Union of Concerned Scientists

Citizens and Scientists for Environmental Solutions

September 19, 2008

California Energy Commission
Dockets Office, MS-4
Re: Docket No. 07-AB-1632 and 08-IEP-1F
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512

SUBJECT: AB 1632 Assessment

Good Day:

On behalf of the Union of Concerned Scientists, I have read the draft consultant report, *AB 1632 Assessment of California's Operating Nuclear Plants*, and submit the attached comments. A prior commitment prevents me from participating in the public workshop scheduled for September 25, 2008, even by telephone.

To emphasis the our first comment, AB 1632 and the study it produced are invaluable pro-active measures that serve the people of California, including the many members of the Union of Concerned Scientists, very well.

Sincerely,

David Lochbaum
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Washington Office

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Comments by the Union of Concerned Scientists on the *AB 1632 Assessment of California's Operating Nuclear Plants* Draft Report

Section	Comment
Overall	AB 1632, the reason for this study, is an invaluable pro-active measure that serves the people of California, including the many members of the Union of Concerned Scientists, very well.
Overall	It is apparent from a review of the draft report that a capable team was assembled and sought to address the issues tasked in AB 1632 in as unbiased and thorough way as possible. The draft report reflects commendably on the team's efforts. The draft report presents results from technical assessments, but does a fine job of presenting this information in a reader-friendly way. UCS points out that the comments we provide below should not be construed as criticisms of the team and its efforts. Our comments are provided with the intention of reinforcing and enhancing their results.
p. 10, header	The header of this and every text page states "Preliminary Draft – Not to Be Cited." UCS intentionally violates this instruction in order to provide meaningful comments on the study. We were unable to figure out how to comment on the draft report without citing it and citing the specific parts of the draft report's contents.
p. 10, Executive Summary, 2nd paragraph	The recommendation is made that "*California needs a long-term plan to prevent major disruptions and to be ready should a disruption occur.*" This recommendation is valid. More than two dozen nuclear power reactors have permanently shut down in the United States. In each case, the shut down occurred prior to the end of the operating license period. In the vast majority of the cases, the shut downs occurred unexpectedly. In addition, more than three dozen nuclear power reactors have experienced year-plus outages. Thus, it seems more of a question of when than if the need for this long-term plan occurs.
p. 16, Vulnerability of Power Plant Buildings and Structures, 3rd paragraph and p. 109, Table 3	The valid point is made that the non-safety-related electrical switchyard is vulnerable to damage during an earthquake. Another key system not as well protected from seismic damage as safety-related systems is the fire protection system. This vulnerability is as significant as that from the electrical switchyard. Consideration should be given to also including the fire protection vulnerability during seismic events to the text and to Table 3.
p. 19, Plant Aging and Reliability Assessment, Bullet 1	A companion point to the point made about the need to adequately monitor, maintain and repair aging plant components is the need to ensure replacement parts have equivalent fit, form, and function. For example, the Nuclear Regulatory Commission reported in Information Notice 2006-04 (available online at http://www.nrc.gov/reading-rm/doc-collections/gen-comm/info-notices/2006/in200604.pdf) that the owners of Palo Verde and Waterford nuclear plants replaced the aging heater elements in their pressurizers only to experience failures that necessitated unplanned outages to replace the replacements. The first replacement heater elements were longer than the original elements, causing higher heat transfer to the region of the electrical connectors. Other NRC licensees have experienced unexpected failures from replacement electrical breakers, valves, motor operators, etc. Consideration should be given to expanding Bullet 1 to include the need for adequate replacements or to adding another bullet explicitly covering this need.

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p. 21, first full paragraph	The statement is made that SONGS "achieved the highest level of the NRC's maintenance-related performance indicators since the second quarter of 2006." Perhaps, but the *Los Angeles Times* recently reported that SONGS received a "3" rating from the Institute for Nuclear Power Operations ("3" is the middle of INPO's 5-point rating scale). UCS has been informed that among the serious problems pointed out by INPO was a larger than typical backlog of maintenance items. If so, SCE is increasing the likelihood of an outage by deferring maintenance rather than maintaining proper equipment conditions. Consideration should be given to obtaining and reviewing this INPO information if SCE with-held it from the AB 1632 Study Team. It is relevant to the subject and seems to directly counter a conclusion reached by the team, perhaps because the team was not provided all the available information.
p. 23, Economic, Environmental, and Policy Issues Assessment	This section covered topics such as potential impacts on the environment from the nuclear plants and the policy implications of proposed license renewal of the nuclear plants for up to 20 years' additional operation. This section should also evaluate the potential impacts of the environment on the nuclear plants, especially in context of extended operation of the plants. Global warming is causing ambient temperatures to rise. Rising river and air temperatures have caused nuclear plants in France, Alabama, and Pennsylvania to shut down or reduce power in recent years. The Pacific Ocean is the cooling water source for Diablo Canyon and SONGS and is less vulnerable to temperature rises than the inland rivers used for cooling the nuclear plants in France, Alabama, and Pennsylvania, rising air temperatures could adversely impact operation at Diablo Canyon and SONGS. For example, a tornado touched down near the Davis-Besse nuclear plant in June 1999. The tornado's high winds toppled one power line transmission tower and resulted in Davis-Besse being disconnected from its electrical grid. The plant's emergency diesel generators automatically started and provided electrical power to the safety equipment needed to cool the reactor core. Because the air temperatures were high and remained high (over 90°F), the HVAC system for the structure housing the emergency diesel generators was unable to handle the rising internal temperature caused by the running diesel generators. About one day later, the operators had to turn off the emergency diesel generators because the room temperatures were too high for electrical components (relays, control circuits, monitoring systems, etc.). Fortunately, a connection to the electrical grid had been restored about one hour prior to the loss of the diesel generators, so reactor core cooling equipment remained operating. Global warming's effects are reducing nuclear plant safety margins. Consideration should be given to describing the potential impact from global warming on the operation of Diablo Canyon and SONGS, particularly in context of possible 20-year extensions to their operating licenses.
p. 29, License Renewal Issues for State Policymakers, 2nd paragraph	The point is made that the decision to renew the nuclear plant operating licenses will have a significant impact on the state's power supply portfolio and on the local communities. While it is uncertain when Diablo Canyon and SONGS permanently shut down, it is 100 percent certain that the nuclear plants will permanently shut down. The NRC (and its predecessor, the Atomic Energy Commission) licensed 130 nuclear power reactors to operate. Only 104 reactors operate today, meaning that over two dozen reactors have permanently shut down. One reactor (Three Mile Island Unit 2) shut down after only a year's operation and NONE of the reactors operated for the full

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	40-year term of their operating license. Most of the permanent shut downs, like that at SONGS Unit 1, happened with little or no advance planning and preparations. The AB 1632 Study Team recommended that a long-term plan be developed to minimize the disruption from the protracted shut down of Diablo Canyon or SONGS. Consideration should be given to a similar recommendation for developing a long-term plan to minimize the impact on the state's portfolio and the local communities for life after the permanent shutdown of the reactors. For example, after the unexpected permanent shut down of the Maine Yankee nuclear plant, state and local governments rushed through legislation and acts to deal with issues like job re-training, property and school tax re-assessments, etc.
p. 101, 3rd full paragraph	The statement is made that only one earthquake exceeding the operational basis earthquake parameters has occurred at a U.S. nuclear plant. On January 31, 1986, an earthquake occurred near the Perry nuclear plant northeast of Cleveland, OH. The unexpected occurrence and magnitude of that earthquake prompted the Committee on Interior and Insular Affairs of the U.S. House of Representatives to conduct a hearing on April 8, 1986. Dr. Leonardo Seeber from the Lamont-Doherty Geological Observatory of Columbia University, Dr. Robert L. Wesson from the United States Geological Survey, and the Nuclear Regulatory Commission testified at the hearing. I worked in the nuclear industry at the time of this event and had colleagues working at Perry. From what they told me, which is consistent with the written testimony provided at the April 8, 1986, House hearing, the magnitude of the ground motion recorded at Perry exceeded the OBE levels, but the duration of that motion was less than the OBE parameters. The NRC relied on this outcome in concluding the seismic design for the recently constructed Perry nuclear plant was adequate and the plant could be licensed to operate. Consideration should be given to including this 1986 earthquake in the report, particularly because the record strongly suggests that two injection wells drilled very near to the Perry site and the ensuing injection of nearly 300,000 gallons of fluid into the ground was likely a contributing factor in causing the ground motion.
p. 112, list of possible earthquake consequences	The list of potential consequences from a safe shutdown earthquake is illustrative and not meant to be inclusive. Consideration should be given to adding a potential consequence that is as at least as severe as several of the items on the list. In January 1999 as the hydrogen storage tanks were being re-filled from a truck, a leak lead to a hydrogen fire that took nearly six hours to extinguish. This event is described in NRC Information Notice 2001-12, available online at http://www.nrc.gov/reading-rm/doc-collections/gen-comm/info-notices/2001/in01012.html. This event was not caused by an earthquake. But it is suggestive of what can happen when a hydrogen leak occurs. Nuclear power plants, including those in California, use large amounts of hydrogen to cool the main generator rotors. This cooling system is non-safety-related, meaning it is more vulnerable to earthquake damage. While the consequences of an earthquake-induced hydrogen leak and fire in the turbine building at Diablo Canyon or SONGS may not directly impact reactor safety, it could take considerable time to recover.

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	The flammable oil used to cool and lubricate the turbine shaft (physically connected to the generator rotor) and its bearings is also contained within non-safety-related systems vulnerable to earthquake damage. In November 1991, the Unit 2 reactor at the Salem nuclear plant in New Jersey experienced a turbine fire that took a long time to repair. This event is described in NRC Information Notice 1991-83 (available online at http://www.nrc.gov/reading-rm/doc-collections/gen-comm/info-notices/1991/in91083.html). On December 25, 1993, the Unit 2 reactor at the Fermi nuclear plant in Michigan also experienced a turbine fire. It took over a year to repair the damage and restart the reactor. Coupled with the previously stated vulnerability of the non-safety-related fire protection system to earthquake damage, the fire hazards from the hydrogen and oil used to cool the turbine/generator within non-safety-related systems seems worthy of inclusion in the list.
p. 114, 4th bullet	It is stated that spills from and broken seals on drums containing radioactive waste "would be the most likely form of radioactive material release in event of an earthquake twice as intense as the safe shutdown earthquake. While no source is specified for this information, it seems to be the July 2007 earthquake at the Japanese nuclear plant which included spills of radioactive materials from waste drums. This event cannot be dismissed, but it is only a single data point. It seems tenuous to assume that this scenario is the most likely pathway for release of radioactive material from such a severe earthquake. A more likely candidate involves the system used to collect, treat, and release radioactive gases. Leaks from equipment for this system in the auxiliary building at Three Mile Island Unit 2 allowed radioactive material to reach the environment during that accident. Nearly 8.8 curies of radioactive noble gases escaped from this system at SONGS Unit 1 in July 1981 (information on this event is available online at http://www.nrc.gov/reading-rm/doc-collections/gen-comm/info-notices/1981/in81027.html). Chapter 11 of the Updated Final Safety Analysis Reports for Diablo Canyon and SONGS describes the gaseous waste systems and their radioactive contents. Consideration should be given to describing this potential pathway for release of radioactive material following such severe earthquakes.
p. 161, top paragraph	The statement is made "...these events [loss of spent fuel pool cooling] were recovered long before fuel heat-up occurred." This statement is false. For example, on May 12, 1992, the NRC resident inspector at the Comanche Peak nuclear plant in Texas questioned operators about data recorded in a log. His questions lead to the discovery that the cooling system for the Unit 1 spent fuel pool was misaligned. This discovery happened nearly 17 hours after the lineup error was made and the thousands of gallons of water in the spent fuel pool did heat up more than a little bit. The NRC fined the plant's owner $125,000 for this event, strongly suggesting it was more than a minor problem.

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	On November 14, 1996, the NRC's Office for the Analysis and Evaluation of Operational Data (AEOD) presented to the Commission results from its inquiry into spent fuel cooling and draindown events. The AEOD's 8th slide was a graph of events involving loss of spent fuel pool cooling. Several events, including one lasting 72 hours and one lasting 24 hours, were reported. Consideration should be given to correcting this erroneous passage.
p. 161, 6th paragraph	The point about NRC and EPRI studies concluding "there is a greater risk of an event leading to public harm during cask loading and transportation, which occur primarily during the first year of operation, than from routine operations" seems improperly placed contextually. The statement appears in a discussion of the pros and cons of spent fuel storage in wet pools vice dry casks. As presented, the point implies that people like Bob Alvarez who advocate accelerated transfer of spent fuel from pools to casks are doing so by solely looking at the relative risk from routine, static conditions and overlooking or discounting the risk from the transfer evolutions. But two crucial facts are overlooked in this discussion within the draft report. First, spent fuel cannot be transferred from pools to dry casks for at least five years. This period allows ample time for short-lived radioisotopes (e.g., Iodine-131) to decay away to negligible inventories. Medium and long-lived radioisotopes remain. Risk is the product of probability and consequences. The probability of a dry cask loading evolution is essentially the same whether it is performed in 2008 or in 2015. The consequences of a dry cask event, should one occur, depends on the radioactive material inventory. As noted above, the short-lived radioisotopes will have decayed leaving only the medium and long-lived radioisotopes. The consequences from a dry cask event involving spent fuel discharged from the reactor 6 years ago will be incrementally higher than from an event involving fuel discharged from the reactor 16 years ago. But the risk, being the product of equivalent probabilities and slightly different consequences, is increased even less than the consequence difference. Besides, the NRC's regulations permit dry casks to be loaded with spent fuel discharged from the reactor only five years ago, so that risk must be managed to an acceptably low level. Second, the spent fuel must someday be transferred from pools to casks, if for no other reason than for shipment to the federal geological repository. Thus, it's not a question of incurring or avoiding the transfer risk, but rather when that risk occurs. The final paragraph on page 149 of the draft report states "Dry cask storage of spent fuel is among the safest of all the phases of the nuclear fuel cycle." UCS wholeheartedly agrees. By doing as Alvarez and others advocate, the avoidable risk of transferring spent fuel from pools to casks results in significantly reduced risks of spent fuel storage. One final point – nuclear plant owners like PG&E seek NRC permission to transfer spent fuel from pools to casks in order to allow their nuclear reactors to continue operating (and generating spent fuel). If the increased risk associated with transfer of spent fuel from pools to casks is tolerable from the perspective of allowing nuclear reactors to continue operating, fairness dictates that it also be tolerable from the perspective of better protecting American lives while those reactors operate.

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	Consideration should be given to better describing the risks of spent fuel storage versus dry cask storage along with the readily available means for better managing those relative risks.
p. 167, Figure 29	The statement is made that "This [Figure 29] indicates that age-related degradation of SSCs has not yet had any significant impact on overall nuclear plant performance." This conclusion is very questionable.

Typically, analysis of whether factors such as age-related degradation of SSCs is affecting performance is done by examining the causes for forced outages. Table 3.8 from NRC's NUREG/CR-1496, "Nuclear Power Plant Operating Experience – 1979," reflects this commonly applied approach. It shows which components caused forced outages at nuclear power plants in 1979 and how long those forced outages lasted. It is common to then drill down on these causes to identify any maintenance, design, or operations trends.

Table 3.8. Components Involved in Forced Outages

System	Component	BWR		PWR	
		%	Av. hours per plant	%	Av. hours per plant
Steam and power	Pipes and/or fittings			6	199
	Instrumentation			6	186
	Turbines			4	140
	Pumps			3	85
	Heat exchangers			2	70
	Main generator	1	21		
Engineered safety features	Pipes, fittings	8	183	9	281
	Shock suppressors	1	24	6	197
Reactor coolant	Pumps	1	32	1	42
	Valves	3	68	1	26
	Pipes and/or fittings	4	91		
Reactor	Inlet diffuser	8	194		
	Control rod drives	1	28		
Electric power	Transformers	4	104		

It is very unusual, to the point of being nearly unprecedented, to look for trends like age-related degradation from overall fleet capacity factors.

But, even if one where to use this highly unusual, extremely curious tool to search for age-related degradation, one should at least address the apparently significant "blips" that appear on the capacity factor plot.

The overall fleet capacity factor in 1997 dropped nearly 3 to 4 percent from 1998. Did age-related degradation cause this drop? After all, the Clinton nuclear plant in Illinois was shut down throughout all of 1996 in response to age-related degradation of its recirculation pumps.

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	The overall fleet capacity factor in 2003 dropped nearly 3 to 4 percent from 2002. Did age-related degradation cause this drop? After all, the Davis-Besse nuclear plant in Ohio was shut down throughout all of 2003 in response to age-related degradation of its reactor vessel head. Age-related degradation may or may not be significant in the nuclear industry. Figure 29 and its associated discussion are superficial at best and provide no useful insights to the issue. Consideration should be given to significantly revising this very weak, suspect analysis.
p. 169, last paragraph	The statement about the cooling tower collapse at Vermont Yankee being an example of a reactor coolant system failure is simply wrong. The reactor coolant system at Vermont Yankee includes the piping, valves, etc. connecting the reactor pressure vessel to the turbine and those components carrying water from the condenser hotwell back to the reactor vessel. The cooling towers form part of a secondary cooling system. Of the systems listed in Table 5 on page 170, the cooling towers most closely fit in the "Condensate System" or "Misc – Steam Turbine" categories. Consideration should be given to correcting this error.
p. 173, last paragraph	The discussion of the steam generator tube leak at Indian Point states that "The NRC issued an Alert declaration…". It's a minor point, but the NRC doesn't make emergency declarations. The plant owners make the emergency declarations to the NRC, state, and local officials. Consolidated Edison, then the owner of Indian Point Unit 2, made the Alert declaration.
pp. 176-177, Tritium Releases section	The Tritium Releases section overlooks one of the major reasons that EPRI and the nuclear industry undertook the voluntary groundwater protection initiatives program. As the draft report discusses, avoiding the release of tritium into public drinking water was a major factor. But the equaling compelling reason, from the industry perspective, involved decommissioning and its costs. Undetected spills and leaks of radioactively contaminated water has the potential for significantly increasing the cost of decommissioning nuclear plants. For example, the radioactively contaminated water leaked from the spent fuel pool at the Haddam Neck nuclear plant in Connecticut created more contaminated soil that had to be disposed of, at considerable cost, as low-level radioactive waste. Plant owners are required by 10 CFR 50.75(g) to maintain records on radioactively contaminated water spills and leaks. The NRC and others periodically review this information to determine if the funds set aside for decommissioning are adequate. The nuclear industry developed the groundwater protection initiative to protect against insufficient decommissioning funding, and the associated liability issues, from unknown contamination. Consideration should be given to discussing this collateral aspect of the tritium releases issue.
p. 184, 3rd paragraph	This discussion describes the role of the Institute for Nuclear Power Operations (INPO). INPO's results are extremely questionable to the degree that very little reliance should be placed on their efforts. INPO claims to measure performance against standards of excellence, whereas the NRC inspects against regulations that define minimally acceptable performance. Thus, when performance drops below NRC's minimums, it has fallen sooner and further from INPO's standards of excellence.

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	NRC has been criticized, including from its internal lessons learned reviews, for not having detected declining performance levels at Davis-Besse, Indian Point, South Texas Project, Palo Verde, and many other reactors sooner. Such indictments are implicitly indictments of even worse behavior by INPO. In our *Walking a Nuclear Tightrope* report, UCS documented nearly four dozen outages lasting a year or longer at U.S. nuclear power reactors since INPO was formed 38 years ago. That it took longer than a year to restore safety levels to the minimal level accepted by NRC demonstrates that NRC waited too long to intervene. But again, since INPO purportedly measures performance against standards of excellence, this reality strongly suggests that INPO repeatedly cannot distinguish excellence from rampant poor performance. Consideration should be given to striking all reference to INPO from this report since there's scant evidence that INPO adds value.
p. 185, Diablo Canyon Independent Safety Committee box	This draft report mentions that the Diablo Canyon Independent Safety Committee (DCISC) exists, but does not comment on whether this function is a useful or valuable one. If the DCISC serves some tangible function of value, it's hard to explain why the CPUC has not provided comparable protection for SONGS. From a strictly liability perspective, the CPUC seems to be at great risk. If a serious accident where to occur at SONGS, the CPUC would seem to be open to valid criticism that had it simply provided SONGS with an independent safety committee, the added oversight would have identified the problem and avoided the disaster. Conversely, if the DCISC has no discernible value, it's hard to explain why that money is being wasted each year. This draft report, for example, identified numerous questions that could not be answered with the available information. The funds wasted on the useless DCISC would seem to be better applied towards productive efforts. UCS has no opinion on whether DCISC has value or not. But Diablo Canyon operating with a state-mandated oversight panel and SONGS operating without one leaves us, and the people of California, in the awkward position of knowing that both situations cannot be right but not knowing which situation is wrong.
pp. 187-189, Plant Staffing and Training	This section provides a very good discussion of the challenges facing Diablo Canyon, SONGS, and the nuclear industry from the aging work force. To supplement this fine discussion, consideration should be given to discussing the licensed operator staffing and training area. During a briefing in July 2007 before the NRC Chairman and Commissioners, senior managers from Palo Verde talked about allowing their staff of licensed operators to drop too low. It takes considerable time to recruit, train, and quality licensed operators, so falling low on staffing remains a problem for a fairly long time. Palo Verde's senior managers pointed out that the shortage of licensed operators had a ripple effect on their work control group and outage planning group.