**

- Investigation of the failure of a large sheet-pile retaining structure for a 100 m high building, Grenoble, France (1964-65).
- Investigation of failures of pile foundations of a steel plant, Fos-sur-Mer, France (1969).
- Forensic analyses, remedial measures, and expert testimony for a dozen landslides in the Alps (1970-78).
- Investigation of failure and design of remedial measures for a geomembrane-lined reservoir subjected to intensive wind and wave action, Aire sur la Lys, France (1972).
- Investigation of failure and design of remedial measures for a geomembrane-lined reservoir on karstic terrain, Tancarville, France (1972).
- Monitoring of dynamic compaction of a clayey soil, Villeneuve-Grenoble, France (1973).

- Investigation of movements of spread footings on a slope, causing serious damage to 60 houses, Gap, France (1975).
- Investigation of the partial failure of the pile foundations of a multi-story building in Grenoble, France (1978).
- Investigation of failure of two brine reservoirs, Hauterives, France (1978).
- Analysis of geotextile filter failure, Camacari, Brazil (1979).
- Forensic analysis of geomembrane failure and expert testimony, Avoriaz dam and reservoir, France (1980).
- Investigation of the malfunctioning of geomembrane-lined reservoirs and remedial measures, Arlit, Niger (1981).
- Analysis of leakage and related liner failure at a geomembrane-lined underground cavity for the Proton Decay Experiment, Lake Erie, Ohio (1980-82).
- Investigation of failure of a geomembrane-lined evaporating pond, Aqaba, Jordan (1983).
- Experimental study of the aging of geomembranes exposed during four years in the Sahara desert (1983).
- Forensic analysis of geomembrane-lined wastewater treatment ponds, Mountain Home, Idaho (1984).
- Review of performance of two lined reservoirs, Essex Junction, Vermont (1985).
- Investigation of malfunctioning of four reservoirs for sulfuric acid in San Onofre, California (1985).
- Analysis of causes of failure and quality assurance of rehabilitation of the geomembrane liner of a landfill in Norridgewock, Maine (1986).
- Analysis of the causes of leakage of six geomembrane-lined concrete reservoirs in Long Beach, California (1986).
- Evaluation of the performance of a secondary containment liner, in Oakland, California (1986).
- Analysis of the behavior of the liner system of an existing pond and recommendations for a new pond for a gold mine, near Nye, Montana (1987).
- Analysis of the behavior of the liner system for concrete vaults to store low level radioactive waste, in Hanford, Washington (1987).
- Analysis of geogrid-reinforced wall displacement, League City, Texas (1987).
- Design and interpretation of a full scale test to evaluate geomembrane landfill cap stability, New Milford, Connecticut (1987-88).
- Analysis of leakage rates of three lined ponds for a gold mine, Chesterfield County, South Carolina (1988).
- Review of waste pile closure performance, Chalmette, Louisiana (1988).
- Review of monitoring data for a geomembrane-lined hazardous waste landfill, Peoria, Illinois (1989).
- Analysis of the behavior of an installed geomembrane liner exposed to extremely cold temperatures, Delta, Utah (1989).
- Analysis of the performance of a lining system in a landfill (sideslope stability, leakage), Fulton County, New York (1989).
- Analysis of the leakage rate of an ore leach pad liner system, Deadwood, South Dakota (1989).

- Analysis of potential leakage out of geomembrane-lined municipal landfill and potential ground water contamination, Azusa, California (1989).
- Analysis of construction problems at a flood retention dam with a geomembrane core, Signal Buttes, Utah (1990).
- Analysis and remedial measures for liner system instability in a landfill, Babylon, New York (1990).
- Analysis of the failure of a geomembrane liner in a large wastewater reservoir, Canton, Mississippi (1990).
- Analysis of a waste slide in a geomembrane-lined hazardous waste landfill, Kettleman City, California (1990).
- Analysis of failures of geomembrane seams and definition of remedial measures at Uranium mine pond, Blanding, Utah (1991).
- Investigation of waste slide at Pinewood Landfill, South Carolina (1991).
- Preparation of remedial measures for a pond in Soldotna, Alaska (1993).
- Evaluation of geomembrane performance at an ore leach pad in Hayden, California (1994).
- Investigation of foundation soil and waste slide in a geomembrane-lined landfill, Portugal (1995-1996).
- Expert testimony on the evaluation of the design of a waste disposal landfill, St. Etienne, Canada (1995-1996).
- Landfill liner system stability evaluation, Huntington, New York (1996).
- Analysis of a very large waste slide in a landfill, Bogota, Colombia (1997-1998).
- Review of the analysis of the failure of a geomembrane liner in two wastewater lagoons, Ridgely, Maryland (1998).
- Performance evaluation of 16 geomembrane-lined evaporation ponds in Salar, Argentina (1998).
- Performance evaluation of geomembrane-lined lagoons for deicing fluid at Dayton airport, Ohio (1999).
- Performance evaluation of a landfill cap geomembrane liner with substandard seams, Clarkstown, New York (1999).
- Performance evaluation of a landfill cover system with defective drainage geocomposite, Buckeye, Ohio (2001).
- Performance evaluation of a geomembrane-lined multicell hazardous waste landfill, Lake Charles, Louisiana (2001).
- Leakage evaluation of silos converted into PVC-lined reservoirs, New York (2005).

## **EXPERT TESTIMONY**

- Preparation of calculations used in a report to the court for the failure of Malpasset Dam, France (1962)
- Expert testimony presented in report to court for the failure of a large sheet-pile retaining structure for a 100 m high building, Grenoble, France (1964-65).
- Expert testimonies presented in reports to court for a dozen landslides in the Alps, France (1970-78).

- Expert testimony presented to court-appointed arbitrator, Avoriaz dam and reservoir, France (1980).
- Expert testimony at administrative hearing and technical assistance to the South Dakota Department of Natural Resources for liner regulation applicable to ore leach pads at St. Joe's mine, South Dakota (1988).
- Expert testimony at administrative hearing for the permitting of a municipal solid waste landfill, Edmonton, Canada (1989).
- Expert testimony at administrative hearings for the permitting of a municipal solid waste landfill in Guaynabo, Puerto Rico (1991).
- Expert testimony at administrative hearing for the permitting of a low-level radioactive waste disposal facility, Martinsville, Illinois (1992).
- Expert testimony at administrative hearing for a geosynthetic drainage system for septic tank effluents in Tallahassee, Florida (1992).
- Expert testimony at administrative hearing for a geomembrane used to line a concrete tank, in Norfolk, Virginia (1993).
- Expert testimony at administrative hearing for geosynthetic drainage system for septic tank effluents in Asheville, North Carolina (1995).
- Expert testimony at administrative hearing for a litigation regarding specifications of geotextiles used in permanent roads, Helsinki, Finland (1995).
- Expert testimony presented in court on the evaluation of the design of a waste disposal landfill, St. Etienne, Canada (1995-1996).
- Expert testimony at administrative hearing for the permitting of municipal solid waste landfill, Salinas, Puerto Rico (1996-1997 and 1999).
- Expert testimony presented in court for geosynthetic drainage system for septic tank effluents in Portland, Oregon (1999).
- Expert testimony at administrative hearing on the performance evaluation of lagoons for deicing fluid at Dayton airport, Ohio (1999).
- Expert testimony at public hearing of California Central Valley Authority on double liner rule, on behalf of Solid Waste Industry Group (SWIG) (2002).

## **RESEARCH PROGRAMS AND MANUAL PREPARATION**

- Design methods for shallow foundations, French Ministry of Industry (1970-1974).
- Guidelines for the selection and installation of geomembranes to line experimental solar ponds, Solar Energy Research Institute, USA (1981).
- Preparation for the Nuclear Regulatory Commission, through Battelle Pacific Northwest Laboratories, of a report on geomembrane liner assessment (1983).
- Review of methods for constructing geotextile-reinforced soil structures as a part of the National Cooperative Highway Research Program (NCHRP), USA (1983-84).
- Preparation of a manual on the use of drainage nets, for a manufacturer, Atlanta, USA (1984).
- Preparation and revision of a quality assurance manual for geomembrane and geotextile installation for a major waste management firm, USA (1984-85).
- Preparation of a manual on design and construction of reinforced soil structures for the Federal Highway Administration (FHWA), USA (1984-89).

- Review of "Geotextiles for Embankment Dams", a design manual for the U.S. Bureau of Reclamation (1989).
- Preparation of a manual on the use of "Geomembranes in Embankment Dams" for the U.S. Bureau of Reclamation (1990).
- Review of Chapter 6 of "Mine Waste Management", a 654 page manual prepared for the California Mining Association (1990).
- Preparation of a manual on geotextile filters for a geotextile manufacturer, Atlanta, USA (1991).
- Preparation of a manual on long-term performance of geomembrane seams for the Electric Power Research Institute (EPRI) (1991-1992).
- Systematic study of the effect of temperature on geomembranes in cooperation with Florida Atlantic University (1991-1992).
- Experimental evaluation of geogrid stress cracking for the Reinforced Earth Company (1992).
- Technical editor of a video-cassette on landfills co-sponsored by ASCE and IGS (1994).
- Preparation of report on geogrid cracking resistance for the Federal Highway Administration (1996-1997).
- Preparation of report on problems associated with liner systems in landfills for the U.S. Environmental Protection Agency (USEPA) (1997-1998).
- Preparation of design manual on geosynthetic clay liners for GSE (2001).
- Preparation of design manual on geocomposite drains for Tenax (in preparation).
- Preparation of design manual for the Geosynthetics Manufacturers Association (GMA) (in preparation).

## **TECHNICAL ASSISTANCE TO REGULATORY AGENCIES**

- Preparation of guide specifications for geomembrane installation in hazardous waste disposal facilities, for the U.S. Environmental Protection Agency (USEPA), USA (1983).
- Preparation of "Assessment of Synthetic Membrane Performance at Waste Disposal Facilities" for the USEPA (1984).
- Participation in meetings with the USEPA for the revision of leachate collection and leakage detection rules to incorporate synthetic drainage layers (1984-1985).
- Demonstration of the equivalency between synthetic drainage layers and conventional granular drains for several landfills (1985-1989).
- Review of "Avoiding Failure of Leachate Collection and Cap Drainage Systems" for the USEPA (1986).
- Review of "Construction Quality Assurance for Hazardous Waste Land Disposal Facilities", a Technical Guidance Document for the USEPA (1986).
- Preparation of "Background Document on Proposed Liner and Leak Detection Rule", for the USEPA (1987).
- Preparation of "Background Document on Bottom Liner performance in Double-Lined Landfills and Surface Impoundments", for the USEPA (1987).

- Expert testimony at public hearings and technical assistance to the South Dakota Department of Natural Resources for liner regulation applicable to ore leach pads at St. Joe's mine, South Dakota (1988).
- Rhode Island Department of Environmental Management (RIDEM), evaluation of Birchwood demolition debris landfill permit application (1988).
- Participation in the Technical Advisory Task Force of the Florida Department of Environmental Regulations for the preparation of new landfill rules (1990-1992).
- Review of "Leakage Detection, Collection, and Removal System Flow Data from Operating Units — Technical Support for Proposed Liner/leak Detection System Rule", for the USEPA (1991).
- Technical assistance for the development of rules on gypsum storage by the Florida Department of Environmental Regulation (FDER) (1991-1992).
- Review of "Action Leakage Rates for Leak Detection Systems, Supplemental Background Document for the Final Double Liners and Leak Detection Systems Rule for Hazardous Waste Landfills, Waste Piles, and Surface Impoundments", for the USEPA (1992).
- Preparation of technical documents in relation to California rules for siting landfills in sand and gravel pits (1992).
- Demonstration of equivalency between prefabricated bentonite panels and clay liners (1992).
- Participation in "Performance Criteria for Landfill Cover", for the California Integrated Waste Management Board (1992-1993).
- Review of Hidden Valley landfill permit application for the Department of Ecology of the State of Washington (1993).
- Review of "Leakage Detection Collection and Removal System Flow from Double-Lined Landfills and Surface Impoundments", a report prepared for the USEPA (1993).
- Participation in the preparation of the national guidelines on geomembrane construction quality assurance for the French environmental regulatory agency, ADEME (1996).
- Assessment of Soil Reinforcement Products and Systems for the Geotechnical Engineering Office of the Government of Hong Kong, 11 reports prepared (1999-2003).
- Memorandum on proposed regulations for liquid impoundments, Pennsylvania Department of Environmental Protection (2003).

## **ASSISTANCE TO GEOSYNTHETIC MANUFACTURERS**

From 1971 to date, assistance to more than 20 manufacturers in Europe, North America, Latin America, South Africa, Australia and Japan:

- Activities included product development, testing program, development of design methods, application design, technical presentations, meetings with potential users, manual preparation, review and evaluation of technical documents and research programs, and market studies (including three major market studies where Dr. Giroud was the principal investigator).

- Products involved included: geosynthetics, such as woven and nonwoven geotextiles, geomembranes manufactured in factory (including smooth and textured geomembranes) as well as made in situ, geogrids, geonets, erosion control geomats, and geocomposites (continuous sheets as well as strips); and other products such as roofing membranes, steel reinforcement, tire chips, and polystyrene drainage geocomposites for drainfields.
- Technical fields involved included: geosynthetic testing interpretation (e.g., puncture of geomembranes, creep of geotextiles and geogrids), filtration, drainage and leachate collection, clogging of geocomposites, geocomposite strip drains, geomembrane protection, impact of textured geomembranes on slope stability, unpaved roads design methods, and reinforced soil walls and slopes.

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