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**Testimony for the Committee on Energy, Utilities, Technology and Communications,  
Minnesota State Senate, in support of maintaining the moratorium on new nuclear reactors**  
Delivered by Lisa Ledwidge, Outreach Director of the Institute for Energy and Environmental Research  
Representing Arjun Makhijani, Ph.D., President of the Institute for Energy and Environmental Research  
March 2, 2010

My name is Lisa Ledwidge. I live in Minneapolis MN. I am the Outreach Director of the Institute for Energy and Environmental Research. IEER is a non-profit technical institute that provides the public and policy-makers with thoughtful, clear, and sound scientific and technical studies on a wide range of issues including energy.

Chair Prettnner-Solon, members of the committee, thank you for the opportunity to speak to you today. I am speaking on behalf of Arjun Makhijani, the president of IEER, who unfortunately could not be here today. He has a distinguished record of doing studies on energy issues and more generally of doing science in the public interest. That record was recognized in 2007, when he was elected a Fellow of the American Physical Society, an honor accorded to at most one-half of one percent of its members. His CV is attached. I prepared this testimony under Dr. Makhijani's guidance. In the event that you have questions that I am not able answer here, Dr. Makhijani and I will provide answers to the committee for the record as soon as possible after this hearing.

We will focus on some of nuclear power's economic and waste considerations that we hope will inform your vote on the bill before you.

**Nuclear power is too expensive and too risky**

In 2007, Jeffrey Immelt, the CEO of General Electric was quoted in the Financial Times:

"If you were a utility CEO and looked at your world today, you would just do gas and wind," Mr Immelt says. "You would say [they are] easier to site, digestible today [and] I **don't have to bet my company on any of this stuff. You would never do nuclear. The economics are overwhelming.**" [Emphasis added]<sup>1</sup>

While General Electric sells all three types of power plants (nuclear, gas turbines, wind), Mr. Immelt was arguing for loan guarantees for nuclear because only nuclear power requires

<sup>1</sup> As quoted in Ed Crooks and Sheila McNulty, "US utilities are sceptical over nuclear energy revival," *Financial Times*, November 19 2007. Accessed February 28, 2010 via [www.ft.com/cms/s/0/8975e03c-9601-11dc-b7ec-0000779fd2ac.html](http://www.ft.com/cms/s/0/8975e03c-9601-11dc-b7ec-0000779fd2ac.html).

betting the whole company and more on the success of a project. It illustrates why Wall Street won't touch nuclear projects with a ten-foot pole. They are, after all, reminders of the sorry history of cost overruns, rate hikes, and bond defaults of the 1980s that led Forbes to call nuclear power "the largest managerial disaster in business history."<sup>2</sup>

The problems that Minnesota could face if it lifts the moratorium and starts down the nuclear road can be illustrated by what is happening right now in places like Florida and San Antonio, Texas.

In Florida, two utilities – Progress Energy and Florida Power and Light (FPL) – have announced nuclear projects of two reactors each. Progress Energy's market capitalization on March 1, 2010 at 1 pm was about \$10.9 billion,<sup>3</sup> which is less than two-thirds of the \$17 billion price tag of the project. This is betting far more than the company. The FPL project, which involves the same reactors but a lower transmission cost estimate, is somewhat better, but even there the company, one of the largest private electric companies in the United States, has a market capitalization of about \$19.5 billion,<sup>4</sup> not much more than the \$14 billion estimated cost of the project, before unforeseen delays and cost escalations, which have been common in the past.

Since Wall Street won't finance the projects, the Florida state legislature has allowed both utilities to collect money in advance from ratepayers for the projects without any promise in return that the projects will be completed or that ratepayers will get any electricity. This is like giving an advance to a builder for a house without any assurance that he will build the house and give you the keys. Florida ratepayers began their revolt almost as soon as the utilities started collecting money for these projects. It increases energy costs for businesses; they must either swallow these increases or, even tougher, pass them on to their customers in the middle of a recession. As a result, even large businesses and industries – in Florida and Georgia – are now beginning to oppose these advance payments, according to an article in *The Washington Post*:

The utilities' gains [advance payments] are the consumers' losses -- and businesses such as the Georgia Industrial Group and the Georgia Textile Manufacturing Association have joined consumer and environmental groups in combating the state laws and higher rates.

In Florida, PCS Phosphate, which has a fertilizer plant that uses about 1 percent of Progress Energy's output, told the Public Service Commission that new rate increases "will substantially affect" the company "by directly increasing the cost of power."<sup>5</sup>

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<sup>2</sup> <http://www.time.com/time/nation/article/0,8599,1888119,00.html>

<sup>3</sup> <http://finance.yahoo.com/q?s=PgN>, viewed at 1:00 pm, March 1, 2010.

<sup>4</sup> <http://finance.yahoo.com/q?s=Fpl>, viewed at 1:05 pm, March 1, 2010.

<sup>5</sup> Steven Mufson, "Nuclear Projects Face New Hurdle," *The Washington Post*, March 2, 2010, on the web at [www.washingtonpost.com/wp-dyn/content/article/2010/03/01/AR2010030103975.html?hpid=topnews](http://www.washingtonpost.com/wp-dyn/content/article/2010/03/01/AR2010030103975.html?hpid=topnews), viewed on March 2, 2010 at 8:33 AM.

Ratepayer anger has resulted in the Florida Public Service Commission denying further rate increases to Progress Energy and FPL, putting both projects in jeopardy. FPL responded by suspending further investment in its nuclear project and now seems to be headed in a direction of relying on renewable electricity sources for company revenue growth.<sup>6</sup> If the Progress Energy project is also abandoned, it is unclear whether ratepayers will get any of their money back – so far \$196.6 million.<sup>7</sup> But the stance of utilities is clear. According to a Progress Energy spokesperson, “[w]ithout this legislation [allowing collection of advance payments from ratepayers], we would not be considering building new nuclear generation in Florida.”<sup>8</sup>

A similar story is unfolding in San Antonio, Texas. There, the municipal utility, CPS Energy, took a 50 percent stake in a two-reactor project, whose cost has already jumped from an initially stated \$5.4 billion in 2007 to \$18.2 billion as of the end of 2009.<sup>9</sup> Such escalations were not hard to foresee. In March 2008, when the company that initiated the project, NRG, put it at \$6 billion to \$7 billion, Dr. Makhijani estimated that the cost would be much higher – \$12 billion to \$17.5 billion, even in the absence of cost escalations and delays. CPS Energy’s share of the project is greatly in excess of the net value of its entire electrical generation, transmission and distribution assets. In the past three years CPS Energy aggressively pursued the nuclear project (on which it has spent about \$370 million of ratepayer money<sup>10</sup>) as well as renewables and it has also tried to complete prior generating projects. The result has been a rate increase and overcapacity. This AAA-rated utility is now in financial difficulties even before a license has been granted. The nuclear cost increases and associated controversies have caused a scandal and the resignation of the Board’s Chair. CPS Energy is now on a course to stop spending any more money on the project and to reduce its share from 50 percent to 7.625 percent. It is far from clear that the project will be completed. It has no loan guarantees as yet. Nuclear tends to marginalize efficiency and renewables – especially since it ties up so much capital for a decade without any revenue inflow.

The San Antonio example illustrates that you pursue all options at your peril. CPS is now increasing rates, and it is saddled with overcapacity even without the nuclear plant.

The so-called “nuclear renaissance” is already fading. We have been here before. After the start of the energy crisis in October 1973, none of the reactors ordered – more than 100 in all – was completed. Demand was overestimated; efficiency and cost were underestimated at great

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<sup>6</sup> Katarzyna Klimasinska, FPL’s Hay Relies on Wind as Rate Case Clouds Utility Outlook, Bloomberg, Feb. 26, 2010, [www.businessweek.com/news/2010-02-26/fpl-s-hay-relies-on-wind-as-rate-case-clouds-utility-outlook.html](http://www.businessweek.com/news/2010-02-26/fpl-s-hay-relies-on-wind-as-rate-case-clouds-utility-outlook.html)

<sup>7</sup> Steven Mufson, “Nuclear Projects Face New Hurdle,” *The Washington Post*, March 2, 2010, on the web at [www.washingtonpost.com/wp-dyn/content/article/2010/03/01/AR2010030103975.html?hpid=topnews](http://www.washingtonpost.com/wp-dyn/content/article/2010/03/01/AR2010030103975.html?hpid=topnews), viewed on March 2, 2010 at 10:27 AM.

<sup>8</sup> As quoted in Steven Mufson, “Nuclear Projects Face New Hurdle,” *The Washington Post*, March 2, 2010.

<sup>9</sup> Tracy Idell Hamilton and Anton Caputo, “Nuclear cost estimate rises by as much as \$4 billion”, San Antonio Express News, October 28, 2009, [www.mysanantonio.com/news/Nuclear\\_cost\\_estimate\\_rises.html](http://www.mysanantonio.com/news/Nuclear_cost_estimate_rises.html)

<sup>10</sup> “San Antonio utility settles over nuke plant expansion,” San Antonio Express-News, Feb. 18, 2010. Accessed Mar. 2, 2010 via [www.chron.com/disp/story.mpl/business/6872806.html](http://www.chron.com/disp/story.mpl/business/6872806.html)

cost to ratepayers, bondholders, and industry, which suffered needlessly higher electricity rates as a result.

A similar situation is evolving now, but more rapidly. The ratio of electricity growth per unit of economic growth is falling so low that electricity growth is fading altogether. Before 1973, the ratio of electricity growth to gross domestic product growth was about 2 to 1; between 1973 and 1993 it was about one to one. From 1993 to 2000, it was about two-thirds to one. In the past decade, before the onset of the present recession in 2008, it was only 0.55 to one. Any serious carbon-restraining legislation that gets passed at the federal level would include stringent building efficiency standards. And buildings account for 70% of electricity demand. For instance, the Waxman-Markey bill passed by the US House would require new residential and commercial buildings to in 20 years be 70% more efficient relative to today. So it is likely that per capita electricity growth will continue this downward trend in relation to growth overall.

In this context, a long-lead time, capital intensive power plant can be ruinous. While wind turbines are capital intensive, they can be built quickly – typically in about two years. If a wind farm is half-complete, you get half the electricity from the completed turbines. If a nuclear power plant is half complete, typically you get nothing but the bills. Even twin reactor projects are phased so that they are completed close on one-another's heels. And while some may proclaim that small, modular reactors could address these issues, this is akin to whistling in the dark. None of these reactors has been certified. Indeed, there isn't even an application for certification.

### **Nuclear waste**

Spent fuel is now being stored in 34 dry-cask storage units at Minnesota's two nuclear power plants, with additional amounts in the reactors' spent fuel pools. It is uncertain when – or if – Minnesota's nuclear waste will leave the state. Yucca Mountain has been de-funded and may never open.

Reprocessing does not solve the problem. Rather, it increases the volume of waste to be disposed of in a repository by about six times, even though the high-level waste volume is somewhat decreased.<sup>11</sup> This counterintuitive result derives from the large increase in plutonium-contaminated waste generated in reprocessing operations and plutonium fuel fabrication that must be disposed of in a deep geologic repository.

Some point to France's nuclear program as one the US should emulate. IEER has studied the French program in detail and we can assure you that it is not free of problems. The French are also struggling in their search for a repository. French reprocessing operations discharge about 100 million gallons of liquid radioactive waste into the English Channel every year which,

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<sup>11</sup> U.S. Department of Energy, Office of Nuclear Energy, Draft Global Nuclear Energy Partnership Programmatic Environmental Impact Statement, GNEP PEIS; DOE/EIS-0396, October 2008.

together with British reprocessing discharges, have contaminated seafood all the way to the Arctic. Twelve European countries have asked the French and British to stop but they refuse. Reprocessing increases nuclear power's costs by about two cents per kilowatt hour above the cost of uranium fuel resulting in nearly \$1 billion *extra* fuel costs each year for reprocessed fuel for less than ten percent reduction in uranium requirements.<sup>12</sup> Overall, even repeated reprocessing and re-enrichment of the recovered uranium would result in only about 6 percent of the uranium in the original fresh fuel from being used for energy generation, of which over 4 percent occurs without any reprocessing at all. Overall, France only reuses about one percent of the original spent fuel as fuel.

There is another consideration about waste that might bear on the decision whether or not to lift the moratorium. In the mid-1980s, before the US Congress designated Yucca Mountain as the site to receive the country's commercial nuclear waste, 31 states were identified by the Dept of Energy as potentially geologically suitable candidates for a second repository site – including eight sites in Minnesota.

It is possible that the results of this search will be used in the future and that, of the 31 previously identified states, the federal government might consider a state that has repealed a nuclear moratorium more favorably compared to, say, Vermont, in which the state senate last week voted decisively to shut down the state's only nuclear plant in 2012.

### **Lessons for Minnesota**

As Peter Bradford points out in his written testimony, nothing presently prevents discussion of nuclear energy in Minnesota. The function of the moratorium is not to prevent debate, which is already occurring, but to protect Minnesota businesses and households from the kinds of problems that have already emerged in other places before a single new nuclear reactor construction and operating license has been granted. Do we want to invite the same kinds of problems as those in Florida here in Minnesota? Xcel Energy has a market capitalization about the same as that of Progress Energy – 9.6 billion dollars as of March 1, 2010.<sup>13</sup> Do we want consuming businesses to be at loggerheads with our electric utilities? Indeed, the problems could be worse, since Minnesota stands no chance of getting federal loan guarantees at present with 26 projects ahead of it.

Minnesota is already a leader in renewable energy and a leader in climate protection. Continuation on this course could create a large number of jobs not only for the in-state energy sector, but for export. The German solar energy industry is an excellent example of the potential. Germany has become a world leader in export of solar photovoltaic technology, even

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<sup>12</sup> Arjun Makhijani, "Carbon-Free and Nuclear-Free: A Roadmap for U.S. Energy Policy," slide presentation for Minnesota Joint Meeting of the Legislative Energy Commission, 24 March 2009, slide 6. Accessed Feb. 23, 2010 at [www.house.leg.state.mn.us/comm/docs/032509ArjunMakhijani.ppt](http://www.house.leg.state.mn.us/comm/docs/032509ArjunMakhijani.ppt)

<sup>13</sup> <http://finance.yahoo.com/q?s=xel>, viewed t 4:03 PM, March 1, 2010.

though its own potential for solar PV is not very good. Indeed, it is emerging as a leader in concentrating solar PV, which requires frequent clear skies, which Germany does not have.

Minnesota loses nothing by keeping the moratorium in place and simply waiting for a few years to see how the so-called “nuclear renaissance,” which consists largely of payments from ratepayers to utilities and a lot of paperwork, plays out elsewhere. And Minnesota will gain a lot by focusing on jobs in efficiency and renewables that are here today. We have these two birds in hand. Please don’t exchange them for one in the bush.

Attached:  
CV for Arjun Makhijani, Ph.D.

## Curriculum Vita of Arjun Makhijani

### ***Address and Phone:***

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A recognized authority on energy issues, Dr. Makhijani is the author and co-author of numerous reports and books on energy and environment related issues, including two published by MIT Press. He was the principal author of the first study of the energy efficiency potential of the US economy published in 1971. He is the author of *Carbon-Free and Nuclear-Free: A Roadmap for U.S. Energy Policy* (2007).

In 2007, he was elected Fellow of the American Physical Society. He was named a Ploughshares Hero, by the Ploughshares Fund (2006); was awarded the Jane Bagley Lehman Award of the Tides Foundation in 2008 and the Josephine Butler Nuclear Free Future Award in 2001; and in 1989 he received The John Bartlow Martin Award for Public Interest Magazine Journalism of the Medill School of Journalism, Northwestern University, with Robert Alvarez. He has many published articles in journals and magazines as varied as *The Bulletin of the Atomic Scientists*, *Environment*, *The Physics of Fluids*, *The Journal of the American Medical Association*, and *The Progressive*, as well as in newspapers, including the *Washington Post*.

Dr. Makhijani has testified before Congress, and has appeared on ABC World News Tonight, the CBS Evening News, CBS 60 Minutes, NPR, CNN, and BBC, among others. He has served as a consultant on energy issues to utilities, including the Tennessee Valley Authority, the Edison Electric Institute, the Lawrence Berkeley Laboratory, and several agencies of the United Nations.

### ***Education:***

- Ph.D. University of California, Berkeley, 1972, from the Department of Electrical Engineering. Area of specialization: plasma physics as applied to controlled nuclear fusion. Dissertation topic: multiple mirror confinement of plasmas. Minor fields of doctoral study: statistics and physics.
- M.S. (Electrical Engineering) Washington State University, Pullman, Washington, 1967. Thesis topic: electromagnetic wave propagation in the ionosphere.
- Bachelor of Engineering (Electrical), University of Bombay, Bombay, India, 1965.

### ***Current Employment:***

- 1987-present: President and Senior Engineer, Institute for Energy and Environmental Research, Takoma Park, Maryland. (part-time in 1987).
- February 3, 2004-present, Associate, SC&A, Inc., one of the principal investigators in the audit of the reconstruction of worker radiation doses under the Energy Employees Occupational Illness Compensation Program Act under contract to the Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

### ***Other Long-term Employment***

- 1984-88: Associate Professor, Capitol College, Laurel, Maryland (part-time in 1988).
- 1983-84: Assistant Professor, Capitol College, Laurel, Maryland.
- 1977-79: Visiting Professor, National Institute of Bank Management, Bombay, India. Principal responsibility: evaluation of the Institute's extensive pilot rural development program.
- 1975-87: Independent consultant (see page 2 for details)
- 1972-74: Project Specialist, Ford Foundation Energy Policy Project. Responsibilities included research and writing on the technical and economic aspects of energy conservation and supply in the U.S.; analysis of Third World rural energy problems; preparation of requests for proposals; evaluation of proposals; and the management of grants made by the Project to other institutions.
- 1969-70: Assistant Electrical Engineer, Kaiser Engineers, Oakland California. Responsibilities included the design and checking of the electrical aspects of mineral industries such as cement plants, and plants for processing mineral ores such as lead and uranium ores. Pioneered the use of the desk-top computer at Kaiser Engineers for performing electrical design calculations.

### ***Professional Societies:***

- Institute of Electrical and Electronics Engineers and its Power Engineering Society
- American Physical Society (Fellow)
- Health Physics Society
- American Association for the Advancement of Science

### ***Awards and Honors:***

- The John Bartlow Martin Award for Public Interest Magazine Journalism of the Medill School of Journalism, Northwestern University, 1989, with Robert Alvarez
- The Josephine Butler Nuclear Free Future Award, 2001
- Ploughshares Hero, Ploughshares Fund, 2006
- Elected a Fellow of the American Physical Society, 2007, "*For his tireless efforts to provide the public with accurate and understandable information on energy and environmental issues*"
- Jane Bagley Lehman Award of the Tides Foundation, 2007/2008



***Invited Faculty Member, Center for Health and the Global Environment, Harvard Medical School:*** Annual Congressional Course, *Environmental Change: The Science and Human Health Impacts*, April 18-19, 2006, Lecture Topic: An Update on Nuclear Power - Is it Safe?

***Consulting Experience, 1975-1987***

Consultant on a wide variety of issues relating to technical and economic analyses of alternative energy sources; electric utility rates and investment planning; energy conservation; analysis of energy use in agriculture; US energy policy; energy policy for the Third World; evaluations of portions of the nuclear fuel cycle.

Partial list of institutions to which I was a consultant in the 1975-87 period:

- Tennessee Valley Authority
- Lower Colorado River Authority
- Federation of Rocky Mountain States
- Environmental Policy Institute
- Lawrence Berkeley Laboratory
- Food and Agriculture Organization of the United Nations
- International Labour Office of the United Nations
- United Nations Environment Programme
- United Nations Center on Transnational Corporations
- The Ford Foundation
- Economic and Social Commission for Asia and the Pacific
- United Nations Development Programme

***Languages:*** English, French, Hindi, Sindhi, and Marathi.

***Reports, Books, and Articles (Partial list)***

(Newsletter, newspaper articles, excerpts from publications reprinted in books and magazines or adapted therein, and other similar publications are not listed below)

Hower, G.L., and A. Makhijani, "Further Comparison of Spread-F and Backscatter Sounder Measurements," *Journal of Geophysical Research*, 74, p. 3723, 1969.

Makhijani, A., and A.J. Lichtenberg, *An Assessment of Energy and Materials Utilization in the U.S.A.*, University of California Electronics Research Laboratory, Berkeley, 1971.

Logan, B. G., A.J. Lichtenberg, M. Lieberman, and A. Makhijani, "Multiple-Mirror Confinement of Plasmas," *Physical Review Letters*, 28, 144, 1972.

Makhijani, A., and A.J. Lichtenberg, "Energy and Well-Being," *Environment*, 14, 10, June 1972.

Makhijani, A., A.J. Lichtenberg, M. Lieberman, and B. Logan, "Plasma Confinement in Multiple Mirror Systems. I. Theory," *Physics of Fluids*, 17, 1291, 1974.

*A Time to Choose: America's Energy Future*, final report of the Ford Foundation Energy Policy Project, Ballinger, Cambridge, 1974. One of many co-authors.

Makhijani, A., and A. Poole, *Energy and Agriculture in the Third World*, Ballinger, Cambridge, 1975.

Makhijani, A., *Energy Policy for the Rural Third World*, International Institute for Environment and Development, London, 1976.

Kahn, E., M. Davidson, A. Makhijani, P. Caeser, and S. Berman, *Investment Planning in the Energy Sector*, Lawrence Berkeley Laboratory, Berkeley, 1976.

Makhijani, A., "Solar Energy for the Rural Third World," *Bulletin of the Atomic Scientists*, May 1977.

Makhijani, A., "Energy Policy for Rural India," *Economic and Political Weekly*, 12, Bombay, 1977.

Makhijani, A., *Some Questions of Method in the Tennessee Valley Authority Rate Study*, Report to the Tennessee Valley Authority, Chattanooga, 1978.

Makhijani, A., *The Economics and Sociology of Alternative Energy Sources*, Economic and Social Commission for Asia and the Pacific, 1979.

Makhijani, A., *Energy Use in the Post-Harvest Component of the Food Systems in Ivory Coast and Nicaragua*, Food and Agriculture Organization of the United Nations, Rome, 1982.

Makhijani, A., *Oil Prices and the Crises of Debt and Unemployment: Methodological and Structural Aspects*, International Labour Office of the United Nations, Final Draft Report, Geneva, April 1983.

Makhijani, A., and D. Albright, *The Irradiation of Personnel at Operation Crossroads*, International Radiation Research and Training Institute, Washington, D.C., 1983.

Makhijani, A., K.M. Tucker, with Appendix by D. White, *Heat, High Water, and Rock Instability at Hanford*, Health and Energy Institute, Washington, D.C., 1985.

Makhijani, A., and J. Kelly, *Target: Japan - The Decision to Bomb Hiroshima and Nagasaki*, July 1985, a report published as a book in Japanese under the title, *Why Japan?*, Kyoikusha, Tokyo, 1985.

Makhijani, A., *Experimental Irradiation of Air Force Personnel During Operation Redwing - 1956*, Environmental Policy Institute, Washington, D.C., 1985.

Makhijani, A., and R.S. Browne, "Restructuring the International Monetary System," *World Policy Journal*, New York, Winter, 1985-86.

Makhijani, A., R. Alvarez, and B. Blackwelder, *Deadly Crop in the Tank Farm: An Assessment of Management of High-Level Radioactive Wastes in the Savannah River Plant Tank Farm*, Environmental Policy Institute, Washington, D.C., 1986.

Makhijani, A., "Relative Wages and Productivity in International Competition," *College Industry Conference Proceedings*, American Society for Engineering Education, Washington, D.C., 1987.

Makhijani, A., *An Assessment of the Energy Recovery Aspect of the Proposed Mass Burn Facility at Preston, Connecticut*, Institute for Energy and Environmental Research, Takoma Park, 1987.

Makhijani, A., R. Alvarez, and B. Blackwelder, *Evading the Deadly Issues: Corporate Mismanagement of America's Nuclear Weapons Production*, Environmental Policy Institute, Washington, D.C., 1987.

Franke, B. and A. Makhijani, *Avoidable Death: A Review of the Selection and Characterization of a Radioactive Waste Repository in West Germany*, Health & Energy Institute, Washington, DC; Institute for Energy and Environmental Research, Takoma Park, November 1987.

Makhijani, A., *Release Estimates of Radioactive and Non-Radioactive Materials to the Environment by the Feed Materials Production Center, 1951-85*, Institute for Energy and Environmental Research, Takoma Park, 1988.

Alvarez, R., and A. Makhijani, "The Hidden Nuclear Legacy," *Technology Review*, 91, 42, 1988.

Makhijani, A., Annie Makhijani, and A. Bickel, *Saving Our Skins: Technical Potential and Policies for the Elimination of Ozone-Depleting Chlorine Compounds*, Environmental Policy Institute and Institute for Energy and Environmental Research, Takoma Park, 1988.

Makhijani, A., Annie Makhijani, and A. Bickel, *Reducing Ozone-Depleting Chlorine and Bromine Accumulations in the Stratosphere: A Critique of the U.S. Environmental Protection Agency's Analysis and Recommendations*, Institute for Energy and Environmental Research and Environmental Policy Institute/Friends of the Earth, Takoma Park, 1989.

Makhijani, A., and B. Franke, *Addendum to Release Estimates of Radioactive and Non-Radioactive Materials to the Environment by the Feed Materials Production Center, 1951-85*, Institute for Energy and Environmental Research, Takoma Park, 1989.

Makhijani, A., *Global Warming and Ozone Depletion: An Action Program for States*, Institute for Energy and Environmental Research, Takoma Park, 1989.

Makhijani, A., *Managing Municipal Solid Wastes in Montgomery County*, Prepared for the Sugarloaf Citizens Association, Institute for Energy and Environmental Research, Takoma Park, 1990.

Saleska, S., and A. Makhijani, *To Reprocess or Not to Reprocess: The Purex Question - A Preliminary Assessment of Alternatives for the Management of N-Reactor Irradiated Fuel at the*

*U.S. Department of Energy's Hanford Nuclear Weapons Production Facility*, Institute for Energy and Environmental Research, Takoma Park, 1990.

Makhijani, A., "Common Security is Far Off," *Bulletin of the Atomic Scientists*, May 1990.

Makhijani, A., *Draft Power in South Asian Agriculture: Analysis of the Problem and Suggestions for Policy*, prepared for the Office of Technology Assessment, Institute for Energy and Environmental Research, Takoma Park, 1990.

Mehta, P.S., S.J. Mehta, A.S. Mehta, and A. Makhijani, "Bhopal Tragedy's Health Effects: A Review of Methyl Isocyanate Toxicity," *JAMA* 264, 2781, December 1990.

Special Commission of International Physicians for the Prevention of Nuclear War and the Institute for Energy and Environmental Research, *Radioactive Heaven and Earth: The Health and Environmental Effects of Nuclear Weapons Testing In, On, and Above the Earth*, Apex Press, New York, 1991. One of many co-authors.

Makhijani, A., and S. Saleska, *High Level Dollars Low-Level Sense: A Critique of Present Policy for the Management of Long-Lived Radioactive Waste and Discussion of an Alternative Approach*, Apex Press, New York, 1992.

Makhijani, A., *From Global Capitalism to Economic Justice: An Inquiry into the Elimination of Systemic Poverty, Violence and Environmental Destruction in the World Economy*, Apex Press, New York, 1992.

Special Commission of International Physicians for the Prevention of Nuclear War and the Institute for Energy and Environmental Research, *Plutonium: Deadly Gold of the Nuclear Age*, International Physicians Press, Cambridge, MA, 1992. One of several co-authors.

Makhijani, A., "Energy Enters Guilty Plea," *Bulletin of the Atomic Scientists*, March/April 1994.

Makhijani, A., "Open the Files," *Bulletin of the Atomic Scientists*, Jan./Feb. 1995.

Makhijani, A., "'Always' the Target?" *Bulletin of the Atomic Scientists*, May/June 1995.

Makhijani, A., and Annie Makhijani, *Fissile Materials in a Glass, Darkly: Technical and Policy Aspects of the Disposition of Plutonium and Highly Enriched Uranium*, IEER Press, Takoma Park, 1995.

Makhijani, A., and K. Gurney, *Mending the Ozone Hole: Science, Technology, and Policy*, MIT Press, Cambridge, MA, 1995.

Makhijani, A., H. Hu, K. Yih, eds., *Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and the Health and Environmental Effects*, MIT Press, Cambridge, MA, 1995.

Zerriffi, H., and A. Makhijani, *The Nuclear Safety Smokescreen: Warhead Safety and Reliability and the Science Based Stockpile Stewardship Program*, Institute for Energy and Environmental Research, Takoma Park, May 1996.

Zerriffi, H., and A. Makhijani, "The Stewardship Smokescreen," *Bulletin of the Atomic Scientists*, September/October 1996.

Makhijani, A., *Energy Efficiency Investments as a Source of Foreign Exchange*, prepared for the International Energy Agency Conference in Chelyabinsk, Russia, 24-26 September 1996.

Makhijani, A., "India's Options," *Bulletin of the Atomic Scientists*, March/April 1997.

Ortmeyer, P. and A. Makhijani, "Worse than We Knew," *Bulletin of the Atomic Scientists*, November/December 1997.

Fioravanti, M., and A. Makhijani, *Containing the Cold War Mess: Restructuring the Environmental Management of the U.S. Nuclear Weapons Complex*, Institute for Energy and Environmental Research, Takoma Park, October 1997.

Principal author of three chapters in Schwartz, S., ed., *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons Since 1940*, Brookings Institution, Washington, D.C., 1998.

Franke, B., and A. Makhijani, *Radiation Exposures in the Vicinity of the Uranium Facility in Apollo, Pennsylvania*, Institute for Energy and Environmental Research, Takoma Park, February 2, 1998.

Fioravanti, M., and A. Makhijani, *Supplement to Containing the Cold War Mess - IEER's Response to the Department of Energy's Review*, Institute for Energy and Environmental Research, Takoma Park, March 1998.

Makhijani, A., "A Legacy Lost," *Bulletin of the Atomic Scientists*, July/August 1998.

Makhijani, A., and Hisham Zerriffi, *Dangerous Thermonuclear Quest: The Potential of Explosive Fusion Research for the Development of Pure Fusion Weapons*, Institute for Energy and Environmental Research, Takoma Park, July 1998.

Makhijani, A., and Scott Saleska, *The Nuclear Power Deception - U.S. Nuclear Mythology from Electricity "Too Cheap to Meter" to "Inherently Safe" Reactors*, Apex Press, New York, 1999.

Makhijani, A., "Stepping Back from the Nuclear Cliff," *The Progressive*, vol. 63, no. 8, August 1999.

Makhijani, A., Bernd Franke, and Hisham Zerriffi, *Preliminary Partial Dose Estimates from the Processing of Nuclear Materials at Three Plants during the 1940s and 1950s*, Institute for Energy and Environmental Research, Takoma Park, September 2000. (Prepared under contract to the newspaper USA Today.)

Makhijani, A., and Bernd Franke, *Final Report of the Institute for Energy and Environmental Research on the Second Clean Air Act Audit of Los Alamos National Laboratory by the Independent Technical Audit Team*, Institute for Energy and Environmental Research, Takoma Park, December 13, 2000.

Makhijani, A., *Plutonium End Game: Managing Global Stocks of Separated Weapons-Usable Commercial and Surplus Nuclear Weapons Plutonium*, Institute for Energy and Environmental Research, Takoma Park, January 2001.

Makhijani, A., Hisham Zerriffi, and Annie Makhijani, "Magical Thinking: Another Go at Transmutation," *Bulletin of the Atomic Scientists*, March/April 2001.

Makhijani, A., *Ecology and Genetics: An Essay on the Nature of Life and the Problem of Genetic Engineering*. New York: Apex Press, 2001.

Makhijani, A., "Burden of Proof," *Bulletin of the Atomic Scientists*, July/August 2001.

Makhijani, A., "Reflections on September 11, 2001," in Kamla Bhasin, Smitu Kothari, and Bindia Thapar, eds., *Voices of Sanity: Reaching Out for Peace*, Lokayan, New Delhi, 2001, pp. 59-64.

Makhijani, A., and Michele Boyd, *Poison in the Vadose Zone: An examination of the threats to the Snake River Plain aquifer from the Idaho National Engineering and Environmental Laboratory*, Institute for Energy and Environmental Research, Takoma Park, October 2001.

Makhijani, A., *Securing the Energy Future of the United States: Securing the Energy Future of the United States: Oil, Nuclear, and Electricity Vulnerabilities and a post-September 11, 2001 Roadmap for Action*, Institute for Energy and Environmental Research, Takoma Park, November 2001.

Makhijani, A., and Sriram Gopal, *Setting Cleanup Standards to Protect Future Generations: The Scientific Basis of Subsistence Farmer Scenario and Its Application to the Estimation of Radionuclide Soil Action Levels (RSALs) for Rocky Flats*, Institute for Energy and Environmental Research, Takoma Park, December 2001.

Makhijani, A., "Some Factors in Assessing the Response to September 11, 2001," *Medicine and Global Survival*, International Physicians for the Prevention of Nuclear War, Cambridge, Mass., February 2002.

Makhijani, Annie, Linda Gunter, and A. Makhijani, *Cogema: Above the Law?: Concerns about the French Parent Company of a U.S. Corporation Set to Process Plutonium in South Carolina*. A report prepared by Institute for Energy and Environmental Research and Safe Energy Communication Council. Takoma Park, MD, May 7, 2002.

Deller, N., A. Makhijani, and J. Burroughs, eds., *Rule of Power or Rule of Law? An Assessment of U.S. Policies and Actions Regarding Security-Related Treaties*, Apex Press, New York, 2003.

Makhijani, A., "Nuclear targeting: The first 60 years," *Bulletin of the Atomic Scientists*, May/June 2003.

Makhijani, A., "Strontium," *Chemical & Engineering News*, September 8, 2003.

Makhijani, A., and Nicole Deller, *NATO and Nuclear Disarmament: An Analysis of the Obligations of the NATO Allies of the United States under the Nuclear Non-Proliferation Treaty and the Comprehensive Test Ban Treaty*, Institute for Energy and Environmental Research, Takoma Park, Maryland, October 2003.

Makhijani, A., *Manifesto for Global Democracy: Two Essays on Imperialism and the Struggle for Freedom*, Apex Press, New York, 2004.

Makhijani, A., "Atomic Myths, Radioactive Realities: Why nuclear power is a poor way to meet energy needs," *Journal of Land, Resources, & Environmental Law*, v. 24, no. 1, 2004, pp. 61-72. Adapted from an oral presentation given on April 18, 2003, at the Eighth Annual Wallace Stegner Center Symposium titled "Nuclear West: Legacy and Future," held at the University of Utah S.J. Quinney College of Law."

Makhijani, A., and Michele Boyd, *Nuclear Dumps by the Riverside: Threats to the Savannah River from Radioactive Contamination at the Savannah River Site*, Institute for Energy and Environmental Research, Takoma Park, Maryland, March 2004.

Makhijani, A., and Brice Smith, *The Role of E.I. du Pont de Nemours and Company (Du Pont) and the General Electric Company in Plutonium Production and the Associated I-131 Emissions from the Hanford Works*, Institute for Energy and Environmental Research, Takoma Park, Maryland, March 30, 2004.

Makhijani, A., Peter Bickel, Aiyou Chen, and Brice Smith, *Cash Crop on the Wind Farm: A New Mexico Case Study of the Cost, Price, and Value of Wind-Generated Electricity*, Institute for Energy and Environmental Research, Takoma Park, Maryland, April 2004.

Makhijani, A., Lois Chalmers, and Brice Smith, *Uranium Enrichment: Just Plain Facts to Fuel an Informed Debate on Nuclear Proliferation and Nuclear Power*, Institute for Energy and Environmental Research, Takoma Park, Maryland, October 15, 2004.

Makhijani, A., and Brice Smith, *Costs and Risks of Management and Disposal of Depleted Uranium from the National Enrichment Facility Proposed to be Built in Lea County New Mexico by LES*, Institute for Energy and Environmental Research, Takoma Park, Maryland, November 24, 2004.

Makhijani, A., project director, *Examen critique du programme de recherche de l'ANDRA pour déterminer l'aptitude du site de Bure au confinement géologique des déchets à haute activité et à vie longue: Rapport final*, prepared for le Comité ocal d'Information et de Suivi; coordinator: Annie Makhijani; authors: Detlef Appel, Jaak Daemen, George Danko, Yuri Dublyansky, Rod Ewing, Gerhard Jentsch, Horst Letz, Arjun Makhijani, Institute for Energy and Environmental Research, Takoma Park, Maryland, December 2004

Institute for Energy and Environmental Research, *Lower Bound for Cesium-137 Releases from the Sodium Burn Pit at the Santa Susana Field Laboratory*, IEER, Takoma Park, Maryland, January 13, 2005. (Authored by A. Makhijani and Brice Smith.)

Institute for Energy and Environmental Research, *Iodine-131 Releases from the July 1959 Accident at the Atomics International Sodium Reactor Experiment*, IEER, Takoma Park, Maryland, January 13, 2005. (Authored by A. Makhijani and Brice Smith.)

Makhijani, A., and Brice Smith. *Update to Costs and Risks of Management and Disposal of Depleted Uranium from the National Enrichment Facility Proposed to be Built in Lea County New Mexico by LES*. Institute for Energy and Environmental Research, Takoma Park, Maryland, July 5, 2005.

Makhijani, A., "A Readiness to Harm: The Health Effects of Nuclear Weapons Complexes," *Arms Control Today*, **35**, July/August 2005.

Makhijani, A., *Bad to the Bone: Analysis of the Federal Maximum Contaminant Levels for Plutonium-239 and Other Alpha-Emitting Transuranic Radionuclides in Drinking Water*, Institute for Energy and Environmental Research, Takoma Park, Maryland, August 2005.

Makhijani, A., and Brice Smith, *Dangerous Discrepancies: Missing Weapons Plutonium in Los Alamos National Laboratory Waste Accounts*, Institute for Energy and Environmental Research, Takoma Park, Maryland, April 21, 2006.

Makhijani, Annie, and A. Makhijani, *Low-Carbon Diet without Nukes in France: An Energy Technology and Policy Case Study on Simultaneous Reduction of Climate Change and Proliferation Risks*, Institute for Energy and Environmental Research, Takoma Park, Maryland, May 4, 2006.

Makhijani, Annie, and A. Makhijani. *Shifting Radioactivity Risks: A Case Study of the K-65 Silos and Silo 3 Remediation and Waste Management at the Fernald Nuclear Weapons Site*, Institute for Energy and Environmental Research, Takoma Park, Maryland, August 2006.

Smith, Brice, and A. Makhijani, "Nuclear is Not the Way," *Wilson Quarterly*, v.30, p. 64, Autumn 2006.

Makhijani, A., Brice Smith, and Michael C. Thorne, *Science for the Vulnerable: Setting Radiation and Multiple Exposure Environmental Health Standards to Protect Those Most at Risk*, Institute for Energy and Environmental Research, Takoma Park, Maryland, October 19, 2006.

Makhijani, A., *Carbon-Free and Nuclear Free: A Roadmap for U.S. Energy Policy*, IEER Press, Takoma Park, Maryland; RDR Books, Muskegon, Michigan, 2007.

Makhijani, A., *Assessing Nuclear Plant Capital Costs for the Two Proposed NRG Reactors at the South Texas Project Site*, Institute for Energy and Environmental Research, Takoma Park, Maryland, March 24, 2008.



Makhijani, A., *Energy Efficiency Potential: San Antonio's Bright Energy Future*, Institute for Energy and Environmental Research, Takoma Park, Maryland, October 9, 2008.

Makhijani, A., *The Use of Reference Man in Radiation Protection Standards and Guidance with Recommendations for Change*, Institute for Energy and Environmental Research, Takoma Park, Maryland, December 2008.

Makhijani, A., *Comments of the Institute for Energy and Environmental Research on the U.S. Nuclear Regulatory Commission's Proposed Waste Confidence Rule Update and Proposed Rule Regarding Environmental Impacts of Temporary Spent Fuel Storage*, Institute for Energy and Environmental Research, Takoma Park, Maryland, February 6, 2009.

Makhijani, A., *Technical and Economic Feasibility of a Carbon-Free and Nuclear-Free Energy System in the United States*, Institute for Energy and Environmental Research, Takoma Park, Maryland, March 4, 2009.

Fundación Ideas para el Progreso, *A New Energy Model For Spain: Recommendations for a Sustainable Future* (originally: *Un nuevo modelo energético para España: Recomendaciones para un futuro sostenible*), by the Working Group of Foundation Ideas for Progress on Energy and Climate Change, Fundación Ideas , Madrid, May 20, 2009. Arjun Makhijani contributed Section 2.2. The cost of nuclear energy and the problem of waste.

Makhijani, A., *IEER Comments on the Nuclear Regulatory Commission's Rulemaking Regarding the "Safe Disposal of Unique Waste Streams Including Significant Quantities of Depleted Uranium,"* Institute for Energy and Environmental Research, Takoma Park, Maryland, October 30, 2009.

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