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AB 1632 NUCLEAR POWER PLANT ASSESSMENT

STUDY PLAN

Prepared For:
California Energy Commission

Prepared By:
MRW & Associates, Inc.

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INTRODUCTION

California's two operating nuclear power plants, Diablo Canyon and the San Onofre Nuclear Generating Station (SONGS), contribute a significant portion (nearly 13%) of California's electricity supply.¹ However, these plants also pose risks to the state. Much of the risk arises because the plants are located in seismically active zones along California's central and southern coast and they generate significant quantities of spent nuclear fuel. The spent fuel is currently stored at the plant sites since the development of a federal waste disposal repository has been delayed.

California Assembly Bill 1632 (Blakeslee, Chapter 722, Statutes of 2006; Public Resources Code (PRC) 25303) directs the Energy Commission to compile and assess existing scientific studies by experts in the subject areas to determine the potential vulnerabilities of SONGS and Diablo Canyon to a major disruption due to a major seismic event or plant aging. AB 1632 also directs the Energy Commission to assess the impacts of such a disruption, to assess the costs and impacts from nuclear waste accumulating at these plants, and to evaluate other major issues related to the future role of these plants in the state's energy portfolio. The purpose of this assessment is to provide the state's policymakers with information about the state's operating nuclear power plants that can inform the energy policymaking process.

This document provides the final Study Plan for the Nuclear Power Plant Assessment required under AB 1632 that is to be completed in 2008. The study plan details the topic areas to be covered, the scope of assessment for each topic, scientific studies to be reviewed, and a proposed schedule for completing major components of the overall assessment.

The Energy Commission held a public workshop on December 12 to present and receive public comments on a draft of the Study Plan. Interested parties, including the Seismic Vulnerability Advisory Team, also were invited to submit written comments on the draft Study Plan.² The Energy Commission staff and its contractor reviewed and considered all comments in preparing this revised Study Plan.

¹ The Palo Verde Nuclear Generating Station in Arizona, which is partially owned by several California utilities, also supplies nuclear power to the state.

² The Seismic Vulnerability Advisory Team is a team of senior seismic technical experts established by the Energy Commission to provide technical review and advice on the seismic safety portions of the AB 1632 Nuclear Power Plant Assessment. This team includes representatives from the California Department of Conservation California Geological Survey, the California Seismic Safety Commission, and the California Coastal Commission.

SCHEDULE AND WORK PRODUCTS

Two work products required by AB 1632 will set the schedule for the Nuclear Power Plant Assessment. The first of these is the Energy Commission's AB 1632 Report, which must be adopted in early November 2008. The second is the related chapter in the *2008 Integrated Energy Policy Report (IEPR) Update*, which is expected to be adopted in the last quarter of 2008. The project timeline and deliverables must support the preparation and completion of these reports.

Energy Commission staff and the Energy Commission's contractor will conduct the research and technical activities associated with the tasks outlined below. Each task will result in a preliminary assessment prepared by the contractor for review by Energy Commission staff and other reviewers and experts as appropriate. During this phase of the project, the Energy Commission staff will seek input and technical review from appropriate experts in particular subject areas, taking into consideration schedule and budgetary restrictions.³ Energy Commission staff will also coordinate with and seek technical review and input from the California Public Utilities Commission and the California Independent System Operator on tasks related to the impact of a major disruption to plant operations.

A guiding principle for the assessment will be to rely on existing literature, studies, and data where possible. One result of this assessment may be the identification of "data gaps," i.e., areas where information is lacking or additional information would be useful. The assessment will specifically identify such data gaps and assess their importance, with recommendations for potential action by policymakers.

The separate task assessments will be finalized by the contractor after receiving and incorporating comments from the Energy Commission. The contractor then will prepare a draft Consultant Report based on the task assessments. This draft report will be released for public review and comment and a public workshop will be held to receive input. Comments on the draft Consultant Report will be incorporated into a final Consultant Report. A draft Committee Report building on the Consultant Report and CEC staff work will be released for review; a public workshop or other opportunity to receive public input will be considered. A proposed Committee Report will be released and proposed for adoption by the full Commission in late October 2008.

Table 1 lays out the estimated schedule for research and technical activities and preparing the reports associated with the Nuclear Power Plant Assessment.

³ This will include input from the Seismic Vulnerability Advisory Team.

Table 1: Estimated Schedule for the AB 1632 Nuclear Power Plant Assessment

Public workshop on study plan	December 12, 2007
Release final study plan	January 2008
Begin research and technical tasks	January
Provide preliminary assessments to Energy Commission	Mid-March through early May
Optional public input opportunity	Mid-May
Release draft Consultant Report	End June
Public workshop and written comments on draft Consultant Report	Mid-July
Release Final Consultant Report	End August
Release Energy Commission AB 1632 Committee Report	End September
Optional public workshop and/or written comments on Committee Report	early October
Commission adoption of AB 1632 Committee Report	October 22, 2008
2008 IEPR Update Report	4 th quarter 2008

TECHNICAL TASKS

The following technical tasks will be completed to support the Nuclear Power Plant Assessment. These tasks were specified in AB 1632, which was codified in PRC sections 25303(a)(8)(A-D) and 23303(c). The task numbers presented here (beginning with Task 2), match the Energy Commission's Request For Proposals (RFP) #150-07-101, "AB 1632 Nuclear Power Plant Assessment."⁴

The task descriptions below identify the topic areas to be addressed and the scope of the assessment to be conducted for each task. Additionally, each task description includes a representative list of studies and documents from government agencies, industry, academia, and other experts that the contractor expects will be reviewed in the course of completing the AB 1632 assessment.⁵ These lists illustrate the types of documents that the contractor will review and are not intended to be comprehensive.

Task 2: Seismic Vulnerability Assessment

In this task, the contractor will review studies that assess the vulnerability of Diablo Canyon and SONGS to a major disruption due to seismic or tsunami hazards and identify the cumulative damage that is anticipated at each plant as a result of earthquakes and tsunamis of various magnitudes. The Seismic Vulnerability Advisory Team will advise the Energy Commission staff and the contractor during this assessment.

Scope of Seismic Vulnerability Assessment

Topic Areas	Scope of Assessment
1. Review Diablo Canyon and SONGS seismic studies	<ul style="list-style-type: none">• Compile and review existing studies to describe the tectonic/seismic setting for both plants based on an assessment of available evidence.• Review the scientific evidence related to the faults in the vicinity of each plant and consider information regarding the seismic setting of the surrounding area that might impact access to the plant, the transmission of power to and from the plant, and the storage of highly radioactive waste.• Compare existing studies based on date of analysis, methodology used, scope of the study, purpose, summary results, similarities and differences as compared to other studies, strengths and weaknesses, and implications for plant operation and local impacts.

⁴ Task 1 in RFP #150-07-101 is the creation of this Study Plan.

⁵ The term "studies" as used in this document may include reports, data, research summaries, and other available information that would inform the AB 1632 assessments.

Topic Areas	Scope of Assessment
2. Identify seismic vulnerabilities of Diablo Canyon's and SONGS' components	<ul style="list-style-type: none"> • Identify and review existing studies on the seismic design of each major plant component and identify the major plant components that are vulnerable to damage during a major seismic event. Also consider safety systems, nuclear steam supply systems, and plant systems needed for the production of electricity. Consider evidence arising from the June 2007 Kashiwazaki earthquake in Japan. • Review portions of these studies or other existing information that identify the level of ground motion that could be sustained by key plant systems and structures and discuss the probability of these levels being exceeded. To the extent information is readily available, summarize the state of knowledge on how multiple seismic events may lead to cumulative stress and/or damage on key plant components. • Summarize seismic design information, including design basis information, for each plant. Describe a safe shutdown earthquake and, if appropriate, the operating basis earthquake. • Characterize systems, components, and structures according to distinct categories of "time to repair/replace." • Identify and discuss existing information that addresses the seismic vulnerability of the key plant systems and structures to a major disruption, and consider the vulnerability of spent fuel storage facilities, transmission systems, and evacuation routes and other access roadways near the plant.
3. Assess the Vulnerability of Plants to Major Seismic/Tsunami-Caused Disruptions	<ul style="list-style-type: none"> • Use information from existing studies to create a table of critical components for each plant, their seismic capacities (fragilities), and their vulnerabilities to tsunami-induced flood damage. For each component in the table, determine the time to repair or replace the item for each ground motion level at the plant and for various-sized tsunamis. Describe the cumulative damage anticipated for a given major seismic or tsunami event at the plant. • Compile similar information for infrastructure components such as transmission facilities, and access roadways.
4. Assess the Impact of the Hosgri Fault and Other Faults on the Diablo Canyon Site	<ul style="list-style-type: none"> • Review the most current information available on the Hosgri Fault, as well as other faults in the area, with respect to their implications for causing an extended shutdown at Diablo Canyon. • Summarize the current state of knowledge regarding these faults and compare this information with the current seismic risk reports available for Diablo Canyon. Discuss the findings of existing studies of the plant's vulnerabilities and seismic frequencies in light of the current state of knowledge of the Hosgri Fault and other faults in the area. • Summarize the state of knowledge on thrust faulting and slip/strike faulting as it pertains to vulnerabilities for nuclear power plants. Particular attention will be paid to the influence of uncertainty in the determination of the displacement and the mean recurrence interval of significant seismic events.

Topic Areas	Scope of Assessment
5. Identify Seismic Vulnerability Assessment Update Triggers	<ul style="list-style-type: none"> • Discuss NRC policies and requirements that may result in the need for an update to a seismic study for Diablo Canyon and SONGS. • Discuss how the knowledge of earthquakes, faults, and fault characteristics is evolving and what implications this evolution of knowledge has for seismic studies for Diablo Canyon and SONGS. • Review and discuss developments in available technology for assessment of seismic characteristics at sites such as Diablo Canyon and SONGS, and potential implications of that technology evolution for the state of knowledge regarding seismic conditions at those sites.

Representative List of Studies to be Reviewed for Seismic Vulnerability Assessment

1. Diablo Canyon and SONGS seismic studies, such as the following:
 - a. Individual Plant Examination of External Events (IPEEE) reports for SONGS and Diablo Canyon
 - b. *The Application of Probabilistic Techniques to Seismic Risk Analysis of the Diablo Canyon Plant*, PG&E
 - c. *Diablo Canyon Seismic Response Utilizing Logic Models to Determine Plant Response to External Events*, PG&E
 - d. *Final Report of the Diablo Canyon Long-Term Seismic Program*, PG&E
 - e. *A Probabilistic Seismic Safety Assessment of the Diablo Canyon Nuclear Power Plant*, N.M. Newmark
 - f. *Seismic Evaluation for Postulated 7.5M Hosgri Earthquake, Units 1 and 2, Diablo Canyon Site*, Docket Nos. 50-275 and 50-323, NUREG Vols. 1 through 7, PG&E
 - g. *Legg and Namson tectonic model*
2. Safety and risk assessment studies, such as the following:
 - a. NRC Safety Evaluation Reports
 - b. NRC "State of the Art Reactor Consequence Analysis for Diablo Canyon"
3. Other resources, such as the following:
 - a. Studies and data produced by PG&E and SCE in response to the 2007 IEPR data requests
 - b. Reports and information from academia and government agencies, including the US Nuclear Regulatory Commission, California Coastal Commission, California Seismic Safety Commission, California Geologic Survey, the U.S. Geological Survey, and the County of San Luis Obispo

Task 3: Plant Aging Vulnerability Assessment

In this task, the contractor will evaluate the potential vulnerability of Diablo Canyon and SONGS to a major disruption due to plant aging. This assessment will consider the impacts on plant reliability from aging plant components and a retiring plant work force. It will also compile and review existing studies to identify trends at Diablo Canyon and SONGS related to extended, unplanned plant outages and compliance with federal plant maintenance requirements, and it will assess the robustness of each plant's safety culture.

Scope of Plant Aging Vulnerability Assessment

Topic Areas	Scope of Assessment
1. Review scientific literature	<ul style="list-style-type: none">• Identify and review available information regarding historical performance of light water reactors with respect to reliability, maintenance, aging, and power outages lasting longer than 6 months.• Consider events involving the repair or replacement of major equipment that resulted in outages or extensions of outages.• Assess plant maintenance programs using data from the U.S. Nuclear Regulatory Commission (NRC) and other oversight agencies and government offices.• Review plant-specific staffing and maintenance plans pertaining to staffing and expertise levels and contingency plans for plant access and recovery of major equipment. Use plant-specific information if available or generic industry information.
2. Review the implications for Diablo Canyon and SONGS of degradation of major plant components	<ul style="list-style-type: none">• Examine the implications for Diablo Canyon's and SONGS' operations of the failure or serious degradation of major plant components based on the experience and lessons learned from other nuclear power plants that have had failure or serious degradation of major plant components. Identify instances, if any, in which replaced major components needed to be repaired or replaced.• Review the long-term impact of radiation on system components and structures with particular focus on the potential for accelerated aging and weakening of containment structures.• Discuss the potential for regulatory action due to the occurrence of a major event at another plant in the U.S. or abroad.
3. Summarize safety culture assessments at Diablo Canyon, SONGS, and Palo Verde	<ul style="list-style-type: none">• Review information, assessments, and programs at Diablo Canyon, SONGS, and Palo Verde related to the safety culture at these plants to infer any safety culture issues at Diablo Canyon and at SONGS.• Examine the NRC's Multiple System Responses Program (MSRP) results to infer any safety culture issues at Diablo Canyon and at SONGS.

Topic Areas	Scope of Assessment
4. Summarize NRC findings and reports on maintenance compliance	<ul style="list-style-type: none"> Using existing reports and other documentation, assess Diablo Canyon's and SONGS' historical and current compliance with NRC plant maintenance requirements.
5. Assess implications of replacing retiring workers on plant performance, safety and reliability	<ul style="list-style-type: none"> Review plant staffing plans focusing on the plants' plans to maintain an adequate number of trained personnel in the operations, safety, and maintenance groups. Review existing studies that address nuclear power plant staffing needs. Consider the range of skills, training, and expertise required by plant employees, including technicians, operators, engineers, and safety personnel. Assess the projected availability of replacement workers in light of the possibility of extending the operations of SONGS and Diablo Canyon beyond current license periods and in the case of an expansion of the nuclear power industry in the U.S. Summarize and assess the quality of the training programs at the plants for maintaining a skilled and trained workforce.
6. Identify trends in radioisotope detection	<ul style="list-style-type: none"> Review generic and plant-specific information regarding any trends in increased detection of radioisotopes in either the primary system or the environment.

Representative List of Studies to be Reviewed for Plant Aging Vulnerability Assessment

1. Studies and reports on nuclear plant aging, such as the following:
 - a. Development and Demonstration of Methods for Nuclear Power Plant Aging Risk Analysis, *Plant-Specific Data Collection and Interpretation*, PLG-0717, Volume1, Rev. 1, prepared for EG&G Idaho, Inc., Idaho National Engineering Laboratory
 - b. Aging PSA Guide, *Final Report of the Mitsubishi Heavy Industries, Ltd., Aging Probabilistic Safety Assessment Report*, prepared for Mitsubishi Heavy Industries, Ltd., PLG-1098
 - c. Lochbaum, David. *Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages*, Union of Concerned Scientists, September 2006.
 - d. Nuclear Plant Aging Research Program Plan, NUREG-1144, NRC
2. Reports and studies from federal agencies, including NRC Licensee Event Reports, the Nuclear Operations Analysis Center (NOAC) report, the Multiple System Responses Program report, and studies from the Office of Nuclear Regulatory Research and the U.S. Government Accountability Office
3. Reports on aging of equipment and components such as the following:

- a. *Aging Assessment of Component Cooling Water Systems in Pressurized Water Reactors (Phase 2)*, NUREG/CR-5693
- b. *Evaluations of Core Melt Frequency Effects Due to Component Aging and Maintenance Risk Assessment*, NUREG/CR-5510
- c. *Aging Effects on Time-Dependent Nuclear Plant Component Unavailability: An Investigation of Variations from Static Calculations*, R.D. Radulovich
- d. *BWR Control Rod Drive System Aging*, presentation at 19th Water Reactor Safety Information Meeting, R.H. Greene

Task 4: Impact of a Major Disruption

AB 1632 requires an analysis of the impacts on system reliability, public safety, and the economy of a major disruption at California's nuclear power plants. In this task, the contractor will review studies on Diablo Canyon and SONGS reliability and examine the system, environmental, and economic impacts of a prolonged, unexpected outage caused by a major seismic event or a major plant component failure.

Scope of Assessment for Impact of Major Disruption Analysis

Topic Areas	Scope of Assessment
1. Assess plant reliability studies	<ul style="list-style-type: none"> • Provide a summary of the available studies on plant reliability for Diablo Canyon and SONGS, with an emphasis on plant-specific local and system reliability issues.
2. Define "major disruption"	<ul style="list-style-type: none"> • Develop a definition of a "major disruption" in operations at Diablo Canyon and SONGS. Factors that may be considered in the definition include outages at multiple units/multiple sites, length of disruption, external causes of disruptions (e.g., earthquake, wildfires), and steps required to return the plant to service. • Review historical data on major power generation disruptions in California, the U.S., Japan, and other geographic areas as needed. • Develop a set of plant shutdown duration categories that characterize the frequency and nature of potential major disruption events, e.g., disruptions lasting 3-6 months, 6-18 months, or permanent shutdown. Include scenarios where SONGS and Diablo Canyon are shut down simultaneously.

Topic Areas	Scope of Assessment
3. Identify transmission issues associated with a major disruption	<ul style="list-style-type: none"> • Working with policymakers, grid operators, and utilities, identify the current transmission issues associated with a potential loss of power at SONGS or Diablo Canyon. Describe the role of SONGS and Diablo Canyon in maintaining system reliability. • Identify short-term impacts on the transmission system from a prolonged outage at SONGS and Diablo Canyon, considering seasonal variations in power demand. Identify the electric contingencies that would need to be addressed should a prolonged outage occur.
4. Assess the availability of replacement power	<ul style="list-style-type: none"> • Review available studies, economic modeling, and other information addressing how much new transmission capacity, generation capacity, or demand side resources would be required in order to maintain reliability of the transmission system and adequate power supply in the event of extended outages at Diablo Canyon and/or SONGS. Use a production cost model to determine incremental power costs during such an outage. • Consider the impact of the loss of California's nuclear power plants on planning reserve margins and local and system capacity requirements. Provide general parameters of the type of replacement power and/or demand-side resources that could be used and the cost of incremental investments in replacement power and transmission that might be needed in the event of extended nuclear power plant outages or retirements. • Perform an economic analysis of the costs of replacement power. • Complete these analyses for the years 2012 and 2020.
5. Assess the public safety and economic impacts of an extended outage	<ul style="list-style-type: none"> • Determine the public safety and economic impacts of an extended outage at Diablo Canyon or SONGS. Include the cost of replacement power and demand side resources and the incremental costs of repairs and replacements in this assessment; to the extent information is available; assess impacts from extended outages on California consumers. • Perform a sensitivity analysis by running the production cost model using different input assumptions relating to load, natural gas price, and/or other input parameters.
6. Assess reserve margin implications	<ul style="list-style-type: none"> • Assess the seasonal adequacy of reserve margins and the impact of a major disruption at Diablo Canyon and/or SONGS on the western grid's system stability and planning reserve margins.
7. Assess environmental and economic implications	<ul style="list-style-type: none"> • Assess the seasonal environmental and economic impacts of relying on replacement power sources and the time required to develop these power sources. • Consider the GHG consequences of an extended outage. • Delineate new and existing replacement resources considering Emission Reduction Credits and other regulatory requirements for those replacement resources.

Topic Areas	Scope of Assessment
8. Assess the economic implications of license extensions for Diablo Canyon and SONGS	<ul style="list-style-type: none"> • Using existing economic and cost studies or other relevant data sources, assess the economic implications of relying on Diablo Canyon and SONGS for 20 years past their current operating license expiration dates. Consider several scenarios to take into account a range of plant expenditures and a range of capacity factors at the plants, including a potential upgrade of the plant cooling systems to closed-cycle or dry cooling. This assessment could be informed by information made available in relicensing proceedings for nuclear power plants located in other U.S. states. • Compare the cost of the continued operation of the nuclear power plants to the cost of replacement power alternatives. Include in these cost estimates the costs of any transmission system upgrades or extensions that would be required in order to make use of the generation portfolio.

Production Cost Modeling Approach:

The economic impacts of an extended outage at Diablo Canyon, at SONGS, and at both these plants will be assessed using the MarketSym production cost model.⁶ The contractor will assume that the outage occurs in the year 2012 and lasts for one year. The contractor will use the Energy Commission's Scenario 1(b), which was prepared for the 2007 IEPR, as the base case and will also consider the possible retirement of aging gas-fired plants in Southern California, as identified in the Energy Commission's Scenario Analysis. The modeling will be informed by analyses completed for other recent studies of the California electricity market such as the study by the Ocean Protection Council assessing the possible retirement of plants that use once-through cooling.

Representative List of Studies to be Reviewed for Impact of Major Disruption Analysis

1. Studies on the social and economic risks of a possible disruption, such as the following:
 - a. Analysis of the Risk to the Public from Possible Damage to the Diablo Canyon Nuclear Power Station from Seismic Events, Units 1 and 2, Diablo Canyon Site, PG&E.
2. Studies on the cost of major outages at nuclear power plants and the impacts of aging on operating costs, such as the following:
 - a. *Review of Palo Verde 2005 Outages*, Report of GDS Associates, Inc. on Behalf of Utilities Division, Arizona Corporation Committee, August 2006
 - b. *An Analysis of Nuclear Power Plant Operating Costs: A 1995 Update*, Energy Information Administration, April 1995
3. Reports on PG&E and SCE reserve margins, such as the following:

⁶ MarketSym was used in the hourly dispatch analysis for the Energy Commission's Scenario Analysis.

- a. PG&E and SCE Long-Term Procurement Plans
- b. *2006 Resource Adequacy Report*, CPUC, March 16, 2007.
- c. Energy Commission energy demand forecasts
- 4. Studies on the cost and environmental impacts of generation and transmission in California, such as the following
 - a. *Comparative Costs of California Central Station Electricity Generation Technologies*, Energy Commission, 2007
 - b. *Scenario-Based Assessment of Resource Plans Predicated on Large Penetration of Preferred Resources*, Energy Commission, 2007
 - c. *Strategic Transmission Investment Plan*, Energy Commission, 2007
 - d. *Environmental Performance Report*, Energy Commission, 2003-2007
 - e. *Ocean Protection Council/WRCB Reliability Study (forthcoming)*
 - f. *Tetra Tech and EPRI Coastal Retrofit Studies*
 - g. *California Independent System Operator (ISO) Aging Power Plant Replacement Study (to the extent information is available)*

Task 5: Nuclear Waste Accumulation Assessment

In this task, the contractor will evaluate potential state and local costs resulting from the steadily accumulating spent fuel and low-level waste at Diablo Canyon and SONGS. This assessment will rely on scientific studies related to the safety and security risks posed by extended, high-density spent fuel storage at reactors as well as potential offsite transportation impacts.

Scope of Nuclear Waste Accumulation Assessment

Topic Areas	Scope of Assessment
1. Quantify amounts of radioactive waste at Diablo Canyon and SONGS	<ul style="list-style-type: none"> Quantify and describe the amounts of radioactive waste generated at Diablo Canyon and SONGS over the plants' operating license periods. Consider the amounts of spent fuel and the amounts of each grade of low-level waste (i.e., Classes A, B, and C, and Greater than Class C) generated at each site, including decommissioning waste.

Topic Areas	Scope of Assessment
2. Assess plans for and costs of waste storage and disposal	<ul style="list-style-type: none"> • Update assessments completed in the 2005 and 2007 IEPR proceedings that evaluated the plans for storage, transportation, and disposal of all nuclear wastes from Diablo Canyon and SONGS. • Review DOE's requirements for transportation casks and the need for repackaging. Assess the costs associated with DOE's proposed requirement to transfer spent fuel into Transportation, Aging and Disposal (TAD) canisters at reactors before transport to a repository. • Update cost estimates for the Diablo Canyon and SONGS waste storage and disposal plans.
3. Assess costs to build and operate ISFSIs, capacity of ISFSIs, and Nuclear Waste Fund (NWF) payments	<ul style="list-style-type: none"> • Review cost estimates to build, maintain, and protect the dry cask storage facilities at Diablo Canyon and SONGS. • Assess the capacity of the ISFSIs to store all the spent fuel that will be generated through the initial reactor operating licenses and through an additional 20 years of license extension. • Compare historic costs to damage amounts that the utilities have been awarded resulting from their breach of contract lawsuits against DOE. • Update estimates made in the 2005 and 2007 IEPR proceedings of the payments that California ratepayers have made to the federal Nuclear Waste Fund in order to pay for the transport, storage, and disposal of Diablo Canyon and SONGS spent fuel.
4. Assess seismic and terrorist risk to onsite waste storage	<ul style="list-style-type: none"> • Review and summarize available documents on the seismic capacity of Diablo Canyon's and SONGS' spent fuel pools and dry cask storage containers. Discuss the magnitude and ground motion of a seismic event necessary to cause functional damage to the spent fuel pool and storage containers, as well as the damage/failure modes. Consider the potential role of recovery actions to prevent or mitigate damage. • Review and summarize public documents on terrorist threats to spent fuel pools and storage containers with a focus on the possible nature, type, and magnitude of terrorist attacks necessary to cause functional damage, as well as the damage/failure modes and the potential role of recovery actions to prevent or mitigate damage. The discussion of this information will be done in a manner that is sensitive to security concerns. • Consider the possible weakening of containment systems due to seismic events.
5. Assess transportation costs of spent fuel transport	<ul style="list-style-type: none"> • Review available industry, government, plant specific, and other relevant documents to assess the costs associated with waste storage onsite and transport offsite to a federal storage or waste disposal facility.
6. Assess risks of spent fuel transport	<ul style="list-style-type: none"> • Review existing information on the potential risks involved with the eventual transport off site of the spent fuel, which will involve movement of hazardous material over existing rights-of-way near populated areas, introducing the potential for an accidental or terrorist-caused release of radionuclides.

Topic Areas	Scope of Assessment
7. Assess costs and impacts of ongoing emergency preparedness if waste sites become semi-permanent	<ul style="list-style-type: none"> • Review and evaluate local and state emergency management plans for dealing with nuclear plant emergencies. Focus on elements of these plans as they relate to spent fuel storage and transport and how these plans might change if the spent fuel was removed from the site. • Summarize existing information on the potential emergency preparedness cost implications if spent fuel remains at the plant site for an indefinite period of time.
8. Assess cost and impacts of land use, coastal access, and property values and tourism if waste sites become semi-permanent	<ul style="list-style-type: none"> • Evaluate the long-term impacts of continuing waste storage at these sites and on surrounding land uses and coastal access in the areas immediately adjacent to nuclear power plant sites by comparing existing and planned uses and projecting land use and economic impacts if nuclear waste remains onsite indefinitely. • Summarize the results of existing studies on the impacts on property values, tourist revenues, and local economies. Determine land use impacts by examining the most recent and appropriate literature and studies and applying the conclusions to the Diablo Canyon and SONGS waste storage sites.
9. Assess status of reprocessing and Yucca Mountain	<ul style="list-style-type: none"> • Provide an update on the status of the U.S. reprocessing initiatives (e.g. GNEP), federal waste management, and high level waste disposal activities.

Representative List of Studies to be Reviewed for Nuclear Waste Accumulation Assessment

1. Reports on the current spent fuel storage installations, such as the following:
 - a. *Diablo Canyon Independent Spent Fuel Storage Installation Safety Evaluation Report*, Center for Nuclear Waste Regulatory Analyses
 - b. Diablo Canyon Independent Spent Fuel Storage Installation (ISFSI) Submittal of Geologic Data Reports (11), in Response to U.S. Nuclear Regulatory Commission Docket No. 72-26, prepared for Pacific Gas & Electric Company, William Lettis & Associates, Inc.
2. Data produced by PG&E and SCE in response to 2007 IEPR data requests on radioactive waste generated at the nuclear plants and plans for and cost of waste storage and transport
3. Studies on the cost of waste storage and transport options, such as the following:
 - a. Bunn, et. al. *Interim Storage of Spent Nuclear Fuel: A Safe, Flexible, and Cost-Effective Near-Term Approach to Spent Fuel Management*, Harvard University-University of Tokyo Joint Report, June 2001

- b. Bunn, et. al. *The Economics of Reprocessing vs. Direct Disposal of Spent Nuclear Fuel*, Harvard University, December 2003
 - c. Shropshire, et. al. *Advanced Fuel Cycle Cost Basis*, Idaho National Lab, April 2007
 - d. PG&E and SCE rate filings
 - e. National Academy of Sciences, *Report on Spent Fuel Storage Safety and Risks*, 2006
 - f. National Academy of Sciences, *Going the Distance: The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the U.S.*, 2006
4. Studies and local planning data related to the local economic impacts of spent fuel storage, such as the following:
 - a. *The impacts of nuclear facilities on property values and other factors in the surrounding communities* by Roger H. Bezdek, Robert M. Wendling, International Journal of Nuclear Governance, Economy and Ecology (IJNGEE), Vol. 1, No. 1, 2006
 - b. General Plans and websites for the Cities of Atascadero, Morro Bay, Pismo Beach and the City and County of San Luis Obispo.
 5. Studies, testimonies, and presentations related to Yucca Mountain and spent fuel transport including by DOE, the State of Nevada, the State of California, and Inyo County.
 6. Information on and reviews of DOE's reprocessing initiative, such as the following:
 - a. DOE reports and presentations
 - b. *Review of DOE's Nuclear Energy Research and Development Program*, National Academies, 2007

Task 6: Assessment of Other Nuclear Power Policy and Planning Issues

In this task, the contractor will consider a number of additional policy and planning issues that should be examined as part of the Nuclear Power Plant Assessment. These will include examining the life cycle costs and environmental impacts of nuclear power plants compared with energy y alternatives, assessing the impact of certain rising prices on the cost of nuclear power, assessing local economic impacts of nuclear power and alternative power sources, and evaluating the costs and benefits of obtaining license extensions for California's nuclear plants.

Scope of Nuclear Power Policy and Planning Issues Assessment

Topic Areas	Scope of Assessment
1. Compare life cycle costs and environmental impacts	<ul style="list-style-type: none"> Compare the life cycle costs and environmental impacts of nuclear power to the life cycle costs and environmental impacts of alternative baseload power sources that could be added in California. Evaluate the impacts of once-through cooling and greenhouse gas emissions related to nuclear power generation. Assess effects of the State Water Resources Control Board's planned regulatory actions pertaining to once-through cooling.
2. Examine options for baseload replacement power	<ul style="list-style-type: none"> Examine the potential sources for additional power in the state and construct a reasonable portfolio of resources from those potential sources over a time frame consistent with evaluation of possible license extensions for Diablo Canyon and SONGS.
3. Assess impacts of rising fuel costs, personnel costs, and security costs	<ul style="list-style-type: none"> Use publicly available information to analyze the impact of rising nuclear fuel prices on the cost of power from Diablo Canyon and SONGS. Evaluate the supply-demand balance in the labor market for nuclear power plant workers and provide a high-level assessment of the availability of workers for Diablo Canyon and SONGS. Monitor proceedings at the NRC, Congress, and state agencies related to security measures at nuclear power plants and spent fuel storage facilities. If additional security requirements are imposed, assess the economic impacts of these requirements on Diablo Canyon and SONGS.
4. Assess local economic impacts of nuclear power and alternatives	<ul style="list-style-type: none"> Provide an update to the 2001 Environmental Performance Report prepared by the Energy Commission which included a detailed analysis of local economic impacts from California's power plants, including its two nuclear facilities. An assessment of the socioeconomic impacts to local communities from long-term waste storage and from possible tritium leaks will be included.
5. Assess costs, benefits, and impacts of license extensions for Diablo Canyon and SONGS	<ul style="list-style-type: none"> Use the cost and impact data compiled as part of Task 5 to assess additional costs, benefits, and impacts to state and local governments from extending the life of SONGS and Diablo Canyon through license renewal.

Representative List of Studies to be Reviewed for Nuclear Power Policy and Planning Issues Assessment

1. Reports on power generation life cycle costs, such as the following:
 - a. *Comparative Costs of California Central Station Electricity Generation Technologies*, Energy Commission 2007
 - b. *Scenario-Based Assessment of Resource Plans Predicated on Large Penetration of Preferred Resources*, Energy Commission 2007

- c. *Alternatives to the Indian Point Energy Center for Meeting New York Electric Power Needs*, National Academies, 2006
 - d. Data produced by PG&E and SCE in response to 2007 IEPR data requests on costs of Diablo Canyon and SONGS
 - e. Shropshire, et. al. *Advanced Fuel Cycle Cost Basis*, Idaho National Lab, April 2007
 - f. California Energy Commission, *Environmental Policy Report*, December 2007.
2. Reports on the nuclear labor market, such as the following:
 - a. NRC and U.S. Department of Labor reports, data, and presentations on the supply-demand balance in the nuclear plant labor market
 - b. Leonard Bond, Kevin Kostelnik, and Richard Holman, *Addressing the Workforce Pipeline Challenge*, ANS Winter Meeting and Nuclear Technology Expo, INL/CON-06-11700 November 2006
 3. NRC reports and decisions related to reactor and spent fuel storage security, including from the following proceedings:
 - a. Docket 72-26: Diablo Canyon dry cask storage licensing
 - b. State of Massachusetts and State of California petitions for rulemaking PRM 51-10 and PRM 51-12: Environmental impact assessments of spent fuel storage (including impacts of sabotage)