UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	**Docket Nos. 52-025 and 52-026**
Southern Nuclear Operating Company, Inc.	)	
	)	
(COL Application for Vogtle Electric Generating Plant, Units 3 and 4)	)	**March 4, 2010**

JOINT DECLARATION OF ARJUN MAKHIJANI AND DIANE D'ARRIGO IN SUPPORT OF INTERVENORS' OPPOSITION TO MOTION FOR SUMMARY DISPOSITION OF CONTENTION SAFETY-1

Under penalty of perjury, Arjun Makhijani and Diane D'Arrigo do hereby state as follows:

Statement of Qualifications

1. (Makhijani only) My name is Arjun Makhijani. I am employed by the Institute for Energy and Environmental Research (IEER) as President and Senior Engineer. My business address is 6935 Laurel Avenue, Suite 201, Takoma Park, MD 20912. I hold a Ph.D. in Engineering from the University of California at Berkeley, where I specialized in the application of plasma physics to controlled nuclear fusion. I have over 25 years of experience in the technical, policy and economic issues relating to radioactive waste storage and disposal, including low level radioactive waste (LLRW). I have authored and co-authored articles, reports, and books on the subject of radioactive waste disposal. I have testified as an expert on nuclear waste issues before the Nuclear Regulatory Commission (NRC). A copy of my *curriculum vitae* is attached as Exhibit 1.

2. (D'Arrigo only) My name is Diane D'Arrigo. I am employed by Nuclear Information and Resource Service as Radioactive Waste Project Director. My business address is 6930 Carroll Ave., Takoma Park, Maryland 20912. I have over 25 years of experience in the technical, policy and economic issues relating to LLRW storage and disposal. I have spoken publicly and published articles on these topics. I have testified as an expert on nuclear waste issues before the NRC. A copy of my *curriculum vitae* is attached as Exhibit 2.

Purpose of Declaration

3. The purpose of our declaration is to provide factual support for Joint Intervenors' opposition to Southern Nuclear Company's (SNC's) motion for summary disposition of

Contention Safety-1 regarding SNC's inadequate provisions for onsite storage of so-called "low-level" radioactive waste (LLRW).

Operational Status of LLRW Disposal Sites in the United States

4. Currently, there are only two operating commercial facilities that dispose of Classes A, B, and C LLRW: US Ecology at Hanford, near Richland, Washington; and EnergySolutions in Barnwell, South Carolina. EnergySolutions in Clive, Utah, is licensed to dispose of Class A waste and cannot take Class B or C. The Richland and Barnwell facilities can take LLRW only from the Northwest, Rocky Mountain, and Atlantic compacts. WCS has a license to store a limited amount of waste (see below) but can dispose of waste only from the Texas-Vermont compact when its license is approved and it overcomes other outstanding hurdles (see below).

Limitations on the Disposal Capacity of WCS

5. WCS holds a license (License R04100) which permits it to dispose of LLRW generated inside the Texas-Vermont LLRW Disposal Compact. The facility is not authorized to accept LLRW from outside the two states that comprise the Compact. The Texas-Vermont Compact Commission is currently considering whether to adopt rules that could allow the importation of additional LLRW from outside the Compact. Proposed Rule for 31 TAC §§ 675.21-675.23, published at 35 Tex. Reg. 1028 on February 12, 2010.

6. WCS is not currently disposing of commercial LLRW, because License R04100 has several conditions which remain unfulfilled. According to the regulator, the Texas Commission on Environmental Quality (TCEQ), "[c]onstruction may not begin until several preconstruction license conditions are completed and approved by the executive director. Once approved construction is complete, additional conditions of the license must be met prior to commencement of disposal."[1]

7. Several pending lawsuits create uncertainty about when and under what terms the WCS facility may open for disposal of LLRW. *See Sierra Club v. Texas Commission on Environmental Quality,* No. D-1-GN-09-000660 (250th Dist. Ct., Travis County, Texas. March 2, 2009); Sierra Club v. Texas Commission on Environmental Quality, No. D-1-GN-09-000894 (98th Dist. Ct., Travis County, Texas. March 19, 2009); Sierra Club v. Texas Commission on Environmental Quality, No. D-1-GN-09-003492 (200th Dist. Ct., Travis County, Texas. October 9, 2009); Sierra Club v. Texas Commission on Environmental Quality, No. D-1-GN-09-004020 (261st Dist. Ct., Travis County, Texas. November 24, 2009). An Andrews County election for the issuance of a bond to build the WCS facility is also under legal challenge. *Pryor vs Dolgener, County Judge of Andrews County*, No. 08-09-00284 CV, on appeal to the Texas 8th Court of Appeals from the 109th Judicial District of Andrews County Texas, Cause No. 17,988.

Limitations on Storage Capacity of WCS

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[1] From TCEQ website: Waste Control Specialists LLC License Application for Low-Level Radioactive Waste Disposal, Current Status of this Application http://www.tceq.state.tx.us/permitting/radmat/licensing/wcs_license_app.html#wcs_status

8. WCS also holds a license for the processing and storage of LLRW (License R04971). The License was due to expire 2004, but it is still in effect because of WCS' timely application for renewal. WCS' renewal application currently is under review by the TCEQ.

9. Even if License R04971 for storage is renewed with the present terms, there are limitations to the quantity of LLRW that can be stored by WCS and the duration for which it can be stored.

10. For instance, paragraph 23.B of the License requires that within 365 days of arrival at WCS, all LLRW must be placed in interim storage or transferred to an authorized recipient.

11. Paragraphs 7A and 7C of the License also limit LLRW storage at WCS to 2,255,000 curies. Given that WCS is the only offsite facility available for storage of Class B and C waste, that radioactivity limit could be exceeded in just a few years by Class B and C waste that is being generated by facilities without access to disposal. We believe that the storage capacity at WCS could be exceeded well before Vogtle Units 3 and 4 begin operation.

12. The operators of Vogtle will not be the only ones to need storage for Class B and C LLRW. While the Clive, Utah, site can accept Class A LLRW from across the country, only the generators in the Northwest, Rocky Mountain and Atlantic Compacts (which have access to the Richland and Barnwell facilities for LLRW disposal) currently have a disposal path for Class B and C waste. If we assume that a license will be granted to WCS for commercial waste disposal and that WCS will be meet all the other conditions and overcome all legal challenges – which is by no means assured – then Texas and Vermont Class B and C waste will also have a disposal path. The remaining states will be in a situation where sending Class B and C waste to storage will become an increasingly problematic. Hence the viability of the applicant's proposal to store waste at WCS must be analyzed in the context of all Class B and C generators in all states outside of the ones with a disposal path. We call these no-disposal-path states for convenience in the rest of this declaration.

13. We looked at the amounts of Class B and C LLRW sent for disposal from nuclear generators in the no-disposal-path states. We used past data as posted on the DOE's Manifest Information Management System (MIMS) website, which allows computation of data for specific sites, volumes and radioactivity as well as specific compacts. All sites except Barnwell have been closed to the no-disposal-path states in recent years. On July 1, 2008, the Barnwell site was closed to these states as well. The total amount of Class B and C waste disposed of at Barnwell by these states over an eight-year period ending on June 30, 2008 was about 4.6 million curies, or about 580,000 curies per year. About 95 percent of this radioactivity came from utilities (spreadsheets attached). At this rate, even if there were no other generators, the storage capacity of the WCS site would run out in just under four years. If at least some of the recently submitted license applications are approved and result in new operating reactors, the storage capacity would run out sooner, in the absence of a disposal site for the no-disposal-path states.

14. Based on the facts and available data, we conclude that the assumption that offsite storage space will be available for the new reactors for the license period or anything close to it at WCS is unwarranted.

Limitations on the Storage Capacity of Studsvik

15. Studsvik holds Material License R-86011-E17 for the processing of LLRW. The Studsvik License contains provisions that rule out the use of that site for long-term storage. Specifically, Paragraph 17 of the License limits the duration of the storage period to 365 days. Paragraph 24 requires that Studsvik "establish in every contractual obligation relating to radioactive materials the ability to return the radioactive materials, processed or unprocessed, to the prior licensed or exempt processor." Thus even if Studsvik takes title to the LLRW, it has the right to send it back to the generator and, in any event, may not keep it for more than a year. In view of these limitations, Studsvik is not a plausible option for storage of accumulating Class B and C wastes for existing or new reactors.

Delays and Limitations on LLRW Disposal Capacity

16. In FSAR Section 11.4.2.4.3, SNC claims that it has the capacity to store Vogtle Units 3 and 4's LLRW onsite for a year. But one year is not nearly a sufficient period of time to accommodate the potential delay in the availability of offsite LLRW disposal capacity. Currently, there is no LLRW disposal facility that can accept Class B and C radioactive waste from Plant Vogtle. WCS disposal is not an option that SNC can rely on because WCS is not accepting LLRW from any state at this time and because under its current disposal license it cannot accept LLRW from outside the Texas-Vermont Compact.

17. Even if WCS begins disposing of LLRW and even if it receives permission to accept LLRW from outside the Texas-Vermont Compact, it cannot be relied on for disposal of LLRW beyond the immediate future due to its limited capacity.

18. The licensed disposal capacity of the WCS commercial facility is 2.31 million cubic feet. The Compact States (Texas and Vermont) have estimated their combined need for LLRW disposal under the Compact at 6 million cubic feet: 5 million for Texas and one million for Vermont. Adopted Rules, 34 Tex. Reg. 6341 (September 11, 2009); Vermont Health and Safety Code Chapter 403, Sec. 3.04 (11).[2] The total needed storage capacity of 6,000,000 cubic feet, as estimated by the Compact States, exceeds currently licensed capacity under the Compact. Therefore, the WCS facility does not have the capacity to dispose of LLRW generated at Plant Vogtle Units 3 and 4 or at any reactor outside the Texas-Vermont Compact. While WCS could in theory apply for a license modification to allow for more waste disposal, basing a disposal strategy on such an assumption for an-out-of-compact state would be speculative at best, since WCS does not even have an operating license for disposal for a much smaller amount of commercial LLRW within the Texas-Vermont Compact.

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[2] The Vermont Code states: "The shipments of low-level radioactive waste from all nonhost party states shall not exceed 20 percent of the volume estimated to be disposed of by the host state during the 50-years period." The Proposed Volume Rule states: "Vermont indicated that its needs would probably meet or exceed 1,000,000 cubic feet of capacity based on observed experiences during decommissioning of the Maine Yankee generating facility. There are similar decommissioning requirements in Vermont that indicate the volume could be similar to that generated in the Maine decommissioning process." 34 Tex. Reg. 4279.

19. Because of the longevity of much of the radioactivity of LLRW and the history of problems at closed LLRW disposal sites, new facilities have been and will continue to be extremely difficult, time-consuming, and expensive. Since the 1980 passage of the Low Level Radioactive Waste Policy Act passed, there have been many siting efforts that have yielded no new full service facilities. According to a 1999 GAO Report: "[s]tates acting alone or within Compacts of two or more, have collectively spent $600 million over the last 18 years attempting to find and develop about 10 sites for disposing of commercially generated low-level radioactive wastes." Yet, states' efforts to license new facilities "have come to a standstill." GAO/RCED-99-238 *Low-Level Radioactive Wastes: States Are Not Developing Disposal Facilities,* page 26.

Storage Onsite

20 There is no offsite disposal available for SNC at present and none is on the horizon. The above analysis shows that SNC does not have a reasonably assured path for long-term offsite storage. This leaves long-term onsite storage as the only remaining option.

21. SNC proposed to construct additional storage capacity onsite in the event that no offsite option is available. Normally, onsite storage capacity for LLRW is very limited since the waste is periodically sent off for disposal. All reactors, including the AP1000 have provision for such limited storage. In this case, SNC is planning to construct an additional outdoor storage site that could accommodate accumulating wastes from many years and even decades of operation.

22. Outdoor storage of large amounts of waste representing years and decades of accumulation has been carried out at Department of Energy (DOE) sites, but not at reactor sites. The experience of such outdoor storage has often been poor. The photographs below (Figures 1 and 2) show corroded drums as well as the repackaging that has been necessary at DOE sites as a direct result of outdoor storage. The figures are from two different sites. Such handling and repackaging can create additional worker exposures. While SNC may claim that its approach will have greater integrity, it has provided no radiological data to show that is proposed storage approach will be safe, or that it would last for decades without corrosion or other problems that could result in exposures.

"Figure 1: Empty drums used for storing waste await treatment and disposal at Oak Ridge. These drums corroded prematurely when a 1987 waste-stabilization project failed to follow guidelines for combining waste sludge with cement. *K-1417 Drum Storage Yards, Pond Waste Management Project, Oak Ridge, Tennessee. January 10, 1994"*
Source: U.S. Department of Energy. *Closing the Circle on the Splitting of the Atom: The Environmental Legacy of Nuclear Weapons Production in the United States and What the Department of Energy is Doing About It*. DOE/EM-0266. Washington, D.C.: DOE Office of Environmental Management, Office of Strategic Planning and Analysis, January 1995. Links on the Web at http://ndep.nv.gov/lts/close/circle.htm, p. 6. Hereafter DOE 1995.

"Figure 2: A Fernald worker overpacks rusting 55-gallon drums of low-level mixed waste by sealing them inside larger new 85-gallon drums. Some 50,000 deteriorating drums of Fernald waste stored outdoors for many years are being overpacked in a project that began in the late 1980s. *Plant 5, formerly the Metals Production Plant, Fernald Environmental Management Project, Fernald, Ohio. December 28, 1993."*
Source: DOE 1995, op cit, p. 53.

23. Storage of Class B and C waste generated over decades at a reactor site is without precedent, as is storage of such wastes in an outdoor facility that would be needed once the short-term storage building runs out of room. Experience elsewhere of outdoor storage has often been poor. We do not claim that SNC will necessarily repeat this unfortunate experience. But in view of the unprecedented nature of the storage that is proposed and the fact that it is would be outdoor storage, it is essential that SNC provide the design of the storage facility as part of the COLA and demonstrate its safety and long-term integrity as part of the COLA process.

Estimated Volume of LLRW Generated by Vogtle Units 3 and 4

24. In Section 11.4.2.4.3, SNC predicts that all Class B and C waste will be wet. The statement is contradicted by § 11.4.1.3 of the AP1000 DCD, which asserts that "[t]he expected disposal volumes of wet and dry wastes are approximately 547 and 1417 cubic feet per year, respectively. . . ." During reactor operations, components, parts, piping, hardware can require replacement. Activated metal components and parts – which do not constitute "wet" LLRW -- would be expected to comprise some portion of the Class B and/or C wastes during operations and certainly as part of decommissioning. For instance, a PWR's lower support columns and upper core grid plate will be Class C LLRW upon decommissioning and the upper core barrel, miscellaneous internals and lower core forging will be Class B waste. Resnikoff, *Living Without Landfills*" A Special Report by the Radioactive Waste Campaign at 48 (1987).

We declare that the foregoing facts are true and correct to the best of our knowledge and that the statements of opinion are based on our best professional judgment.

Diane D'Arrigo — March 4, 2010

Arjun Makhijani — March 4, 2010

Spreadsheets

Source:
http://mims.apps.em.doe.gov/Report_WasteClass_GenCat.asp

Barnwell disposal, non-disposal path states, July 1, 1999 to June 30, 2008

Disposal Site	Year Received	Generator Class	Total Volume (ft3)	Total Activity (curies)	Class A Volume (ft3)	Class A Activity (curies)	Class B Volume (ft3)	Class B Activity (curies)	Class C Volume (ft3)	Class C Activity (curies)
Barnwell	1999	Academic	947.16	9.72	890.42	3.19	28.01	4.99	28.73	1.53
Barnwell	1999	Government	6,506.07	5,370.60	6,104.01	85.83	104.78	4,248.52	297.28	1,036.26
Barnwell	1999	Industry	6,000.99	477.62	4,001.39	54.04	1,733.75	279.33	265.85	144.25
Barnwell	1999	Medical	293.15	3.02	280.19	0.63	0	0	12.96	2.39
Barnwell	1999	Utility	58,705.02	153,652.40	47,744.24	8,345.06	7,324.13	7,088.29	3,636.65	138,219.05
Barnwell	2000	Academic	1,859.45	42.32	1,804.30	33.5	0	0	55.15	8.83
Barnwell	2000	Government	7,733.88	253.64	7,391.79	40.28	70.3	119.65	271.79	93.71
Barnwell	2000	Industry	12,439.93	31,244.25	8,444.05	140.69	3,004.41	30,721.67	991.47	381.89
Barnwell	2000	Medical	195.8	4.88	159.23	0.36	0.68	0	35.89	4.51
Barnwell	2000	Utility	75,215.80	565,228.29	56,380.03	11,028.32	11,653.22	18,067.77	7,182.55	536,132.20
Barnwell	2001	Academic	1,175.54	295.38	1,107.55	11.13	9.6	270.67	58.39	13.59
Barnwell	2001	Government	7,250.36	918.38	6,860.61	94.73	276	148.42	113.75	675.23
Barnwell	2001	Industry	4,794.29	2,267.38	3,290.29	75.25	222.55	1,039.80	1,281.45	1,152.33
Barnwell	2001	Medical	167.33	3.27	143.09	0.35	0.68	0	23.56	2.92
Barnwell	2001	Utility	68,301.55	396,440.05	48,646.36	4,866.74	12,547.89	13,395.40	7,107.30	378,177.91
Barnwell	2002	Academic	758.58	311.04	515.72	16.32	47.5	211.82	195.36	82.9
Barnwell	2002	Government	8,203.53	560.8	7,450.53	105.62	390	245.06	363	210.11
Barnwell	2002	Industry	2,909.69	4,059.78	1,745.49	35.44	266.17	700.43	898.03	3,323.91
Barnwell	2002	Medical	73.79	1.85	50.55	0.08	0	0	23.24	1.76
Barnwell	2002	Utility	24,459.03	112,299.99	11,572.84	3,497.64	7,013.25	9,750.77	5,872.94	99,051.58
Barnwell	2003	Academic	187.6	2.73	110.8	0.67	0.7	0	76.1	2.06
Barnwell	2003	Government	5,088.69	88,050.09	4,791.57	71.25	231.4	87,974.14	65.72	4.7
Barnwell	2003	Industry	1,623.81	25,520.53	971.37	87.94	153	25,179.22	499.44	253.37
Barnwell	2003	Medical	77.44	14.45	27.5	0.07	0	0	49.94	14.38
Barnwell	2003	Utility	48,327.10	473,547.69	19,839.45	2,870.23	9,482.62	14,108.95	19,005.03	456,568.51
Barnwell	2004	Academic	71.08	7.74	32.62	0.18	0	0	38.46	7.56
Barnwell	2004	Government	7,194.55	10,753.49	5,641.94	36.22	655.81	45.54	896.8	10,671.73
Barnwell	2004	Industry	1,026.45	847.4	521.38	0.8	138.7	275.33	366.37	571.27
Barnwell	2004	Medical	24.68	6.61	1.36	0	0	0	23.32	6.61

Barnwell	2004	Utility	25,773.88	282,922.80	8,853.65	2,928.72	11,124.14	17,104.12	5,796.09	262,889.97
Barnwell	2005	Academic	55.54	16.36	4.17	0	0	0	51.37	16.36
Barnwell	2005	Government	5,474.60	66.4	5,396.87	49.27	38.2	13.42	39.53	3.72
Barnwell	2005	Industry	880.11	23,995.31	230.24	3	275.04	23,089.53	374.83	902.77
Barnwell	2005	Medical	58.51	5.89	16.74	0.03	17	0.05	24.77	5.8
Barnwell	2005	Utility	24,458.96	431,096.35	11,847.93	3,620.21	7,080.84	12,390.52	5,530.19	415,085.62
Barnwell	2006	Academic	197.7	956.87	8.78	0.01	18.7	155.11	170.22	801.75
Barnwell	2006	Government	6,145.02	204	6,011.51	134.31	61.2	45.44	72.31	24.25
Barnwell	2006	Industry	778.52	1,464.88	476.84	0.61	69.13	67.44	232.55	1,396.82
Barnwell	2006	Medical	15.07	4.96	0.14	0	0.68	0	14.25	4.96
Barnwell	2006	Utility	20,440.20	293,659.97	5,615.39	2,395.56	8,068.32	8,730.79	6,756.49	282,533.62
Barnwell	2007	Academic	28.3	2.15	1.36	0	0	0	26.94	2.15
Barnwell	2007	Government	4,722.53	138.44	4,613.25	88.38	87.8	40.67	21.48	9.39
Barnwell	2007	Industry	506.53	12,147.22	37.17	0.86	178.12	10,632.72	291.24	1,513.64
Barnwell	2007	Medical	41.77	33.73	0	0	7.5	23.5	34.27	10.23
Barnwell	2007	Utility	25,294.78	1,028,993.14	4,052.27	1,642.57	9,078.29	11,453.85	12,164.22	1,015,896.72
Barnwell	2008	Academic	59.02	281.91	0	0	0	0	59.02	281.91
Barnwell	2008	Government	2,476.70	381.19	2,269.08	54.09	28	14.7	179.62	312.4
Barnwell	2008	Industry	645.64	13,709.47	8.28	0.6	243.96	11,303.54	393.4	2,405.32
Barnwell	2008	Medical	68.86	24.7	0	0	0	0	68.86	24.7
Barnwell	2008	Utility	13,402.29	723,493.36	1,839.62	1,323.14	4,064.34	6,562.37	7,498.33	715,607.85
		Total:	483,136.87	4,685,794.49	297,803.96	43,743.94	95,796.41	315,503.54	89,536.50	4,326,547.01

Barnwell disposal, non-disposal path states, July 1, 1999 to June 30, 2008 for utilities only

Disposal Site	Year Received	Generator Class	Total Volume (ft3)	Total Activity (curies)	Class A Volume (ft3)	Class A Activity (curies)	Class B Volume (ft3)	Class B Activity (curies)	Class C Volume (ft3)	Class C Activity (curies)
Barnwell	1999	Utility	58,705.02	153,652.40	47,744.24	8,345.06	7,324.13	7,088.29	3,636.65	138,219.05
Barnwell	2000	Utility	75,215.80	565,228.29	56,380.03	11,028.32	11,653.22	18,067.77	7,182.55	536,132.20
Barnwell	2001	Utility	68,301.55	396,440.05	48,646.36	4,866.74	12,547.89	13,395.40	7,107.30	378,177.91
Barnwell	2002	Utility	24,459.03	112,299.99	11,572.84	3,497.64	7,013.25	9,750.77	5,872.94	99,051.58
Barnwell	2003	Utility	48,327.10	473,547.69	19,839.45	2,870.23	9,482.62	14,108.95	19,005.03	456,568.51
Barnwell	2004	Utility	25,773.88	282,922.80	8,853.65	2,928.72	11,124.14	17,104.12	5,796.09	262,889.97
Barnwell	2005	Utility	24,458.96	431,096.35	11,847.93	3,620.21	7,080.84	12,390.52	5,530.19	415,085.62
Barnwell	2006	Utility	20,440.20	293,659.97	5,615.39	2,395.56	8,068.32	8,730.79	6,756.49	282,533.62
Barnwell	2007	Utility	25,294.78	1,028,993.14	4,052.27	1,642.57	9,078.29	11,453.85	12,164.22	1,015,896.72
Barnwell	2008	Utility	13,402.29	723,493.36	1,839.62	1,323.14	4,064.34	6,562.37	7,498.33	715,607.85
		Total:	384,378.61	4,461,334.04	216,391.78	42,518.19	87,437.04	118,652.83	80,549.79	4,300,163.03

Exhibit 1 – Arjun Makhijani's *curriculum vitae*

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Curriculum Vita of Arjun Makhijani

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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)

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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.

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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.

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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.

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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.

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CV updated January 15, 2010

Exhibit 2 – Diane D'Arrigo's *curriculum vitae*

Diane D'Arrigo
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1988- Present RADIOACTIVE WASTE PROJECT DIRECTOR, Nuclear Information and Resource Service, Washington, D.C.
1986-1988 REGULATORY OVERSIGHT COORDINATOR, Nuclear Information and Resource Service, Washington, D.C.

Track, analyze and report on federal agencies' and Congressional policies, rulemaking and proposals regarding radioactive waste, radiation and nuclear energy issues. Coordinate national and support local initiatives and responses regarding radioactive waste. Publicize federal and international programs that increase public risk and exposure to radioactive waste and radioactivity.

Provide information and assistance to concerned community groups and individuals, local and state officials involved in siting of disposal facilities for nuclear waste including so-called "low-level" radioactive waste.

Track national, international and state efforts to deregulate/prevent deregulation of radioactive waste to destinations not controlled for radioactivity. Track reactor specific rule changes, amendments, rulemaking.

1985-1986 ANALYTICAL CHEMIST, Ecology and Environment, Cheektowaga, NY

1984-1985 CHEMICAL RESEARCH ASSISTANT, Great Lakes Laboratory, Buffalo, NY
Chemical research on toxic and carcinogenic compounds.

1982-1984 RESEARCH ASSOCIATE, Sierra Club Radioactive Waste Campaign, Buffalo, NY
Prepared and presented scientific testimony before federal, state, county and local legislatures and agencies. Commented on proposed rules. Researched, wrote and edited educational materials including fact sheets, brochures, slide shows, and research papers for the public on complicated technical issues. Conducted community outreach programs. Organized regional and local workshops.

1981-1982 CHEMIST, FMC, Inc. Research and Development, Middleport, NY
Research, analysis and synthesis of chemicals to be tested for biological activity. Regularly used IR, NMR, UV, TLC, HPLC and GC for identification and quantification.

1980 COMMUNITY ORGANIZER, Citizens Alliance, Massapequa Park, NY
Trained community residents in building and maintaining an active chapter of the statewide Citizens Alliance, focussing on energy, toxics and housing issues.

1979-1980 FIELD SUPERVISOR, CANVASSER, New York Public Interest Research Group, Buffalo, NY

EDUCATION AND SPECIAL STUDY

1978 B.S. Chemistry, Course Concentration in Environmental Studies. William Smith College, Geneva, NY
1981 Environmental Law Course, University of NY at Buffalo.