

**COMPLAINT COUNSEL’S
PROPOSED FINDINGS OF FACT,
CONCLUSIONS OF LAW,
AND ORDER**

TABLE OF CONTENTS

VOLUME 1

COMPLAINT COUNSEL’S PROPOSED FINDINGS OF FACT:

I.	Background and Introductory Material.	-1-
	A. Introductory Matter.	-1-
	B. Executive Summary and Theory of the Case.	-2-
	C. Background on Key Players.	-9-
	1. Union Oil Company of California.	-9-
	2. California Air Resources Board.	-19-
	3. Refining Industry in California.	-20-
	4. Auto/Oil Air Quality Improvement Research Program.	-22-
	5. Western States Petroleum Association.	-22-
	D. Background on Gasoline.	-22-
	1. Reformulated Gasoline.	-23-
	a. What Is Reformulated Gasoline?	-23-
	b. How Can Reformulated Gasoline Reduce Pollution?	-23-
	2. Types of Regulations Relating to Reformulated Gasoline: Standards Based on Specifications and Predictive Models. . .	-25-
II.	The California Air Resources Board and Clean Fuels Efforts Prior to the Phase 2 Reformulated Gasoline Rulemaking.	-27-
III.	CARB's Phase 2 Reformulated Gasoline Rulemaking.	-30-
	A. Overview of the Phase 2 RFG Rulemaking.	-30-
	B. CARB Operated Under Significant Constraints During the Phase 2 Reformulated Gasoline Rulemaking.	-32-
	1. The California Legislature Mandated that CARB Take Specific Actions to Improve Air Quality.	-32-
	a. CARB Did Not Have Unbridled Discretion to	

	Take Whatever Actions it Wished to Promote Cleaner Air.	-32-
b.	The California Clean Air Act Constrained CARB’s Discretion in the Phase 2 Reformulated Gasoline Rulemaking.	-33-
c.	CARB Officials Recognized that California Law Constrained CARB’s Discretion.	-35-
2.	The California Administrative Procedures Act Required Substantial Evidence for CARB’s Regulatory Actions.	-37-
3.	The California APA Required CARB to Base its Regulations on an Extensive Record.	-40-
4.	CARB Routinely Engaged in Highly Complex Scientific and Economic Analysis.	-43-
a.	Unocal Knew that CARB Made Decisions Based on Technical Merit Rather than Political Considerations.	-45-
b.	Participants in the Phase 2 Reformulated Gasoline Rulemaking Process Had a Technical Focus.	-46-
c.	Refiners Provided CARB With Scientific and Technical Information.	-47-
d.	CARB Managers Believed Sound Science Should Govern the Phase 2 Rulemaking.	-49-
5.	CARB Wanted to Preserve its Credibility and International Reputation for Technical Expertise.	-50-
D.	CARB Had an Obligation to Minimize the Costs of the Phase 2 Reformulated Gasoline Regulations.	-51-
1.	California Law Required CARB to Consider the “Effect on the Economy of the State” and Take “Cost Effective” Measures in Developing the Regulations.	-51-
2.	CARB Sought to Develop Regulations that Minimized the Cost to Consumers.	-52-
E.	CARB Sought to Avoid Taking Regulatory Action That Would Adversely Impact Competition.	-52-
F.	CARB Sought to Avoid Taking Regulatory Action That Would Adversely Affect Supply of Reformulated Gasoline.	-54-
IV.	Unocal Developed Emissions Research to Obtain a Competitive Advantage.	-56-
A.	Unocal Recognized the Impact of the Regulatory Process on Its Business, and Participated in this Process to Gain Competitive Advantage.	-56-
1.	Unocal Responded to Financial Pressures and to the Threat of Mandates for Alternative Fuels Such as Methanol.	-56-

2.	Unocal Considered Fuel Emissions Research Done by Others Insufficient for Its Purposes.	-57-
3.	Unocal Recognized the Potential Licensing Value of Emissions Research.	-58-
4.	Unocal Recognized the Need to Both Conduct Research and Participate in the Regulatory Process.	-59-
B.	Unocal Created a Fuels Issues Team to Decide How to Take Advantage of New Regulations.	-60-
C.	Unocal's Reformulated Gasoline Research: the "5/14 Project."	-62-
1.	Unocal Initiated Fuel Emissions Research In Response to Impending Reformulated Gasoline Regulations.	-62-
2.	Unocal Scientists Performed Experiments to Determine the Effects of Gasoline Properties on Automobile Exhaust Emissions	-64-
a.	Unocal's Research Showed the Relationships Between Key Gasoline Properties and Automobile Emissions.	-66-
b.	Unocal's Research Showed that Reducing T50 Significantly Reduces Emissions.	-66-
c.	Unocal's Study Determined Specific Directional Relationships Between Fuel Properties and Emissions.	-67-
d.	Unocal Discovered Mathematical Equations Demonstrating the Directional Relationships Between Gasoline Properties and Automobile Emissions.	-68-
e.	Unocal's Research Showed That A "Predictive Model" Could Be Used to Predict Emissions Associated with A Given Formula of Gasoline.	-70-
f.	Unocal's Research Data Showed How to Make and Use Low Emissions Gasoline.	-70-
D.	The Highest Levels of Unocal Management Recognized the Importance of Unocal's Emissions Research to the Company.	-72-
1.	Unocal Scientists Presented Their Research to Roger Beach, President of the Refining and Marketing Division, on May 11, 1990.	-72-
2.	Unocal's Executive Committee Received a Presentation of the Emissions Research, Which Became Known as the "5/14 Project," on May 14, 1990.	-72-
3.	Unocal Senior Management Had the Knowledge, Experience, and Interest to Recognize the Importance of Unocal's 5/14 Research.	-74-

4.	Unocal’s Executive Committee Approved Funding for Further Research in Late May 1990 and Monitored the Progress of the 5/14 Project.	-75-
V.	Unocal Recognized the Connection Between the Licensing Value of its Emissions Research and Reformulated Gasoline Regulations.	-77-
A.	In Memos Circulated to Unocal Management Throughout 1989 and 1990, Unocal Recognized the Value of Having Every Gallon of Gasoline Covered by A Patent.	-81-
B.	In Memos Circulated to Unocal Management Throughout 1989 and 1990, Unocal Employees Described Plans to Make Unocal Research Required in the Industry.	-83-
C.	In the Spring of 1991, Unocal’s Senior Management Knew That a “Pot of Gold” Could Result From Unocal’s Issued Patents Based on the 5/14 Project.	-84-
VI.	Unocal Determined That Competitive Advantage Could Best Be Achieved Through Use of the Regulatory Process.	-87-
A.	Unocal’s Researchers Led An Early Push to Influence Regulations By Publicizing the Results of Their Research.	-87-
B.	Unocal Pursued a Patent Based on the 5/14 Project.	-91-
1.	Unocal Management Decided to Pursue a Patent.	-91-
a.	Unocal’s Senior Management Approved Pursuing a Patent in May 1990.	-91-
b.	Unocal Scientists Filed An Invention Disclosure in July 1990.	-91-
c.	Unocal Management Recognized the Importance of a Potential Patent.	-94-
i.	Unocal’s Conception Committee Gave the Invention an “A” Rating.	-94-
ii.	The Process Used to Prosecute the Patent Demonstrates Unocal’s Recognition of the Importance of the Invention.	-96-
d.	Unocal Filed a Patent Application on December 13, 1990.	-97-
2.	Unocal’s Scientists and Co-Inventors Aided the Chief Patent Counsel’s Preparation and Prosecution of the Patent Application.	-97-
3.	Unocal Knew That the Scientists’ Invention Had Significant Value and Intended to Enforce its Proprietary Rights.	-99-
C.	Unocal Explored, But Abandoned, the Option of Seeking Competitive Advantage by Using the 5/14 Project Results Internally.	-101-
1.	Unocal Explored the Possibility of Introducing an “Interim RFG” in the Marketplace.	-102-

	a.	Unocal Management Initially Decided Not to Publicize the 5/14 Research While it Considered the “Interim RFG” Option.	-102-
	b.	Unocal Management Concluded in May 1991 That the “Interim RFG” Product Could Not Be Successfully Marketed.	-105-
	2.	Unocal Explored Using the 5/14 Project Results to Make Refinery Modifications that Would Enable it to Gain Competitive Advantage By Producing Reformulated Gasoline.	-106-
D.		Unocal Engaged in a Strategy of Using Its Emissions Research to Influence Fuels Regulations and the Industry.	-106-
	1.	Unocal Management Monitored the Patent Prosecution Process.	-109-
	2.	Unocal Management Knew that Achievement of a Competitive Advantage Required Influencing Regulations.	-110-
	3.	Unocal Management Knew That Unocal Could Obtain a “Pot of Gold” From Licensing its Reformulated Gasoline Technology.	-111-
	4.	Unocal Management Knew That Obtaining Competitive Advantage Required Pursuit of a Patent Strategy.	-113-
VII.		Unocal’s Patent Application on the Invention from the 5/14 Project	-115-
	A.	Summary of the Invention: ‘393 Patent Application.	-116-
	B.	The Patent Application Included a Drawing Section with Graphs and Tables.	-118-
	C.	The Patent Application Contained Equations That Embodied the Directional Relationships Between Emissions and Gasoline Properties.	-119-
	D.	The Patent Application Contained Illustrative Examples Demonstrating How Drs. Jessup and Croudace Developed Their Invention.	-120-
	E.	The Patent Application Contained a Detailed Description of the Invention.	-121-
	F.	The Patent Application’s Detailed Description Discloses Limitations of the ‘126, ‘567, ‘866 and ‘521 Patents.	-122-
	G.	The Patent Application Contains Original Claims.	-123-
	H.	Drs. Jessup and Croudace Monitored the Status of the Patent Application.	-124-
VIII.		CARB’s Initiation of the Phase 2 Reformulated Gasoline Rulemaking.	-126-
	A.	CARB Staff Engaged in an Intensive Collaborative Dialogue With the Refining and Automobile Industries in Order to Obtain the Necessary Technical Information to Develop the Regulations.	-126-
	B.	CARB Depended Heavily on Industry Sources to Provide Accurate Cost Information.	-129-

C.	CARB Staff Repeatedly Requested Actual Cost Information from Refiners, Including Unocal.	-132-
D.	CARB Expected That Refiners, in Making Assertions About Cost Generally, Would Incorporate Any Information That Could Significantly Affect Costs.	-133-
E.	Industry Members Collaborated Throughout the Phase 2 Reformulated Gasoline Rulemaking to Assist CARB in the Regulatory Development.	-136-
1.	Auto/Oil Developed Data and Information for CARB.	-136-
2.	WSPA Developed Data and Information for CARB.	-137-
IX.	Unocal Management Decided by May 1991 to Seek Competitive Advantage Through Use of the 5/14 Project Results to Influence the CARB Phase 2 Reformulated Gasoline Regulations.	-138-
A.	Unocal Requested a Meeting With CARB in May 1991.	-139-
1.	Unocal Wanted to Convince CARB to Adopt a T50 Specification.	-140-
2.	Unocal Wanted to Convince CARB to Adopt a Predictive Model.	-141-
B.	Prior to the June 20, 1991 Meeting With Unocal, CARB Had Not Proposed A T50 Specification.	-142-
C.	Prior to the June 20, 1991 CARB Meeting, Unocal Employees Discussed What Information Should Be Disclosed to CARB.	-144-
D.	Unocal Management Decided to Conceal From CARB Unocal's Pending Patent Application Relating to the 5/14 Project Results.	-145-
1.	No Absolute Unocal Policy Prohibited Disclosure of the Pending Patent Application to CARB.	-147-
2.	Unocal Had Earlier Considered Disclosing the RFG Patent Application to the Public.	-148-
3.	Unocal and Other Companies Had Disclosed Patents Pending on Proprietary Information.	-149-
E.	Unocal Urged CARB at the June 20, 1991 Meeting to Incorporate its Invention in the Regulations.	-149-
1.	Unocal Presented Information to CARB at the June 20, 1991 Meeting in a Manner Consistent with Unocal's Goal to Achieve Competitive Advantage.	-149-
2.	Unocal Showed CARB its 5/14 Test Design and Experiments.	-152-
3.	Unocal Showed CARB the Directional Relationships the Scientists Discovered Between Properties and Emissions.	-153-
4.	Unocal's Presentation to CARB Taught CARB the Importance of T50.	-154-
5.	Unocal Showed CARB That Mathematical Equations Expressed the Directional Relationships Between Gasoline Properties and	

	Automobile Emissions.	-154-
6.	Unocal’s Presentation Taught CARB How to Identify Gasoline Compositions with Reduced Emissions (Many of Which Were Covered By Unocal’s Pending Patent Claims).	-155-
7.	Unocal Knew That CARB’s Use of its 5/14 Project Results Would Lead to Regulations That Intersected Unocal’s Pending Patent Rights.	-159-
8.	Unocal “Got What it Wanted” at the June 20, 1991 CARB Meeting.	-161-
F.	Following the June 20, 1991 CARB Presentation, Unocal Provided CARB All of its 5/14 Data and Represented That These Data, Including the Presentation Slides, Equations, and Underlying Database, Were “Non-proprietary.”	-164-
1.	Unocal Provided CARB With the Complete Mathematical Equations in a July 1, 1991 Letter.	-164-
2.	Unocal Provided CARB with a Computer Disk Containing Information from Unocal’s Research.	-166-
3.	CARB Requested Unocal’s Research Information for Use in the Phase 2 Reformulated Gasoline Rulemaking.	-167-
4.	In an August 27, 1991 Letter Unocal Represented to CARB That Its Data Were “Non-Proprietary” and “Available.” . . .	-169-
G.	Unocal Conveyed the Deceptive Message That CARB Could Freely Use Unocal’s 5/14 Research Without Any Cost or Economic Consequences.	-170-
1.	The Reference to “Data” in the August 27, 1991 Letter Meant All of Unocal’s Research Information, Including the Presentation Slides, Equations, and Database.	-172-
2.	Unocal’s Use of the Term “Non-Proprietary” in the August 27, 1991 Letter Was Consistent With Its Use of the Term “Proprietary” As Referring to Ownership and Property Rights-	-173-
a.	Prior to August 27, 1991, Unocal Employees Understood the Term “Proprietary” to Mean Possessing a Property Interest in a Product or Technology.	-173-
b.	After August 27, 1991, Unocal Employees Continued to Use the Term “Proprietary” to Mean Possessing a Property Interest in a Product or Technology.	-176-
X.	During the Phase 2 Reformulated Gasoline Development Unocal Knew That CARB Had Concerns About the Costs and Potential Supply of Reformulated Gasoline. . .	-177-

A.	Unocal Knew That CARB Was Actively Seeking Cost Information.	-179-
1.	CARB Actively Sought This Information.	-179-
2.	Unocal Representatives Were Aware of CARB’s Requests for Cost Information.	-180-
B.	Unocal Knew That the Industry Was Submitting Economic Studies to CARB.	-181-
1.	Auto/Oil Submitted Economic Studies to CARB.	-181-
2.	WSPA Commissioned Economic Studies for CARB.	-183-
C.	Unocal’s Complaints to CARB About the Costs of CARB’s Regulations Demonstrate that Unocal Knew CARB was Concerned About Cost.	-184-
1.	Unocal Submitted Testimony and Comments About the Cost-Effectiveness of CARB Regulations.	-185-
2.	Unocal Played a Role in Formulating WSPA’s Cost-Effectiveness Position.	-185-
3.	Unocal Railed Against the Small Refiner and Independent Refiner Exemptions Because Unocal Claimed that Those Exemptions Would Tilt the Playing Field.	-186-
XI.	Unocal Viewed its Participation in Auto/Oil as an Integral Part of its Overall Strategy to Gain Competitive Advantage.	-187-
A.	Because of the Scientific Weight Behind Auto/Oil, Unocal Sought to Obtain Auto/Oil’s Support for Unocal’s Research Findings.	-188-
1.	Auto/Oil Established a Formal Working Framework to Facilitate Collaboration In Order to Give Regulators Sound Technical and Scientific Information.	-189-
2.	Unocal Manipulated Auto/Oil In Order to Gain Competitive Advantage.	-195-
B.	Through its Express Statements and Conduct, Unocal Represented it Would Grant to Auto/Oil Members and the Public Full and Free Rights to Unocal’s 5/14 Project Results.	-198-
1.	Dr. Jessup Expressly Represented that the Data Presented, Which Included the Teachings in the Presentation Slides and the Data Disk, Were in the Public Domain.	-200-
a.	Direct Evidence Demonstrates That Dr. Jessup Said the Data Were in the Public Domain and That He Gave the Data Away.	-200-
b.	Contemporaneous Meeting Minutes Confirm that Dr. Jessup Stated That the Data Were in the Public Domain.	-201-
c.	Unocal Understood That It Would Waive Any	

	Proprietary Rights to the Data or Its Use by Presenting the Information to Auto/Oil.	-203-
2.	Dr. Jessup’s Presentation of the 5/14 Research Data to Auto/Oil Amounted to a Representation That the Data Were in the Public Domain.	-205-
	a. The Underlying Purpose of Auto/Oil, and The Agreement Creating That Body, Made Clear That Any Data Presented to Auto/Oil Became the Work of the Program and Placed in the Public Domain.	-207-
	b. The Conduct and Course of Dealing of Auto/Oil and Its Members Made Clear That, Absent Special Measures Not Taken for Unocal’s Presentation, Any Data Presented to Auto/Oil Were in the Public Domain.	-209-
	c. Auto/Oil Members Had a Mechanism for Dealing with Proprietary Information.	-211-
3.	Unocal’s Representation That the 5/14 Research Was in the Public Domain Amounted to a Representation that Anything Derived From Unocal’s Slides, Equations, Directional Relationships, and Data Disk Were Not Subject to Any Patent or Other Intellectual Property Protection.	-215-
C.	Unocal’s Misrepresentations to Auto/Oil Caused Competitive Harm.	-219-
	1. Unocal’s Misrepresentations to Auto/Oil Are an Independent Source of Harm Because the Auto/Oil Member Refiners Made Their Investment and Refinery Modification Choices Without Knowledge of Unocal’s Intent to Charge Royalties For Use of Unocal’s Reformulated Gasoline Technology.	-219-
	a. Auto/Oil Members Relied on Unocal’s Statements and Conduct in Using Unocal’s Research.	-219-
	b. Auto/Oil Members Did Not Find Out About Unocal’s Patents Until it Was Too Late.	-223-
	c. Several Options Were Available to the Auto/Oil Members if Unocal Had Not Made its Misrepresentations to Auto/Oil.	-224-
XII.	Unocal Viewed its Participation in WSPA as an Integral Part of its Overall Strategy to Gain a Competitive Advantage.	-225-

A.	Unocal Highlighted the Effects of T50 Through Its September 1991 Presentation of Its 5/14 Research to WSPA.	-226-
B.	WSPA Members Understood that Unocal’s Research Was Non-Proprietary.	-229-
	1. WSPA Members Based Their Belief That Unocal’s Research was Non-proprietary on the Course of Dealing at WSPA.	-229-
	2. WSPA Members Used Unocal’s Data Because They Believed the Data Were Non-proprietary.	-231-
	3. WSPA Members Would Have Violated Their Respective Corporate Policies Had They Accepted Proprietary Information.	-233-
C.	Unocal Used WSPA to Advocate to CARB That There Should be a Predictive Model Containing T50.	-235-
	1. Unocal Became Very Involved in the WSPA Predictive Model Group In Order to Influence CARB.	-235-
	2. WSPA Developed a Predictive Model Heavily Influenced By Unocal’s Research.	-237-
	3. While Participating in the WSPA Predictive Model Group, Unocal Continued to Work Directly with CARB.	-240-
D.	Unocal Continued to Conceal its Plan to Charge Royalties for its RFG Technology as it Worked With WSPA on Several Studies to Prepare Cost Information for CARB.	-245-
	1. Unocal Knew From Prior Studies that Submitting Information on Royalties Was Important.	-246-
	2. WSPA Selected Turner Mason to Help With Its Cost Studies for CARB.	-247-
	3. CARB Relied on the Turner Mason Cost Study in the Phase 2 Reformulated Gasoline Rulemaking	-248-
	4. The DRI/McGraw-Hill Study Conducted for WSPA Used the Cost Information From the Turner Mason Study and Was Submitted to CARB.	-255-
	5. Sierra Research Conducted a Study on Behalf of WSPA That Was Submitted to CARB.	-256-
E.	WSPA Members Suffered Harm From Unocal’s Conduct Because the Refiners Made Their Investment and Refinery Modification Choices Without Knowledge of Unocal’s Intent to Charge Royalties for Use of Unocal’s Reformulated Gasoline Technology.	-256-
	1. WSPA Members Did Not Find Out About Unocal’s Patent Until It Was Too Late.	-256-
	2. Several Options Were Available to WSPA Members If Unocal Had Not Misled WSPA.	-257-

XIII. CARB Issued Proposed Phase 2 Reformulated Gasoline Regulations That Incorporated

Unocal's 5/14 Research Results.	-259-
A. Summary of the Proposed Regulations.	-259-
B. CARB Relied on Unocal's Research in Developing the Phase 2 Reformulated Gasoline Regulations.	-261-
1. CARB Staff Relied on Unocal's Research to Incorporate a T50 Specification in the Proposed Regulations.	-261-
2. CARB Used Unocal's Regression Equations to Develop the Phase 2 Reformulated Gasoline Regulations.	-263-
3. CARB Included Unocal's Presentation Slides as Technical Support for the Phase 2 Reformulated Gasoline Regulations.	-264-
C. CARB Staff Conducted an Analysis of Expected Costs for the Phase 2 Reformulated Gasoline Regulations.	-265-
XIV. Unocal Continued to Conceal Its Scheme in Interactions with CARB Prior to the CARB Board Hearing on November 21, 1991.	-265-
A. Prior to an October 29, 1991 Meeting with CARB Staff, Unocal Had Internal Discussions About What Concerns to Raise with CARB.	-265-
B. Unocal Met With CARB Staff on October 29, 1991 to Discuss Unocal's Concerns.	-267-
XV. CARB Approved Phase 2 Reformulated Gasoline Regulations at a Board Hearing on November 21-22, 1991.	-269-
A. Unocal In Its Formal Comments and Testimony on the Phase 2 Regulations Failed to Disclose the Pending Patent and Withheld Criticism of T50.	-269-
B. CARB Staff Proposed a Less Costly Regulation Based Largely Upon Information in WSPA's Turner Mason Study.	-270-
C. Unocal's Research Remained the Basis for The Board's T50 Specification.	-271-
D. The CARB Board, and Unocal Itself, Publicly Expressed Concerns About Cost Issues in November 1991.	-272-
E. The CARB Board, and Unocal Itself, Publicly Expressed Concerns About Preserving Competition at the November 1991 Hearing.	-273-
F. The CARB Board and the Refiners at the November 1991 Hearing Publicly Expressed Their Understanding that Refiners Quickly Would Become Locked In to the Phase 2 Specifications.	-274-
XVI. Unocal Continued to Conceal Its Plan to Enforce Proprietary Rights Related to Its 5/14 Research After the November 21-22, 1991 CARB Board Hearing.	-276-
A. Unocal Took Actions Following the CARB Board Hearing That Reflected Its Intent to Capture the Phase 2 RFG Regulations.	-276-
1. In the Fall of 1991, CARB's adoption of Phase 2 specifications Increased the Importance of the Pending Patent Application Because it Seemed Likely that Refiners Would Make Fuel Covered	

	by Unocal’s Pending Patent Claims.	-276-
2.	In March 1992, Unocal Amended Its ‘393 Patent Application to Create Greater Overlap with CARB’s Phase 2 RFG Specifications.	-278-
3.	By the Summer of 1992, the Highest Levels of Management at Unocal Knew That Unocal’s Patent Would Likely Be Granted, and That It Would Cover Most, if Not All, of CARB Phase 2 Reformulated Gasoline.	-283-
4.	In the Summer of 1992, Unocal Hired Outside Counsel and Planned for Litigation to Enforce and Obtain Royalties On What Became the ‘393 Patent.	-286-
5.	The Phase 2 Reformulated Gasoline Mandatory Specifications Were Not Approved by the Executive Officer of CARB for Forwarding to the Office of Administrative Law Until September 1992.	-286-
B.	Unocal Continued to Conceal the Pending Patent in 1991-94, While Posturing as a Champion of Low Cost and Competitive Equity. . . .	-287-
XVII.	Unocal Never Told CARB That Unocal Intended to Seek and Enforce A Patent on the CARB Predictive Model.	-290-
A.	CARB Staff Engaged in a Detailed Statistical Analysis of Emissions Properties.	-290-
B.	Unocal Played A Major Role In the Development of the Predictive Model.	-291-
C.	CARB’s Predictive Model Necessarily Incorporated the CARB Specifications And Included Key Parameters in the Unocal Patents.	-292-
D.	Unocal Took Efforts to Have WSPA Lend Its Credibility to Unocal’s Predictive Model.	-292-
E.	Unocal, While Concealing Its Plan to Charge Money, Postured Itself as a Champion of Low Cost and Competitive Equity in the Predictive Model Phase.	-294-
XVIII.	Refiners Began the Efforts to Modify Their Refineries Around the Time that the Phase 2 Regulations Were Approved in November 1991.	-296-
A.	Refiners Began Their Phase 2 Modifications Planning Years Before the CARB’s 1996 Deadline.	-297-
B.	The Permit Applications Were the Key Factor in Planning Refinery Modifications to Meet the CARB Phase 2 Regulations.	-299-
C.	Refinery Planners Faced Skeptical Management As They Planned Phase 2 Modifications.	-300-
1.	ARCO	-300-
2.	Chevron	-300-
3.	Exxon	-301-
4.	Shell	-302-

	5.	Texaco	-302-
D.		Refiners Made Modifications to Produce Gasoline That Complied with CARB's Phase 2 Regulations.	-303-
	1.	ARCO (BP) Carson Refinery.	-304-
	2.	Chevron El Segundo and Richmond Refineries.	-306-
	3.	Exxon (Valero) Benicia Refinery.	-308-
	4.	Mobil (ExxonMobil) Torrance Refinery.	-310-
	5.	Shell Martinez Refinery.	-311-
	6.	Texaco (Shell) Wilmington and Bakersfield Refineries.	-313-
E.		Refiners Chose Alternatives That Pushed the Refiners Towards the Unocal Patents.	-315-
XIX.		Unocal Perfected its Patent Ambush Following CARB's Adoption of the Phase 2 Regulations.	-317-
	A.	Unocal Knew That Refiners Were Making Specific Investments Totaling Several Billions of Dollars to Comply with the CARB Phase 2 Regulations.	-317-
	B.	Unocal Knew That Refiners Were Making Modifications to Produce Gasoline That Would Fall Within the Claims of Unocal's Patents. .	-319-
	C.	Unocal's '393 Patent Issued in February 1994.	-320-
	D.	Unocal Waited Nearly a Year to Publicly Announce the Issuance of its Patent, Announcing its Patent by a Press Release on January 31, 1995.	-320-
	E.	Refiners Learned about the '393 Patent, But Were Stuck with Their Refinery Modifications.	-323-
	1.	Texaco and Chevron Learned of the Patent in March 1994. .	-323-
		a. Chevron and Texaco Investigated the Unocal Patent.	-323-
		b. Chevron and Texaco Sought to Learn Unocal's Intentions, but Unocal Refused to Discuss the Patent.	-324-
	2.	Exxon Lower Level Employees Learned of the Patent in May 1994, But Never Informed Management.	-326-
	3.	Most Refiners Learned about the Unocal Patent from Unocal's Press Release.	-327-
	F.	CARB Learned of the Patent for the First Time From the Unocal Press Release and CARB Management Was Taken by Surprise and Felt That Unocal Misled CARB.	-327-
XX.		Unocal Met With CARB Following the Public Announcement of the '393 Patent, But Continued Unocal's Deceptive Scheme.	-329-
	A.	Unocal Met with CARB Staff on March 17, 1995.	-329-
	B.	Unocal Met with Governor Wilson in March 1995.	-331-
	C.	Unocal Promised Not to Charge Royalties for CARB's Test Batches.	

.....	-333-
D. Unocal Met with CARB Staff on April 25, 1995.	-333-
XXI. Unocal Continued to Expand the Scope of Its Patents After CARB’s Adoption of the Phase 2 Regulations.	-334-
A. Unocal Filed New Patent Applications.	-334-
1. Unocal Management Made a Conscious Decision Not to Disclose Any of Its Continuation Patent Applications to CARB.	-334-
2. Unocal Began Filing for Additional RFG Patents in June 1993.	-335-
3. Unocal Eventually Obtained Four Additional RFG Patents Based on the Original Patent Application.	-338-
a. Unocal Obtained its ‘567 Patent on January 14, 1997, Which Covers Use of Many of the Gasolines Required to Be Made Under the CARB Phase 2 Regulations.	-338-
b. Unocal Obtained Its ‘866 Patent on August 5, 1997, Which Covers Use of Many of the Gasolines Required to Be Made Under the CARB Phase 2 Regulations.	-339-
c. Unocal Obtained its ‘126 Patent on November 17, 1998, Which Covers Many of the Gasolines Required to be Made Under the CARB Phase 2 Regulations, and Methods of Making and Delivering Them to Service Stations.	-341-
d. Unocal Filed its Fifth Patent Application in 1998, and Obtained its ‘521 Patent on February 29, 2000.	-344-
XXII. Unocal Has Enforced its RFG Patents Through Licensing and Litigation Activities.	-346-
A. Unocal Has Enforced its Patents Through Litigation Activities. ...	-347-
B. Unocal Has Enforced its Patents Through Licensing Activities.	-349-
XXIII. Unocal Engaged in Exclusionary Deceptive Conduct.	-354-
A. Unocal’s Deceptive Conduct Is Inefficient and Should Be Condemned.	-354-
1. Definition of Opportunism.	-356-
2. The Connection Between Opportunism and Market Power. .	-359-
B. Exclusionary Conduct Through Deception and Misrepresentation Has No Efficiency or Other Justification.	-360-
1. There Are No Business Justifications for Unocal’s Misrepresentations to CARB.	-360-

2.	There Are No Business Justifications for Unocal’s Failure to Disclose Its Patent to CARB and Auto/Oil.	-361-
XXIV.	Relevant Markets.	-364-
A.	A Firm That Controls the Technology for Producing Gasoline Compliant with CARB’s Summertime Reformulated Gasoline Regulations Can Profitably Price That Technology above the Competitive Levels. . .	-364-
1.	Technology Markets in General.	-364-
2.	The Technology Market in this Case.	-365-
B.	A Firm That Controls All CARB-Compliant Summertime Reformulated Gasoline Would Be Able to Profitably Price that Gasoline Above the Competitive Levels.	-367-
XXV.	Unocal Has the Ability to Raise or Maintain Prices Above Competitive Levels and Exclude Competitors in the Technology Market.	-369-
A.	The Economic Theory of Opportunism Demonstrates That Unocal Has Obtained Monopoly Power.	-370-
B.	Direct Evidence Demonstrates That Unocal Has the Power to Raise Prices in the Technology Market.	-373-
1.	Unocal Has Extracted Money for Its RFG Technology, Even Though the Competitive Price for Unocal’s Technology Is Zero.	-373-
a.	The Competitive Price was Zero.	-373-
b.	Unocal’s Representation of a Zero Cost Royalty Makes Sense in the Context of Technology Competition.	-374-
c.	Economic Theory Demonstrates the Rationality of Making Royalty-Free Representations.	-375-
d.	Unocal Has Monopoly Power Because It Is Seeking, and Has Collected, Royalties Above Zero.	-376-
e.	{ }	-379-
f.	Royalties Charged By Unocal Outside California are Not the Appropriate Benchmark to Establish the Market Value of Unocal’s Patented Technology.	-380-
g.	{ }	-383-
C.	Indirect Evidence of Market Power.	-386-

- 1. Refiners are Likely Infringing One or More of the Unocal Patents in Large Numbers. -386-
- 2. Unocal's Patents are Valid and Present a Business Risk to Refiners. -386-
- 3. Unocal Has Claimed That Its Patents Cover the CARB Regulations. -389-
- 4. Unocal's Patents Overlap Substantially with the CARB Reformulated Gasoline Regulations. -391-
- 5. The Coverage Rate is a Useful Indicator of Monopoly Power. -394-
 - a. There are No Technology Suppliers Available to Constrain Unocal's Monopoly Pricing -395-
 - b. Approximately 93 Percent of CARB-Compliant Gasoline Falls Within the Numerical Limitations of the Unocal Patents. -395-
- 6. The Evidence Demonstrates That Overlap With the Numerical Property Limitations of the Unocal Patents Shows Likely Infringement. -400-
 - a. { -400-
 - } -400-
 - b. The Refiners Consider the Numerical Limitations of the Unocal Patents as Part of Ordinary Business Practices. -405-
- D. No Serious Dispute Exists as to the Meaning of Any Patent Claim That Unocal Contends Must Be Construed. -406-
 - 1. No Dispute Exists As To the Definition of Gasoline. -406-
 - 2. No Dispute Exists as to Measurement of Hydrocarbons. . . . -407-
 - 3. The Method for Calculating Reid Vapor Pressure Is Clear. . . -408-
 - 4. The Addition of Ethanol to Gasoline Does Not Raise Claim Construction Issues. -408-
- E. Unocal's Own Expert Concedes that 50.4 Percent of the Gasoline in California Actually Infringes the '393 and Part of the '126 Patent, Without Regard to the Remaining Claims of the '126 Patent or the Other Three Unocal Patents. -410-
- F. Unocal's Remaining Patent Elements are Likely to Be Satisfied By the Typical Production Activities at California Refineries. -412-
 - 1. Unocal's Chief Patent Counsel Believed It Inconceivable That Persons Skilled in the Art Would Have Any Doubt as to Whether Refiners Were Infringing Many of the Method and Process Limitations. -412-
 - 2. The '126 Method Claims Describe the Most Basic Elements of Producing Commercial Gasoline. -417-

	a.	Blending at Least Two Hydrocarbon-Containing Streams Together.	-418-
	b.	Produce at Least 50,000 Gallons.	-419-
	c.	Suitable for Combustion in An Automotive Engine.	-419-
	d.	Having the Following Properties:	-420-
	e.	Commencing Delivery of Unleaded Gasoline Produced Pursuant to Step (1) To Gasoline Service Stations.	-420-
	f.	If Only the '393 And The '126 Patents Were Considered, Unocal Would Have A Substantial Overlap Rate With CARB-compliant Summertime RFG Production.	-421-
	3.	The '866 and '567 Claims Describe the Most Basic Elements of Using Gasoline in California Automobiles.	-421-
	a.	Operating an Automobile Having a Spark-induced, Internal Combustion Engine and a Catalytic Converter.	-422-
	b.	To Yield a Reduced Amount of Certain Pollutants When Compared to the A/O Ave.	-423-
	4.	The '521 Claims Merely Describe Making Gasoline Under the Predictive Model.	-424-
G.		California Refiners as a Whole Cannot Avoid the Unocal Patents.	-425-
	1.	Unocal Concedes that Refiners Can Never Avoid the Patents All of the Time.	-427-
	2.	As a Matter of Chemistry, Refiners Cannot Avoid the Unocal Patents to Any Significant Extent.	-428-
	3.	Only Narrow Blending Methods Exist to Avoid the Patents.	-431-
	a.	Refiners Uniformly Testified That They Cannot Avoid the Patents.	-437-
	i.	BP	-437-
	ii.	Chevron	-440-
	iii.	Shell.	-442-
	iv.	Valero.	-453-
	v.	ExxonMobil.	-459-
	4.	{	-464-
	a.	{	-464-
	b.	{	-466-
	c.	{	-467-
	d.	{	-468-

	e.	{	}	-468-
	f.	{	}	-469-
	g.	{	}	-469-
	h.	{	}	-470-
H.	Refiners Cannot Switch to Other Technologies to Substantially Avoid the Unocal Patents.				-471-
	1.	Refiners Cannot Reduce Likely Infringement by Trying Harder.			-471-
	2.	Importing Alkylate to Reduce Likely Infringement Levels is Infeasible and Uneconomic.			-473-
	3.	Importing Iso-Octane to Reduce Likely Infringement Levels is Infeasible and Uneconomic.			-475-
	4.	Importing Iso-Octene to Reduce Likely Infringement Levels is Infeasible and Uneconomic.			-477-
	5.	Refiners Cannot Take Operational Steps to Increase Olefin Levels to a Point Where They Can Consistently Avoid the Patents.			-478-
	6.	On Line Analyzers.			-480-
	7.	CARB’s Phase 3 Regulations Have Not Allowed Refiners to Avoid the Unocal Patents on a Consistent Basis.			-481-
	8.	Even if Refiners Were Able to Avoid the Patents More Frequently, Unocal Would Still Have Monopoly Power.			-482-
I.	Refiners Cannot Avoid the Unocal ‘393 and the ‘126 Patents.				-483-
J.	Unocal Has a Dangerous Probability of Success in Achieving Monopoly Power in the Market for CARB Phase 2-Compliant Summertime Gasoline.				-485-
	1.	Unocal Intended to Monopolize the Downstream Market. . .			-485-
	2.	Suppliers Have Chosen Not to Import CARB-Compliant Gasoline Because of the Unocal Patent Claims.			-486-
	3.	Unocal Royalties Will Raise the Price of CARB-Compliant Summertime Gasoline.			-489-
	4.	Unocal is Still Seeking to Collect Royalties from the Time When Unocal Was in the Refining Business.			-490-
	5.	Unocal Was a California Refiner until 1997.			-491-

XXVI.	By the Time CARB and the Refiners Learned of the Unocal Patent, the Industry and the Regulators Were “Locked-in” to the Phase 2 Regulations and Related Modifications.				-492-
	A.	CARB Could Not Roll Back the Phase 2 RFG Regulations to Avoid the Unocal Patent.			-493-
	B.	CARB Knew That Refiners Had Made Billions of Dollars of Specific Investments to Modify Their Refineries.			-494-
	C.	The Need for Coordination with Refiners and Auto Manufacturers			

	Prevented CARB From Rescinding the Phase 2 Regulations.	-499-
D.	The Need for Coordination by CARB in Implementing a State Implementation Plan Prevented CARB From Rescinding the Phase 2 Regulations.	-501-
E.	CARB Could Not Avoid the Unocal Patents in Subsequent “Phase 3” Amendments to the RFG Regulations.	-501-
	1. Events Leading up to the “Phase 3” Rulemaking in 1999. . .	-501-
	2. Because of Refiner Sunk Investments, EPA’s Approval of the SIP Incorporating Phase 2, and Further California Legislative and Executive Directives, CARB in Phase 3 Could Not Rescind or Reduce the Emissions Benefits of the Phase 2 Rule as a Means of Avoiding the Unocal Patents.	-502-
	3. Due to the Breadth of Unocal’s Patent Claims, CARB in Phase 3 Could Not Revise the Phase 2 Rule in a Manner That Avoided Unocal’s Patents and Maintained the Necessary Emissions Benefits.	-503-
	4. Unocal Representatives Strenuously Argued in Phase 3 Against Relaxing T50 Requirements on Supposed Environmental Protection Grounds.	-504-
	5. CARB’s Issuance of Phase 3 Regulations That Provided No Significant Relief from the Unocal Patents Did Not Signify Indifference to the Patent Issue.	-505-
F.	Unocal Itself Claimed in Subsequent Patent Litigation That CARB and the Refiners Were Locked-in.	-506-
G.	Refiners Are “Locked-in” to Producing Infringing Gasoline.	-507-
	1. By the Time the Refiners Learned of the Unocal Patents, They Had Invested Years of Work in the Phase 2 Modifications. . .	-507-
	a. By the Time Refiners Learned of the Unocal Patent, They Were Stuck with the Plans for Refinery Modifications That They Had Submitted Shortly After the Filing of Permit Applications.	-507-
	b. Opportunities to Make Alternative Refinery Modifications That Would Allow for the Same Level of Production of CARB Gasoline While Avoiding Unocal Patents Were Lost Well Before Refiners Learned of the Patents.	-509-
H.	Phase 2 Modification Pushed Refiners Towards the Claims of the Unocal Patents.	-519-
	1. There Are No Practical Steps That Refiners Can Take Today to Substantially Decrease the Amount of Likely Infringement.	-521-
I.	Unocal’s Own Experts Have Admitted That Refiners Were Locked-in By Their Prior Huge Investments to Produce RFG Under Phase 2 Regulations.	-523-

XXVII.	Unocal’s Deceptive Conduct Caused it to Achieve Market Power.	-526-
A.	Unocal’s Deceptive Conduct Before CARB Was Material to CARB’s Decisionmaking.	-526-
1.	It Was Important for CARB to Know That Unocal’s Plan to Charge Royalties Could Significantly Raise the Cost of the Phase 2 Reformulated Gasoline Regulations.	-526-
a.	CARB Followed its Statutory Mandates and Considered Cost and Maintaining Competition as an Integral Part of the Phase 2 Reformulated Gasoline Rulemaking.	-526-
b.	CARB Expected That Outside Parties, When Urging CARB to Incorporate Research in the Phase 2 Regulations, Would Not Deceive CARB.	-530-
c.	Unocal Knew That CARB Expected, and Depended On, the Accuracy and Truthfulness of Cost Information Provided by Refiners.	-531-
d.	During the Phase 2 Rulemaking, CARB Modified the Proposed Phase 2 Regulations Due to Cost Concerns.	-533-
e.	Unocal Urged CARB to Avoid Costs That Had Far Less Potential Impact than Unocal’s Patents.	-534-
2.	To Preserve the Integrity of its Decisionmaking, it Was Important for CARB to Know That Issuing Phase 2 as Adopted Would Facilitate Unocal’s Acquisition of Monopoly Power.	-536-
a.	Avoiding Favoring Individual Companies Was Integral to CARB’s Mission.	-536-
b.	Unocal Believed and Stated Publicly That CARB Was under a Duty to Preserve Competition and a “Level Playing Field.”	-537-
3.	To Further the Purposes of its Regulatory Decisionmaking, it Was Important for CARB to Know That Unocal’s Pending Patents Could Impact the Supply of Phase 2 Compliant Reformulated Gasoline.	-538-
a.	CARB Had a Responsibility to Ensure an Adequate Supply of Gasoline.	-538-
b.	Unocal Was Well Aware That CARB Viewed Any Threat to Supply as a Critical Factor in the Phase 2 Rulemaking and Implementation.	-539-

B.	CARB Officials Relied on Unocal’s Deceptive Conduct and Were Deceived.	-540-
1.	CARB Included a T50 Specification in the Regulations Because Unocal Presented its Research to CARB Staff.	-540-
	a. CARB Staff Did Not Have Sufficient Information to Justify a T50 Specification Before Receiving Unocal’s Release of Its 5/14 Research.	-540-
	b. The Official Rulemaking Record for Phase 2 RFG Regulations Clearly Shows CARB’s Reliance on Unocal’s T50 Research.	-541-
	i. CARB Relied on Unocal’s Equations.	-542-
	ii. CARB Relied on Unocal’s Presentation Slides.	-543-
	c. Unocal Knew that CARB Relied on Its Research and Informed the U.S. Patent and Trademark Office That Only Unocal Research Persuasively Proved the Emission Reduction Benefits of T50.	-544-
	d. Unocal in the ‘393 Patent Litigation Asserted That Unocal’s T50 Research Was the Basis for CARB’s Decision to Regulate T50.	-547-
	e. Unocal’s Research Provided the Support Necessary for a T50 Parameter in Reformulated Gasoline Regulations.	-548-
	i. CARB Staff Demanded as the Technical Basis for the Regulation Sound Studies That Proved the Independent Effects of the Gasoline Property in Question.	-548-
	ii. CARB Developed the T50 Specification Using Unocal’s Research.	-550-
2.	CARB Reasonably Relied on Unocal’s Assertions That its Research Was “Non-proprietary” and “Available” for Use and That Unocal Would Forego All “Competitive Advantage” If CARB Considered a Predictive Model.	-551-
	a. Unocal Presented its Research as “Non-proprietary” and “Available” for Use.	-551-
	b. Unocal Did Not Reveal its Intentions to Enforce its Patent Rights.	-554-
	c. Unocal Conveyed the Basic Deceptive Message That CARB Could Use Unocal’s 5/14 Research as a Basis for its Phase 2 Reformulated Gasoline Regulations Without Cost.	-555-
	d. Unocal’s Use of the Term Non-Proprietary Was	

	Consistent With the Use of the Term “Proprietary” in Industry As Referring to Ownership and Property Rights.	-556-
e.	Unocal’s Letters, Taken Together, Conveyed the Message That Unocal Would Give up “Competitive Advantage” If CARB Agreed to Consider a Predictive Model.	-557-
f.	CARB Staff Reasonably Understood Unocal’s Communications To Mean That There Were No Associated Costs with Use of Unocal’s Research.	-558-
g.	Unocal Gave CARB All of Its 5/14 Data Including the Graphs, Presentation Materials, and Equations Showing the Invention.	-560-
C.	Unocal’s Deception Before WSPA and Auto/Oil Was Material to the Decisions of California Refiners.	-564-
D.	Refiners Relied on Unocal’s Statements and Conduct Conveying That Unocal’s Research Was in the Public Domain Before Using Unocal’s Research Materials.	-566-
	1. There Were Other Options Available to Refiner Members That Would Have Mitigated Unocal’s Market Power Had Refiners Timely Been Informed of the Unocal Patents.	-566-
	2. Auto/Oil Relied upon Representations That Unocal’s Research Was in the Public Domain and Members Used it to Further Their Own Research.	-567-
	3. WSPA Members Relied upon Representations That Unocal’s Research Was in the Public Domain and Used it to Further Their Own Research.	-570-
E.	Unocal’s Deceptive Conduct Caused Unocal to Achieve Monopoly Power.	-572-
	1. The Proper But-For World Is The One Where Unocal Makes Good On Its Zero Royalty Representation.	-572-
F.	If CARB Had Timely Knowledge of Unocal’s Patent Intentions, CARB Would Not Have Adopted Regulations That Gave Unocal a Monopoly, but Instead Would Have Selected Another Viable Alternative.	-575-
	1. CARB Did Not Know it Was Taking Action Facilitating Unocal’s Exercise of Market Power.	-575-
	2. CARB Decision Makers Would Not Have Approved a Reformulated Gasoline Regulation Giving Unocal Substantial Market Power, But For Unocal’s Misrepresentations About its Patent Rights and Plans to Charge for Use of its Technology.	-576-

a.	CARB Decision Makers Would Not Have Approved the Versions of the Phase 2 Rule That Staff Proposed in October and November 1991.	-576-
b.	The Executive Officer of CARB Would Not Have Approved the Reformulated Gasoline Regulation Proposal Had He Known of Unocal's Plans to Enforce Its Proprietary Interests in Its 5/14 Research.	-578-
c.	CARB's General Counsel Would Not Have Approved Phase 2 RFG Regulations as Adopted Had he Known of Unocal's Pending Patents.	-579-
d.	CARB's Chairman and the CARB Board Would Not Have Approved a Reformulated Gasoline Regulation, As Actually Adopted in November 1991, Knowing That the Reformulated Gasoline it Mandated Potentially Overlapped with a Pending Unocal Patent.	-579-
e.	CARB's Executive Officer Would Have Prevented the Phase 2 Reformulated Gasoline Regulations as Approved, from Being Formally Adopted in September 1992.	-581-
f.	The Views of CARB's Decision Makers Are Entirely Consistent with CARB's Contemporaneous Actions to Avoid Excessive Cost and Adverse Impacts on Competition.	-582-
3.	CARB Had Other Alternatives Than Adopting the Reformulated Gasoline Regulations It Actually Adopted in November 1991.	-582-
a.	CARB Management Had the Option of Delaying the Phase 2 Proceeding to Consider Alternatives.	-582-
b.	CARB Could Have Adopted Other Specifications That Avoided Overlap with Unocal's Patents.	-583-
c.	EPA's RFG Regulations Would Have Achieved Significant Emissions Reductions in California.	-584-
d.	Neither CARB nor Unocal Believed That CARB, to Satisfy the California Clean Air Act, Had No Choice But to Issue Phase 2 as Actually Adopted.	-586-
e.	California Refiners are Able to Avoid the Unocal	

	Patents Under the EPA Complex Model. . . .	-587-
G.	Had Refiners Learned That the Unocal Research Presented to CARB, Auto/Oil and WSPA Was the Subject of a Unocal Patent for Which Unocal Intended to Charge Royalties, the Refiners Could Have Taken a Number of Different Steps to Mitigate Unocal’s Monopoly Power. . .	-591-
	1. Refiners Would Have Informed CARB of the Potential Cost of the CARB Regulations.	-591-
	2. Refiners Would Have Altered Their Investment Plans, Which Would Have Led CARB to Take Action.	-592-
	a. Refiners Would Have Delayed, Limited or Cancelled Investments in Modifications to Make CARB Phase 2-Compliant Gasoline.	-593-
	i. ARCO	-593-
	ii. Chevron	-595-
	iii. Exxon	-599-
	iv. Shell	-604-
	v. Texaco	-607-
	b. Dr. Teece’s Criticisms of Refiners’ Decisions as Not Realistic Is Misplaced.	-609-
	c. As a Matter of Course, the Refiners Would Have Informed CARB of Their Decisions Not to Invest.	-610-
	d. If Refiners Did Not Invest in CARB Phase 2 Capability, the Supply of CARB-Compliant Gasoline Would Have Been Greatly Reduced, and the Price of Gasoline in California Would Have Increased Substantially.	-611-
	3. Refiners Could Have Implemented Alternative Refinery Modifications That Would Have Helped to Minimize Infringement of Unocal’s Patents, Reducing Unocal’s Market Power. . . .	-613-
	a. ARCO’s Carson Refinery.	-616-
	b. Chevron’s El Segundo Refinery.	-617-
	c. Chevron’s Richmond Refinery.	-618-
	d. Exxon’s Benicia Refinery.	-619-
	e. Mobil’s Torrance Refinery.	-622-
	f. Shell’s Martinez Refinery.	-622-
	g. Texaco’s (Shell’s) Wilmington Refinery. . . .	-623-
	h. Valero’s (Ultramar’s) Wilmington Refinery.	-623-
	4. Refiners Could Have Negotiated a Less Expensive Royalty with Unocal.	-625-
XXVIII.	Unocal’s Actions In This Case Are Likely To Harm Consumers.	-629-
A.	Unocal’s Deception Has Harmed the Consumers in the Technology	

Market.	-629-
B. Unocal’s Deceptive and Exclusionary Conduct Has Raised, And Continues To Raise, the Price of CARB Summertime Reformulated Gasoline.	-631-
XXIX. The Proposed Remedy Is Needed to Relieve the Competitive Harm Caused by Unocal’s Conduct.	-636-
A. The Proposed Remedy Will Deter Deceptive Conduct.	-637-
B. The Proposed Remedy Will Not Have Adverse Effects on Innovation.	-637-
C. The Proposed Remedy Will Not Cause Any Harm If The Patents Are Later Found to be Invalid or Not Infringed.	-637-
D. The Harm to Consumers Is Ongoing.	-638-
E. There Is A Strong Likelihood of Recurrence.	-639-
COMPLAINT COUNSEL’S PROPOSED CONCLUSIONS OF LAW	-640-
COMPLAINT COUNSEL’S PROPOSED ORDER	-643-

**UNITED STATES OF AMERICA
BEFORE THE FEDERAL TRADE COMMISSION**

DOCKET NO. 9305

PUBLIC VERSION

**IN THE MATTER OF
UNION OIL COMPANY OF CALIFORNIA**

**COMPLAINT COUNSEL'S PROPOSED
FINDINGS OF FACT**

(VOLUME I)

I. Background and Introductory Material.

A. Introductory Matter.

1. Pursuant to Rule 3.46(d) of the Commission's Rules, 16 C.F.R. § 3.46(d), Complaint Counsel state their intention to file stipulated witness and exhibit indices conforming to the requirements of Rule 3.46(b) and (c) of the Commission's Rules.
2. These Proposed Findings of Fact use the following forms of citation:

Testimony from the trial transcript in this case is cited by witness last name and transcript page, as specified in Paragraph 13 of the Order on Post Trial Briefs, February 3, 2005: (Jessup, Tr. 1544-1545).

Exhibits admitted into evidence in this case are cited by exhibit number and page as specified in Paragraph 17-19 of the Order on Post Trial Briefs, February 3, 2005 and the Order on Joint Request Regarding Post Trial Briefs, February 10, 2005: (CX 5 at 004) or (CX 5 at 004-006).

Testimony from prior depositions is cited by the exhibit number, the deponent's name and the page number, as specified in Paragraph 14 of the Order on Post Trial Briefs, February 3, 2005: (CX 7041 (Alley, Dep at 53)). Page references

refer to the internal numbering of the transcript.

In camera materials are designated using braces and bold type, with reference to the in camera status in italics in the citation, as specified in Paragraph 7 of the Order on Post Trial Briefs, February 3, 2005.

These Complaint Counsel's Proposed Findings of Fact are cited by paragraph, as follows: (CCPF ¶¶ _-_-).

B. Executive Summary and Theory of the Case.

3. On March 4, 2003, the Federal Trade Commission issued a complaint against Union Oil Company of California ("Unocal"). The Complaint alleged that Unocal has violated Section 5 of the FTC Act by monopolizing, attempting to monopolize, and unreasonably restraining trade in the technology market for the production and supply of "summer-time" gasoline to be sold in California pursuant to regulations of the California Air Resources Board ("CARB"). The Complaint further alleged that Unocal has violated Section 5 of the FTC Act by attempting to monopolize, and restraining trade in, the downstream goods market for CARB-compliant "summer-time" gasoline. (Complaint, ¶¶ 99-103).
4. In the Complaint, the Commission set forth a series of factual allegations, which, if proven, would constitute a violation of the FTC Act. (Complaint, ¶¶ 1-103).
5. In this case, there were 43 days of trial, featuring 42 witnesses testifying live. In addition, the testimony of 36 witnesses was offered by deposition, and more than 1,000 exhibits were received into evidence.
6. The evidence demonstrates that Complaint Counsel has proven the key elements identified in the Commission's Complaint. (CCPF ¶¶ 7-69).
7. In late 1988, the California legislature amended the California Clean Air Act to require CARB to reduce harmful automobile emissions, and directed CARB to achieve this goal in part through new standards for automobile fuels. (CCPF ¶¶ 223-245).
8. CARB's specific legislative mandate, promulgated in California Health and Safety Code Section 43018, provided, inter alia, that CARB:
 - a. Take "necessary, cost-effective, and technologically feasible" actions to achieve "reduction in the actual emissions of reactive, organic gases of at least 55 percent, a reduction in emissions of oxides of nitrogen of at least 15 percent from motor vehicles" no later than December 31, 2000;

- b. Take actions “to achieve the maximum feasible reduction in particulates, carbon monoxide, and toxic air contaminants from vehicular sources”; and
- c. Adopt standards and regulations that would result in “the most cost-effective combination of control measures on all classes of motor vehicles and motor vehicle fuels” including the “specification of vehicular fuel composition.”

(CCPF ¶¶ 223-245).

- 9. Following the 1988 California Clean Air Act amendments, CARB embarked on two rulemakings relating to low-emissions gasoline. In these proceedings, “Phase 1” and “Phase 2,” CARB prescribed limits on specific gasoline properties. (CCPF ¶¶ 223-450).
- 10. In the Phase 2 reformulated gasoline proceedings, on which this case focuses, CARB developed comprehensive standards for low-emissions gasoline, commonly referred to as “reformulated gasoline” or “RFG.” (CCPF ¶¶ 246-262). Reformulated gasoline is “cleaner burning gasoline that pollutes less” than standard conventional gasoline. (RX 116 at 001). Generally, reformulated gasoline involves limitations on the properties of gasoline intended to be sold in more densely populated areas where ambient conditions don’t disperse pollutants very effectively. (RX 922 at 144-145).
- 11. Beginning in 1990 and continuing throughout the CARB Phase 2 rulemaking second implementation, Unocal provided materially misleading information to CARB for the purpose of obtaining competitive advantage. (CCPF ¶¶ 1030-1435).
- 12. This information was materially misleading in light of Unocal's suppression of facts relating to the Unocal proprietary interests in Unocal’s emissions research results and Unocal's active prosecution and enforcement of patents based on these research results. (CCPF ¶¶ 1030-1435, 3948-4247, 4358-4447).
- 13. Unocal gave CARB this information in private meetings with CARB, through participation in CARB's public workshops and hearings, and through industry groups that also were commenting on the CARB regulations. (CCPF ¶¶ 1030-2038, 2085-2116, 2275-2325).
- 14. On June 11, 1991 CARB held a public workshop regarding the Phase 2 regulations. (CCPF ¶¶ 935-1029).
- 15. Nine days later, Unocal presented to CARB's staff the results of the Unocal emissions research program (called the “5/14 Project”) to show that cost-effective regulations could be achieved through adoption of a predictive model and to convince CARB of the importance of T50. “T50” is a shorthand term for the temperature at which 50 percent of

a given batch of gasoline evaporates. (CCPF ¶¶ 1129-1241). The specifications CARB had proposed for discussion at the public workshop days earlier did not include a T50 specification. (CCPF ¶¶ 1069-1082).

16. Due to California's severe air quality problems, the state has developed more stringent requirements for reformulated gasoline than otherwise required by federal law. (CX 1665 (Cal. Health & Safety Code §§ 43000, 43018 (1991))).
17. Unocal's then-pending patent application contained numerous claims that included T50 as a critical limitation, in addition to other fuel properties that CARB proposed to regulate. (CCPF ¶¶ 530-532, 726-727).
18. Unocal's management, however, decided not to disclose Unocal's pending '393 patent application to CARB's staff. (CCPF ¶¶ 1093-1128).
19. On July 1, 1991, Unocal provided CARB with the actual emissions prediction equations developed in the Unocal 5/14 Project emissions research program. Unocal requested that CARB "hold these equations confidential, as we feel that they may represent a competitive advantage in the production of gasoline." (CX 25).
20. Nevertheless, Unocal stated: "If CARB pursues a meaningful dialogue on a predictive model approach to Phase 2 gasoline, Unocal will consider making the equations and underlying data public as required to assist in the development of a predictive model." (CX 25).
21. Following CARB's agreement to develop a predictive model, Unocal made the 5/14 emissions research results, including the test data and equations underlying the Unocal 5/14 Project, publicly available. (CCPF ¶¶ 1242-1349).
22. In an August 27, 1991 letter, Unocal stated to CARB: "Please be advised that Unocal now considers this data to be non-proprietary and available to CARB, environmental interest groups, other members of the petroleum industry, and the general public upon request." (CX 29).
23. Read separately or in conjunction with Unocal's July 1, 1991 letter, the August 27, 1991 letter created the materially false and misleading impression that Unocal agreed to give up any competitive advantage Unocal may have had relating to Unocal's purported invention and arising from Unocal's emissions research results. (CCPF ¶¶ 1297-1349).
24. Unocal made numerous subsequent statements and comments to CARB that reinforced the materially false and misleading impression that Unocal had created. (CCPF ¶¶ 1030-1435, 2085-2167).
25. In reasonable reliance on Unocal's representation that the information was no longer

- proprietary, CARB used Unocal's equations in setting a T50 specification. (CCPF ¶¶ 4063-4247).
26. Subsequently, in October 1991 CARB published Unocal's equations in public documents supporting the proposed Phase 2 regulations. (CX 5).
 27. On November 22, 1991, CARB adopted Phase 2 regulations that set standards for the composition of low-emissions Gasoline with specific limits for eight gasoline properties. (CCPF ¶¶ 2117-2167).
 28. Unocal's pending patent claims recited limits for five of the eight properties specified in the CARB Phase 2 regulations, including T50. (CX 1709 at 015; RX 1165A at 012).
 29. In June 1994, CARB amended the Phase 2 regulations to include, as an alternative method of complying, a predictive model that was intended to provide refiners with additional flexibility. (CCPF ¶¶ 218-221).
 30. This “predictive model” permits a refiner to comply with the CARB regulations by producing fuel that – based on the composition and the levels of the eight properties – is predicted to have emissions equivalent to a fuel that meets the strict gasoline property limits set forth in the regulations. (CCPF ¶¶ 218-221).
 31. During the development of the predictive model, Unocal submitted comments to CARB touting the predictive model as offering flexibility and furthering CARB's mandate of cost-effective regulations. (CCPF ¶¶ 2275-2325).
 32. Unocal's statements were materially false and misleading because Unocal suppressed the material fact that assertion of Unocal's proprietary rights would materially increase the cost and reduce the flexibility of the proposed regulations. (CCPF ¶¶ 3948-4062).
 33. Throughout Unocal's communications and interactions with CARB prior to January 31, 1995, Unocal failed to disclose that it had pending patent rights, that Unocal's patent claims overlapped with the proposed regulations, and that Unocal intended to charge royalties. (CCPF ¶¶ 2574-2590).
 34. Unocal's misrepresentations and materially false and misleading statements caused CARB to adopt Phase 2 regulations that substantially overlapped with Unocal's concealed patent claims, including CARB's adoption of a specification for T50 in the CARB Phase 2 regulations and CARB's development of a predictive model that included T50 as one of the parameters. (CCPF ¶¶ 4063-4146).
 35. But-for Unocal's fraud, CARB would not have adopted regulations that substantially overlapped with Unocal's concealed patent claims; the terms on which Unocal was later able to enforce Unocal's proprietary interests would have been substantially different; or

- both. (CCPF ¶¶ 4338-4447).
36. Unocal made misrepresentations to two industry groups. (CCPF ¶¶ 1436-2038).
 37. During the CARB rulemaking, Unocal actively participated in the Auto/Oil Air Quality Improvement Research Program (“Auto/Oil”), a cooperative, joint research program involving the major domestic automobile manufacturers and fourteen oil companies. (CCPF ¶¶ 1439-1494).
 38. The Auto/Oil joint research venture sought to conduct research to measure and evaluate automobile emissions and the potential improvements in air quality achievable through, and relative costs of, the use of reformulated gasolines and other techniques. (CCPF ¶¶ 1439-1494).
 39. The Auto/Oil Agreement provided that “[n]o proprietary rights will be sought nor patent applications prosecuted on the basis of the work of the Program unless required for the purpose of ensuring that the results of the research by the Program will be freely available, without royalty, in the public domain.” (CX 4001 at 007; CCPF ¶¶ 1590-1608).
 40. Once data and information were in fact presented to the Auto/Oil Group, the data and information became the work of the Program. (CCPF ¶¶ 1590-1626).
 41. On September 26, 1991 Unocal presented to Auto/Oil the results of Unocal's emissions research, including the test data, equations, and directional relationships derived from the 5/14 Project. (CCPF ¶¶ 1515-1559).
 42. Unocal informed Auto/Oil participants that the data had been made available to CARB and were in the public domain and that the data would be made available to Auto/Oil participants. (CCPF ¶¶ 1515-1559).
 43. During the CARB rulemaking, Unocal also actively participated in the Western States Petroleum Association (“WSPA”), a trade association of firms engaged in petroleum exploration, production, refining, transportation, and marketing. (CCPF ¶¶ 1749-1789).
 44. WSPA commissioned, and submitted to CARB, three cost studies in connection with the Phase 2 rulemaking. (CCPF ¶¶ 1394-2038).
 45. One of the studies submitted by WSPA and used by CARB to determine the cost-effectiveness of the proposed Phase 2 standards, incorporated information relating to royalty rates associated with refiner patents, including Unocal hydrocracking patents, and could have incorporated costs associated with Unocal’s pending patents. (CCPF ¶¶ 1934-2038).

46. Unocal's presentation of the 5/14 Project research results to WSPA on September 10, 1991 created the materially false and misleading impression that Unocal's emissions research results, including the data and equations, were nonproprietary and could be used by WSPA or WSPA's individual members without concern for the existence or enforcement of any intellectual property rights. (CCPF ¶¶ 1749-1842).
47. Unocal's interactions with Auto/Oil and WSPA prior to January 31, 1995 failed to disclose Unocal's pending patent rights and Unocal's intention to charge royalties, and included false and misleading statements concerning Unocal's proprietary interests in the results of Unocal's emissions research. (CCPF ¶¶ 1749-1842).
48. None of the participants in the WSPA or Auto/Oil groups knew of the existence of Unocal's proprietary interests and/or pending patent rights at any time prior to the issuance of the patent in February 1994, by which time most, if not all, of the oil company participants to these groups had made substantial progress in their capital investment and refinery modification plans for compliance with the CARB Phase 2 regulations. (CCPF ¶¶ 3803-3948).
49. But-for Unocal's fraud, these participants in the rulemaking process would have taken actions including, but not limited to (a) advocating that CARB adopt regulations that minimized or avoided infringement on Unocal's patent claims; (b) advocating that CARB negotiate, or themselves negotiate, license terms substantially different from those that Unocal was later able to obtain; and/or (c) incorporating knowledge of Unocal's pending patent rights in their capital investment and refinery reconfiguration decisions to avoid and/or minimize potential infringement. (CCPF ¶¶ 4433-4716).
50. The relevant Unocal patent claims all derive from patent application No. 07/628,488, filed on December 13, 1990. (Answer ¶ 15; JX 3A at 003).
51. Following the November 1991 adoption of CARB's Phase 2 specifications, Unocal amended Unocal's patent claims in March 1992 to ensure that the claims more closely matched the CARB Phase 2 regulations. (CCPF ¶¶ 2630-2691).
52. On or about July 1, 1992 Unocal received an office action from the U.S. Patent and Trademark Office ("PTO") indicating that most of Unocal's pending patent claims had been allowed, and in February 1993, after submission of additional amendments, Unocal received a notice of allowance from the PTO for all Unocal's pending claims. (CCPF ¶¶ 2220-2245).
53. Unocal did not disclose this information to CARB or other participants to the CARB Phase 2 rulemaking. (CCPF ¶¶ 2543-2573).
54. The PTO issued the '393 patent to Unocal on February 22, 1994. Unocal, however, waited until January 31, 1995 to issue a press release announcing the patent's issuance.

- (CCPF ¶¶ 2519-2542).
55. CARB first became aware of Unocal's '393 patent shortly after that press release. (CCPF ¶¶ 2574-2590).
 56. On April 13, 1995 ARCO, Exxon, Mobil, Chevron, Texaco, and Shell sued in federal district court to invalidate Unocal's '393 patent. (Answer ¶ 68).
 57. Unocal counterclaimed for infringement of that patent. The jury determined that Unocal's '393 patent was valid and infringed, and found that the refiners must pay a royalty of 5.75 cents per gallon for the period from March through July 1996 for sales of infringing gasoline in California. (CCPF ¶¶ 2699-2704).
 58. The United States Court of Appeals for the Federal Circuit subsequently affirmed the trial court's judgment, and the refiner-defendants have made payments totaling \$91 million to Unocal for damages, costs, and attorneys' fees. (Answer ¶ 69).
 59. An accounting action is still ongoing to determine damages for infringing the '393 patent during subsequent periods. (Answer ¶ 70).
 60. On January 23, 2002 Unocal sued Valero Energy Company for willful infringement of both the '393 patent and the '126 patent. In its complaint, Unocal seeks damages at the rate of 5.75 cents per gallon, trebled for willful infringement. (CCPF ¶¶ 2712-2713).
 61. Unocal has also enforced the Unocal patent claims through licensing activities. (CCPF ¶¶ 2718-2757).
 62. To date, Unocal has entered license agreements with { } refiners, blenders, and/or importers covering the use of all five of its reformulated gasoline patents. Unocal has publicly stated that it expects to reap up to \$150 million a year from licensing the Unocal reformulated gasoline patents. (CCPF ¶¶ 2718-2757).
 63. Unocal's fraudulent conduct has resulted in Unocal's acquisition of market power in the following markets: the technology market for the production and supply of CARB-compliant summer-time gasoline in California and the downstream product market for CARB-compliant summer-time gasoline in California. (CCPF ¶¶ 2817-2849).
 64. The extensive overlap between the CARB reformulated gasoline regulations and the Unocal patent claims makes avoidance of the Unocal patent claims technically and/or economically impossible. (CCPF ¶¶ 3174-3654).
 65. Refiners, having invested billions of dollars in sunk capital investments without knowledge of Unocal's patent claims to reconfigure their refineries in order to comply with the CARB Phase 2 regulations cannot produce significant volumes of non-

infringing CARB-compliant gasoline without incurring substantial additional costs. (CCPF ¶¶ 3803-3947).

66. CARB cannot now change the CARB reformulated gasoline regulations sufficiently to provide flexibility for refiners and others to avoid Unocal's patent claims. (CCPF ¶¶ 3703-3802).
67. Had Unocal disclosed Unocal's proprietary interests and pending patent rights earlier, CARB would have been able to consider the potential costs imposed by the Unocal patents, and the harm to competition and to consumers would have been avoided. (CCPF ¶¶ 4338-4447).
68. Unocal has exercised, and continues to exercise, market power through business conduct by enforcing the Unocal reformulated gasoline patents through litigation and licensing activities. (CCPF ¶¶ 2692-2757).
69. Unocal's actions have caused harm to competition and substantial consumer injury. (CCPF ¶¶ 4717-4762).

C. Background on Key Players.

1. Union Oil Company of California.

70. Union Oil Company of California is a public corporation organized, existing, and doing business under, and by virtue of, the laws of California. Unocal's office and principal place of business is located at 2141 Rosecrans Avenue, Suite 4000, El Segundo, California 90245. (Answer ¶ 11; JX 3A at 002).
71. Since 1985, Union Oil Company of California has done business under the name "Unocal." (Answer ¶ 11; JX 3A at 002).
72. Unocal is, and at all relevant times has been, a corporation as "corporation" is defined by Section 4 of the Federal Trade Commission Act, 15 U.S.C. § 44; and at all times relevant herein, Unocal has been, and is now, engaged in commerce as "commerce" is defined in the same provision. (Answer ¶ 12; JX 3A at 001).
73. Prior to 1997, Unocal owned and operated refineries in California as a vertically integrated producer, refiner, and marketer of petroleum products. (Answer ¶ 13; JX 3A at 002).
74. In March 1997, Unocal completed the sale of the Unocal west coast refining, marketing, and transportation assets to Tosco Corporation, but continued to engage in oil and gas exploration and production. (Answer ¶ 13).

75. Unocal is the owner, by assignment, of the following patents relating to low emissions, reformulated gasoline: United States Patent No. 5,288,393 (issued February 22, 1994); United States Patent No. 5,593,567 (issued January 14, 1997); United States Patent No. 5,653,866 (issued August 5, 1997); United States Patent No. 5,837,126 (issued November 17, 1998); United States Patent No. 6,030,521 (issued February 29, 2000). (Answer ¶ 15; JX 3A at 003; Croudace, Tr. 339; Wirzbicki, Tr. 880; CX 617; CX 618; CX 619; CX 620; CX 621).
76. These five patents all share the identical specification. (Answer ¶ 15; JX 3A at 003).
77. These five patents all arise from the same scientific discovery and are related in that they all claim priority based on application number 07/628,488, filed December 13, 1990. (Answer ¶ 15; JX 3A at 003).

Roger Beach

78. Roger Beach became President of Unocal's 76 Division in April 1986. (CX 1578 at 002; Beach, Tr. 1650-1651).
79. Within Unocal, the 76 Division was also referred to as Refining and Marketing. (Beach, Tr. 1676).
80. In 1992, Mr. Beach was appointed COO and President of Unocal Corporation. (Beach, Tr. 1651; CX 593 at 001).
81. In 1994, Mr. Beach was promoted to Chief Executive Officer of Unocal. (Beach, Tr. 1651; CX 1005 at 001; CX 374 at 001).
82. In 1995, one year after being appointed CEO, Mr. Beach became the Chairman of the Board for Unocal. (Beach, Tr. 1651; CX 905 at 001; CX 714 at 001).
83. Mr. Beach served as a member of California's A.B. 234 study panel (the "Leonard Commission") on alternative fuels. (Beach, Tr. 1744; Boyd, Tr. 6693).
84. Roger Beach directed Unocal's efforts to influence CARB during the Phase 2 process. (Beach, Tr. 1658-1659). He was the top person giving directions as to how Unocal would be involved with respect to the Phase 2 regulations. Mr. Beach was the one who instructed Unocal employees who met with CARB. (Beach, Tr. 1658).

Denny Lamb

85. Mr. Dennis W. "Denny" Lamb was employed by Unocal from 1964 until October 1998. (Lamb, Tr. 1796).

86. Mr. Lamb served as Unocal's Manager of Refining and Marketing. (Lamb, Tr. 1796).
87. Mr. Lamb served as Unocal's principal liaison to CARB during the Phase 2 rulemaking. (Lamb, Tr. 1823, 2346).
88. Pursuant to a decision made by Mr. Beach, during the CARB Phase 2 rulemaking, Mr. Lamb was the one person that was designated to speak on behalf of Unocal on fuels issues matters. (Lamb, Tr. 2148).
89. Mr. Lamb had heavy involvement in the drafting of comments and letters submitted to CARB. *See, e.g.*, (Lamb, Tr. 2091-2092; 2094, 2096-2097; CX 1403 (Schmale letter)).
90. Mr. Lamb was never a registered lobbyist for Unocal. (Lamb, Tr. 2154, 2161). At no point in Mr. Lamb's career at Unocal did he work in the Governmental Affairs Division. (Lamb, Tr. 1796-1797).
91. Mr. Lamb had direct dealings with Unocal CEO Richard Stegemeier. Mr. Lamb would meet with Mr. Stegemeier concerning fuels issues, and he would update him from time to time on the progress of CARB's Phase 2 regulations. Roger Beach would ordinarily be present when Mr. Lamb briefed Mr. Stegemeier. (Lamb, Tr. 2094). Mr. Lamb was on a first-name basis with Mr. Stegemeier. (Lamb, Tr. 2120).
92. After Mr. Lamb's retirement, Mr. Lamb participated in 1998 in the CARB Phase 3 RFG proceedings as a consultant for Robins, Kaplan, Miller & Ciresi, counsel for Respondent Union Oil Company of California. (Lamb, Tr. 1799-1801; 1812-1813, 2001; CX 732). Robins, Kaplan, Miller & Ciresi is the law firm that represents Unocal's patent interests. (Lamb, Tr. 1800, 1812).
93. David Beehler, counsel for Respondent Union Oil Company of California, was Mr. Lamb's primary contact person with respect to his contract. (Lamb, Tr. 1812-1813).
94. {
} (Lamb, Tr.
1847-1851, *in camera*). {
} (See CX 1576, *in camera*; CX 1575, *in camera*; CX 1577, *in camera*).
95. {
} (Lamb, Tr. 1849-1850, *in camera*).
96. {

} (Lamb, Tr. 1860-1861, *in camera*).

97. {

} (Lamb, Tr. 1849, *in camera*).

98. {

} (Lamb, Tr. 1849, *in camera*).

99. {

} (Lamb, Tr. 1851-1852, *in camera*).

100. According to a former Unocal employee who worked with Denny Lamb for about ten years (including four years at Unocal), Mr. Lamb “could be sneaky if he wanted to be.” (Kulakowski, Tr. 4558, 4563-4564, 4474).

Peter Jessup

101. Peter John Jessup is a Unocal employee and co-inventor of the discoveries covered by Unocal’s RFG patents. With the exception of one year spent working for Exxon, Dr. Jessup has been at Unocal since 1978. (Jessup, Tr. 1153). During his time at Unocal from 1978 until 1998, Jessup was a research chemist in Unocal’s Science and Technology Division. (Jessup, Tr. 1152-1154). In 1986, Dr. Jessup began working in the area of gasoline blending in refineries. (Jessup, Tr. 1153).

102. In 1989 and 1990, Dr. Jessup and Dr. Croudace discovered the inventions that led to Unocal’s RFG patents. (Jessup, Tr. 1153).

103. Dr. Jessup created for Unocal management to see in 1991 a 4 foot by 8 poster board recounting the history of the fuels research and showing a \$1 billion per year royalty stream from licensing the patents leading to a pot of gold for Unocal. (Jessup, Tr. 1235-1243; CX 2).

104. Dr. Jessup played a key role in preparing and presenting Unocal’s research to CARB in June 1991. (Jessup, Tr. 1244-1245). He also presented Unocal’s research results and supporting emissions test results to industry groups including Auto/Oil and WSPA. (Jessup, Tr. 1480-1481, 1544-1545).

105. Since 1998, Dr. Jessup’s sole role at Unocal has been to provide scientific support to Unocal’s legal department, including support for the litigation relating to the RFG patents. (Jessup, Tr. 1153-1154). During that time, has not been involved in any research for the company. (Jessup, Tr. 1153). Rather, though he is not an attorney, he is directly employed by Unocal’s legal department. (Jessup, Tr. 1154).
106. {
- (Jessup, Tr. 1461, *in camera*).
- } (Jessup, Tr. 1461, *in camera*).
107. Though Dr. Jessup testified that he is “an honest person,” on cross-examination, Dr. Jessup was impeached with his admission that even his “pot of gold” poster – which was intended to influence his management – included information that was “a little dishonest.” (Jessup, Tr. 1589, 1606). Further, though he now testified that the royalty numbers in his memoranda were “pulled out of thin air” and “off-the-wall,” he admitted on cross-examination that he never told his management at the time that he was making these numbers up. (Jessup, Tr. 1587, 1590, 1607).
108. Unocal’s counsel repeatedly rehearsed testimony with their witnesses both during and after Complaint Counsel’s examination. For instance, Dr. Jessup admitted that Unocal’s counsel elicited testimony from him about matters he had only become aware of in meetings with Unocal’s counsel after his examination by Complaint Counsel. (Jessup, Tr. 1601-1602 (“Q. And you remember that when I asked you that very same question about whether the two were the same that you said you didn't know? Do you remember that, sir, in your testimony, your direct testimony? A. No. What I said was that I wasn't aware that it was in the CARB document. Q. And you became aware of it because you had a chance to review these documents over the weekend; is that fair, sir? A. That’s fair.”)).

Michael Croudace

109. Michael Croudace worked as a research chemist in Unocal’s Science and Technology Division from 1981 until 1992. Dr. Croudace was still employed by Unocal in October 1992. (Croudace, Tr. 421-424). Since 1992, Dr. Croudace has been employed by Petroleum Analyzer Company as a product manager. (Croudace, Tr. 579-580).
110. Dr. Croudace is one of the scientists responsible for the research leading to Unocal’s reformulated gasoline patents and he, along with Dr. Peter Jessup, are co-inventors of the patents. (Croudace, Tr. 429, 437).

111. During Dr. Croudace's employment at Unocal, he worked as a scientist in various positions within Unocal's Science and Technology Division. (Croudace, Tr. 423-424). His job duties and responsibilities included conducting testing, analyzing data, and conducting scientific research. Dr. Croudace also made presentations to CARB and industry groups such as WSPA (Croudace, Tr. 424).
112. Dr. Croudace authored many technical memoranda during his employment at Unocal. Copies of these technical memoranda were sent to the Unocal's library and routinely submitted to Unocal's patent department. (Croudace, Tr. 432-433).
113. Dr. Croudace authored Technical Memoranda encouraging the release of Unocal's research results to influence CARB regulations and reap licensing resulting from overlap between the regulations and Unocal's patents. (CX 207; CX 210).
114. Dr. Croudace participated in the presentation of Unocal's research to CARB in June 1991. (Croudace, Tr. 462-463).
115. Dr. Croudace understood, during the time he was employed by Unocal, that he "was supposed to come up with good scientific facts" that could be used by the company (Croudace, Tr. 426, 434)
116. During his employment at Unocal, Dr. Croudace had dealings and interactions with numerous individuals, including Dr. Jessup, Dr. Wayne Miller, Dr. William Mallet, Denny Lamb, Kess Alley, Gregory Wirzbicki, Roger Beach, and Richard Stegemeier. (Croudace, Tr. 429-431).
117. Dr. Croudace had direct meetings with Roger Beach on at least two occasions. Dr. Croudace also had direct meetings with Richard Stegemeier, the former CEO and Chairman of the Board of Unocal, on at least two occasions. (Croudace, Tr. 433-434)
118. { } (CX 712, in
camera).

J. Wayne Miller

119. Dr. John Wayne Miller is a former Unocal employee who supervised Drs. Jessup and Croudace during the time that they worked on the 5/14 Project. (Miller, Tr. 1345-1346, 1348, 1351).
120. Dr. Miller worked for Unocal for roughly 20 years, from the mid-1970's to 1995. (Miller, Tr. 1345-1346).

121. During his 20 years with Unocal, Dr. Miller was repeatedly promoted and eventually became part of Unocal's management. (Miller, Tr. 1345-1347).
122. In about 1980, Dr. Miller was promoted to supervisor, exploratory process research. (Miller, Tr. 1347).
123. Roughly 5 years later, Dr. Miller was promoted to manager of products research in Unocal's Science and Technology Division. (Miller, Tr. 1347).
124. From 1991 until his departure from Unocal, Dr. Miller was manager of fuels technology in Unocal's Science and Technology Division. (Miller, Tr. 1345-1348).
125. Dr. Miller had oversight over Dr. Jessup and Dr. Croudace during the development of the "5/14 Project." (Miller, Tr. 1345-1346, 1348, 1351).
126. In that position, Dr. Miller reported directly to Dr. S. Kess Alley, who was vice president of products and process research. (Miller, Tr. 1347-1348).
127. In his management role in Unocal's Science and Technology Division, by participating in Unocal's Fuels Issues Team, Dr. Miller became aware of the various paths Unocal considered to use the research to gain a competitive advantage for the company. (Miller, Tr. 1352-1353, 1371).
128. Between 1995 and 2000, Dr. Miller worked for Sunoco. (Miller, Tr. 1349).
129. Dr. Miller is currently a staff member at the University of California, Riverside, where he does research on emissions and fuels. (Miller, Tr. 1349).

Michael Kulakowski

130. James Michael Kulakowski worked for Unocal from 1982 to 1993. (Kulakowski, Tr. 4390).
131. Beginning in 1987, Mr. Kulakowski became involved in regulatory issues concerning fuel and air quality. (Kulakowski, Tr. 4391-4392). Mr. Kulakowski worked through trade associations on behalf of Unocal to influence the outcome of both state and federal regulatory processes. (Kulakowski, Tr. 4392).
132. In 1989, Mr. Kulakowski was transferred to Unocal's refining planning department, but returned to the regulatory group in late 1990 or early 1991. (Kulakowski, Tr. 4392). Mr. Kulakowski's supervisor in the regulatory group was Dennis Lamb. (Kulakowski, Tr. 4393). During the CARB Phase 2 rulemaking, Mr. Kulakowski worked for Mr. Lamb on matters involving fuels and air quality, including the Phase 2 rules. (Kulakowski, Tr. 4390, 4391-4395). He remained in that regulatory position until he left Unocal in 1993.

(Kulakowski, Tr. 4393).

133. Besides Mr. Lamb and Mr. Kulakowski, there was only one other employee in Unocal's regulatory group at any given time. (Kulakowski, Tr. 4394). Mr. Lamb and Mr. Kulakowski were the only ones who interacted with CARB on the Phase 2 rulemaking. (Kulakowski, Tr. 4474).
134. In the 1991-92 time period, Mr. Kulakowski spent 75% of his time dealing with the CARB Phase 2 regulations. Prior to that, he had dealt with CARB during the Phase 1 rulemaking. (Kulakowski, Tr. 4395).
135. During the Phase 2 rulemaking, Mr. Kulakowski interacted with Mr. Lamb on a day-to-day basis. (Kulakowski, Tr. 4474).
136. As part of Unocal's regulatory group, Mr. Kulakowski worked directly with CARB as well as through the industry trade association to represent Unocal's interests in the Phase 2 rulemaking proceeding. (Kulakowski, Tr. 4394-4395).
137. In particular, Mr. Kulakowski provided to CARB staff at Mr. Lamb's direction Unocal's regression equations that CARB staff used for the T50 specification. (Kulakowski, Tr. 4424-4425; 4437-4438).
138. Although Mr. Kulakowski knew of Unocal's researchers' desire to reap licensing benefits from the reformulated gasoline research, at Mr. Lamb's instruction, Mr. Kulakowski did not "worry about that" and remained skeptical that Unocal would actually receive a patent. (Kulakowski, Tr. 4510-4512). Thus, Mr. Kulakowski did not disclose the patent application to CARB, even though he believed that information about a patent would have been pertinent to CARB's efforts to gather cost information. (Kulakowski, Tr. 4512, 4586-4587).
139. After he left Unocal, Mr. Kulakowski dealt with CARB during the development of the Phase 3 regulations. (Kulakowski, Tr. 4395).

Gregory Wirzbicki

140. Mr. Wirzbicki had become Unocal's Chief Patent Counsel in August 1989. As Chief Patent Counsel, he was in charge of all patent matters for Unocal, except for licensing. Mr. Wirzbicki also had those same duties before his title changed to Chief Patent Counsel. (Wirzbicki, Tr. 871).
141. Mr. Wirzbicki remained Unocal's Chief Patent Counsel from August 1989 through the time of trial in this matter. (Wirzbicki, Tr. 871, 878).
142. Mr. Wirzbicki in 1995 also became the head of Unocal's patent licensing attorneys, such

as John Kane. (Wirzbicki, Tr. 872).

143. Mr. Wirzbicki eventually prosecuted all five Unocal RFG patents. (Wirzbicki, Tr. 873; CX 617; CX 618; CX 619; CX 620; CX 621).
144. Mr. Wirzbicki suspected the importance of Unocal's RFG research and invention and anticipated in 1990 there might be litigation regarding the subject matter of a patent over Unocal's invention. (Wirzbicki, Tr. 931-932).
145. Mr. Wirzbicki also knew when filing the initial patent application for what became the '393 patent that licensing the patent and obtaining royalties could be a viable option for Unocal. (Wirzbicki, Tr. 932-933).
146. Mr. Wirzbicki, Unocal's Chief Patent Counsel, was {

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} (Wirzbicki, Tr., 1068-1069, *in camera*).

Neil Schmale

147. Neil Schmale oversaw Unocal's research division as a Senior Vice President of the company from 1988 through 1991. (CX 7062 (Schmale, Dep. at 8-9)).
148. At various times Mr. Schmale worked for Unocal as a petroleum engineer and attorney. (CX 7062 (Schmale, Dep. at 6)).
149. As a senior executive at Unocal, Mr. Schmale knew that Unocal had applied for a patent on reformulated gasoline and he understood the significance of the patent for potential licensing fees. (CX 7062 (Schmale, Dep. at 69)). Mr. Schmale participated in meetings with Mr. Beach roughly contemporaneous with the '393 patent's issuance to discuss licensing reformulated gasoline. (CX 7062 (Schmale, Dep. at 70-71)).

Richard Stegemeier

150. Richard Stegemeier served as Unocal's Chief Executive Officer and Chairman of the Board of Directors through 1994. (CX 7065 (Stegemeier, Dep. at 5)).
151. Even as the Chief Executive Officer of Unocal, Mr. Stegemeier took particular interest in the work of Unocal's Science and Technology Division due to his past experience as a research engineer and President of this division. (CX 7065 (Stegemeier, Dep. at 6-9, 15)).

152. Mr. Stegemeier personally supported the expansion of Unocal's fuels research and followed the progress of the research, the resulting patents, and the use of this research in Unocal's participation in the Phase 2 development. (CX 7065 (Stegemeier, Dep. at 47-48, 75-77, 89, 112)).
153. Mr. Stegemeier does not believe that corporations should benefit from deceptive conduct. (CX 7065 (Stegemeier, Dep. at 144)).

William Mallett

154. Dr. William Mallett directly supervised Dr. Jessup and Dr. Croudace in Unocal's Science and Technology Division when they initiated the work leading to Unocal's reformulated gasoline patents. (CX 7055 (Mallett, Dep. at 11)).
155. Dr. Mallett participated with Dr. Jessup in Unocal's presentation of its reformulated gasoline research results to Auto/Oil. (CX 7055 (Mallett, Dep. at 28-29)).

Stephen Lipman

156. Stephen Lipman served as the President of Unocal's Science and Technology Division from 1990 through late 1992. (CX 7053 (Lipman, Dep. at 4, 48)).
157. Mr. Lipman learned that Unocal had received informal notice that the Patent and Trademark Office would allow claims to Unocal's reformulated gasoline patent. Mr. Lipman shared that information with Mr. Beach in a August 1992 report of the activities of the Science And Technology Division. (CX 7053 (Lipman, Dep. at 5-6)).
158. Mr. Lipman also encouraged his employees in the Science and Technology Division to support Mr. Lamb's efforts at CARB on Unocal's behalf. (CX 7053 (Lipman, Dep. at 37-39)).

Starling Kess Alley

159. Dr. Kess Alley served as a Vice President of Unocal, overseeing the Science and Technology Division's Fuels Group. (CX 7041 (Alley, Dep. at 8-9)).
160. Dr. Alley supported the fuels emission research by obtaining financial support within the company, and supported the patent application which led to the reformulated gasoline patents. (CX 7041 (Alley, Dep. at 19, 137-139)).
161. Dr. Alley also represented Unocal in the Auto/Oil group, and shared information about Unocal's participation with other senior management of Unocal. (CX 7041 (Alley, Dep. at 10-11)).

Charles Williamson

162. Charles Williamson is Unocal's Chief Executive Officer and Chairman of the Board of Directors. (CX 7072 (Williamson, Dep. at 5)).
163. Mr. Williamson says, "We don't as a company . . . expect to realize gains or benefits from fraudulent behavior." (CX 7072 (Williamson, Dep. at 19-20)). Mr. Williamson believes that Unocal "shouldn't profit from deceptive conduct." (CX 7072 (Williamson, Dep. at 21)).

2. California Air Resources Board.

164. The California legislature established the California Air Resources Board ("CARB") in 1967 to find ways to improve air quality by conducting research into the causes of, and solutions to, air pollution. CARB's responsibilities include setting and enforcing automobile emissions standards. CARB is a department of the California Environmental Protection Agency. (CX 1665 (Cal. Health & Safety Code § 39003, 39500, 39510, 39601)).
165. California Health and Safety Code § 39500 assigns CARB responsibility to control of emissions and coordinate, encourage, and review the efforts of all levels of government as those efforts affect air quality for the state of California. (CX 1665 (Cal. Health & Safety Code § 39500)).
166. CARB in the early 1990's was required by statute to engage in a wide array of non-rulemaking endeavors of a highly technical nature, including but not limited to produce a biennial report on air quality conditions (CX 1665 (Cal. Health and Safety Code § 39604)), establishing inventories of pollutants and test procedures for air quality districts (CX 1665 (Cal. Health and Safety Code § 39607)), establishing "standards of ambient air quality" based on information from the State Department of Health (CX 1665 (Cal. Health and Safety Code § 39606)), and issuing a report on toxic air contaminants reviewed by a scientific panel. (CX 1665 (Cal. Health and Safety Code § 39661)).
167. CARB issues regulations specifying limits for certain properties of gasoline to be sold in California, including in particular reformulated gasoline regulations to be sold in the summer months. (CCPF ¶¶ 223-450).
168. The CARB Board currently consists of 11 members (Cal. Health & Safety Code § 39510 (2003)). During the Phase 2 rulemaking, the CARB Board had 9 Board members. (CX 1665 (Cal. Health & Safety Code § 39510) (1991)).
169. The Chairperson of the Board is the only full-time member; the remaining members of the Board serve on a part-time basis. (CX 1665 (Cal. Health and Safety Code § 39511(b))).

3. Refining Industry in California.

170. The West Coast of the United States, and California in particular, is geographically isolated from the rest of the United States by the physical barriers of the Rocky Mountains and by distance. As a result of these barriers, the West Coast market is poorly integrated with the petroleum markets in the rest of the United States. (CX 1709 at 017-018).
171. Unlike the East Coast, which has extensive pipelines to supply refined products from the Gulf Coast, California cannot receive refined products by pipeline from any other state. California is similarly isolated in terms of crude oil supply as well, with essentially all crude oil delivered to California by ocean vessel or produced in the state. (CX 1709 at 017-018).
172. There are 13 refineries in California for the production of gasoline. (CX 1709 at 005). The refineries are owned by the following companies: BP Amoco ARCO Company (“BP”); ChevronTexaco Corp. (“Chevron”); ConocoPhillips; ExxonMobil Corp. (“ExxonMobil”); Kern Oil and Refining Company; Shell Oil Co. (“Shell”); Tesoro Petroleum; and Valero Energy Corp. (“Valero”). (CCPF ¶¶ 173-181).
173. BP owns the Carson Refinery, near Los Angeles, California. The Carson refinery is the only BP refinery that produces CARB-compliant summertime gasoline sold in California. (CX 7078 (Youngman, Dep. at 12)). Prior to 2000, when BP purchased ARCO, ARCO had run the Carson refinery. (Hoffman, Tr. 4867-4868, 4970-4971).
174. Chevron has two refineries in California that produce CARB-compliant summertime gasoline: one at Richmond in Northern California and one at El Segundo in Southern California. (Engibous, Tr. 3886).
175. ConocoPhillips owns two refineries in California that produce CARB-compliant summertime gasoline; one at Rodeo in northern California and one at Los Angeles in southern California. (RX 1165 at 045-046, *in camera*). ConocoPhillips obtained these refineries when it purchased the refining assets of Tosco Corp. (Eskew, Tr. 2894-2895). Tosco had obtained these refineries in 1997, when it purchased the refineries from Unocal. (CX 2023 at 001).
176. ExxonMobil owns the Torrance refinery in Southern California, which produces CARB-compliant summertime gasoline. (Eizember, Tr. 3098). In or around December 1999, Exxon Corporation and Mobil Oil Company merged to create ExxonMobil. (Eizember, Tr. 3098). Prior to the merger, Exxon had owned a refinery in Benicia, CA, which is in northern California. In order to complete the merger, ExxonMobil sold the Benicia refinery to Valero, but retained the Torrance refinery. (Eizember, Tr. 3098, 3102).

177. Kern Oil Company owns a refinery in Bakersfield, CA, which produces CARB-compliant summertime gasoline, although Kern's production is very small. (Sarna, Tr. 6164).
178. Shell owns three refineries in California that produce CARB-compliant summertime gasoline: one at Martinez in northern California, one at Wilmington near Los Angeles (this refinery is sometimes referred to as the "Los Angeles" refinery), and one at Bakersfield in central California. (Lieder, Tr. 4737).
179. The Bakersfield and Wilmington refineries were, in the late 1980s and 1990s, owned by Texaco Refining & Marketing, Inc. In 1998, Equilon Enterprises, which was a partnership between Shell and Texaco gained ownership of these refineries. In 2001 or 2002, Shell purchased Texaco's interest in Equilon, becoming sole owner of the Bakersfield and Wilmington refineries. (CX 7048 (Hancock, Dep. at 146-147); CX 7051 (Irion, Dep. at 5)).
180. Valero has two refineries that produce CARB-compliant summertime gasoline: Benicia in northern California and Wilmington in Southern California. (Simonson, Tr. 5967). The Benicia refinery was acquired by Valero from ExxonMobil in mid-May of 2000. (Simonson, Tr. 5967-5968). The Wilmington refinery was acquired from Ultramar Diamond Shamrock in 2001. (Simonson, Tr. 5979).
181. Tesoro owns the Golden Eagle refinery in northern California, which produces CARB-compliant summertime gasoline. (Dowling, Tr. 3680). In the mid-1990s, Golden Eagle was owned by Tosco. Tesoro purchased the Golden Eagle refinery from Valero. (Dowling, Tr. 3682).

4. Auto/Oil Air Quality Improvement Research Program.

182. The Auto/Oil Air Quality Improvement Research Program ("Auto/Oil") was a research joint venture made up of 14 of the largest domestic oil companies (including Unocal) and the traditional Big Three domestic automobile manufacturers. (CX 4001 at 001-002; Burns, Tr. 2409; CX 140; CX 4016 at 004).
183. The member companies of Auto/Oil were Amoco Oil Company, ARCO Products Company, Ashland Oil, Inc., BP Oil Company, Chevron USA, Inc., Chrysler Motors Corporation, Conoco, Inc., Exxon Research and Engineering Company, Ford Motor Company, General Motors Research Labs, Marathon Oil Company, Mobil Research and Development Corporation, Phillips Petroleum Company, Shell Development Company, Sun Refining and Marketing Company, Texaco, Inc., and Union Oil Company of California. (CX 4001 at 029-030).

184. Auto/Oil's primary purpose was to provide scientific research data to CARB in order to assist in the development of scientifically sound regulations that were also cost-effective. (Kiskis, Tr. 3831, 3857; CX 4198 at 001; CX 140 at 003; Klein, Tr. 2475-2476, 2534; Ingham, Tr. 2595; CX 7073 (Wise, Dep. at 8); CX 7049 (Hochhauser, Dep. at 13, 15)).
185. Auto/Oil issued its final program report in January 1997. (RX 424). This January 1997 report marked the end of Auto/Oil. (RX 424 at 036).

5. Western States Petroleum Association.

186. The Western States Petroleum Association ("WSPA"), is a trade organization representing oil producers as well as refiners and marketers in five western United states. (CX 7059 (Moyer, Dep. at 10-11)).
187. WSPA's primary purpose is to represent the interests of the industry, including to "be a conduit of communication to the California Air Resources Board and to provide technical information to the Air Resources Board that would hopefully be utilized by the agency in crafting their fuels regulations." (CX 7059 (Moyer, Dep. at 10-11)).

D. Background on Gasoline.

188. Gasoline is "a volatile mixture of liquid hydrocarbons, generally containing small amounts of additives, suitable for use as a fuel in spark-ignition, internal combustion engines." (Eskew, Tr. 2829). Gasolines used in spark ignition engines are complex mixtures of hydrocarbons that range in boiling points from 85° F to 440° F and are blended from refinery streams so the final product has desirable vehicle performance under a variety of conditions. (CX 5 at 010; Eskew, Tr. 2827).
189. Gasoline is produced from crude oil. Crude oil is a mixture of many different chemical compounds and is described in terms of the particular crude's gross physical properties. (Eskew, Tr. 2824).
190. Petroleum refining is a complex industrial process. The primary activity is that crude oil is converted and processed into a variety of petroleum products that are used in many different markets. (Eskew, Tr. 2821).
191. Crude oil does not have a distinct boiling point, rather it boils over a wide range of temperatures. The portions of the crude oil that boil at specified temperature ranges are called fractions. Crude oil is described in terms of these fractions. (Eskew, Tr. 2824-2825).
192. To make gasoline, crude oil is brought into the refinery, and then split into different streams depending on the molecular weight of the streams. This is called "fractionation." (Jessup, Tr. 1469-1470). These streams are either blended directly into gasoline, or

modified so that the streams are suitable for gasoline blending. Blending is the final process by which these streams are combined to create gasoline. (Jessup, Tr. 1470).

1. Reformulated Gasoline.

a. What Is Reformulated Gasoline?

193. Reformulated gasoline is “cleaner burning gasoline that pollutes less.” (RX 116 at 001; RX 922 at 144-145). Motor vehicle fuel emissions are a significant source of carbon monoxide (“CO”), volatile organic compounds (“VOC”), and oxides of nitrogen (“NOx”). The latter two pollutants are precursors to ozone formation. (CX 5 at 007).
194. Members of the petroleum industry were among the leaders in developing reformulated gasoline, at least in part because these petroleum industry participants did not want alternative products, such as methanol, mandated for use in automobiles. (Venturini, Tr. 128; CX 1021 at 019).

b. How Can Reformulated Gasoline Reduce Pollution?

195. By the late 1980s and early 1990s regulators, oil industry members and scientists realized that, by regulating the various properties of the gasoline, one could limit the amount of harmful emissions that were produced. (RX 922 at 144-145).
196. One property that is regulated for pollution control purposes is the volatility of the gasoline, or how easily it burns. (CX 5 at 019-021). Volatility is measured by Reid Vapor Pressure (“RVP”) and expressed in pounds per square inch (or “psi”). (CX 2149). Generally, a lower RVP indicates better emissions. (CX 5 at 019-021).
197. In California, Reid Vapor Pressure standards apply only during the warmer weather months, which range from April 1 through October 31, depending upon the location within the state. (Cal. Code Regs. Tit. 13 §§ 2262.2, 2262.4 (2003); Venturini, Tr. 130-131). For this reason, California refiners often refer to production during the time when RVP standards apply as “summertime” gasoline. (Eskew, Tr. 2973, *in camera*).
198. Other properties that are regulated for pollution control purposes include the levels of various types of molecules in the gasoline. These include the level of sulfur (measured in parts per million (“ppm”)), benzene, olefin and aromatic levels in the gasoline (measured in terms of percentage by volume). (CX 2149). Generally, lower levels of sulfur, olefins and aromatics will yield better emission results, although higher levels of olefins help in reducing with some pollutants. (CX 5 at 035-037, 042-045).
199. Traditional gasoline specifications control sulfur at relatively high levels in order to prevent corrosion damage from sulfur’s combustion products. Sulfur has become a major target for environmentally-driven specifications as its impact on the catalysts used to

- control vehicle emissions has become more widely appreciated. (CX 1709 at 013).
200. Olefin content has traditionally been subject to some indirect control due to these compounds' propensity to react in storage and form gums and other undesirable substances. Olefin levels have been addressed in environmentally-driven specifications due to their effect on gasoline combustion characteristics as well as their effect on emissions of toxic compounds. (CX 1709 at 013).
 201. Aromatics and benzene are generally desirable gasoline components from a performance perspective, but have been become subject to environmentally-driven specifications due to their effect on gasoline combustion characteristics as well as their effect on emissions of toxic compounds. (CX 1709 at 013).
 202. Another property that is regulated for pollution control purposes is the amount of oxygen in the gasoline, which is measured in terms of percentage by weight. (CX 2149). More oxygen is considered to be a benefit for reducing emissions, and regulators therefore require a minimum oxygen level. (CX 5 at 037-042).
 203. CARB has required oxygenate since 1991. (CX 5 at 032-036). Prior to 2003, the most common oxygenate used by refiners was Methyl tertiary butyl ether, or "MTBE." (Venturini, Tr. 127). Since 2003, largely due to changes in CARB regulations, the oxygenate of choice for most California refiners has been ethanol. (Venturini, Tr. 94).
 204. Because it is not practical to blend ethanol at refineries, California refiners began to produce a gasoline product without ethanol at their refineries, and then ship that product to bulk terminals where the ethanol can be blended. (Venturini, Tr. 400). The gasoline product that is produced before ethanol is added is called CARBOB, or California Reformulated Gasoline Blendstock for Oxygenate Blending. (Eizember, Tr. 3195).
 205. Another property of gasoline that is regulated for pollution control purposes is the distillation temperature. (CX 5 at 025-034).
 206. As described above, crude oil does not have a distinct boiling point, rather it boils over a wide range of temperatures. (Eskew, Tr. 2824-2825). This is different from water, which starts to boil in its entirety at 212 degrees Fahrenheit. This is because water is a single chemical compound, while crude oil is made up of thousands of different hydrocarbon compounds. (RX 922 at 026-027).
 207. A distillation curve is a plot of temperatures on one scale and the percent of the crude oil evaporated on the other. (RX 922 at 027-028).
 208. The distillation temperature can be measured by noting the point on the distillation curve at which a given percentage of crude oil evaporates. For example, the temperature at which 50 percent of the gasoline burns off is the 50 percent distillation point, or the

“T50.” (RX 922 at 145). California’s regulations use this method of describing distillation properties. (Cal. Code Regs. tit. 13, § 2262 (2005)).

- 209. Distillation temperature is a predictor of harmful emissions, and a higher distillation temperature generally means that there are more toxic emissions. (CX 5 at 025-034).
- 210. CARB regulates the following fuel properties of gasoline in the CARB Phase 2 and Phase 3 regulations: RVP, sulfur, aromatics, benzene, olefins, oxygen, T50 and T90 (i.e., the 90 percent distillation point). (CX 1709 at 015).

2. Types of Regulations Relating to Reformulated Gasoline: Standards Based on Specifications and Predictive Models.

- 211. There are different types of reformulated gasoline regulations. One way to comply with Phase 2 regulations is to make a fuel with property values at or below the flat limits. Taken together, the flat limits create a fuel formula (or recipe). (CX 1709 at 15; CX 53 at 008).
- 212. If a refiner decides to produce fuel that complies with the flat limits, then each fuel parameter must not exceed the corresponding flat limit set forth in the regulations. For example, the sulfur content of gasoline could not exceed 40 parts per million by weight. (CX 1709 at 015; CX 53 at 008).
- 213. In other words, compliance with all the flat limits provides a safe harbor. Under the flat limit method of compliance, the refiner does not receive any “credits” for keeping any parameter below the flat limit. (CX 1709 at 015; CX 53 at 008).
- 214. A second way to comply with Phase 2 regulations is to make a fuel pursuant to the CARB averaging limits. The averaging limits provide refiners with flexibility to create different fuel compositions, so long as, on average, the refinery produces fuel that meets CARB’s emissions reductions standards. (CX 1709 at 015; CX 53 at 008).
- 215. The averaging option allows refiners to account for variations in batches of fuel – the average of all batches within a certain time period must meet the averaging limit, as opposed to having each batch meet the flat limit. (CX 1709 at 015; CX 53 at 008). A refiner may average sulfur, benzene, olefins, T90, T50, or aromatic hydrocarbons. (CX 866 at 019-028).
- 216. Within the CARB regulations there are also “caps” that apply to all gasoline throughout the distribution system. Gasoline can be tested at any point in the distribution system, and if any of the fuels’ properties fall above the cap limit, the fuel, *prima facie*, does not comply with the RFG regulations. (CX 53 at 008). CARB staff noted the importance of caps – “[t]he ability to detect violations through field testing can be a significant deterrent to intentional violations, and can encourage more vigorous quality control

[programs].” (CX 5 at 105).

217. Even with averaging, though, the caps stay in effect. For example, some fuel produced by a refinery could have a sulfur content of 60 ppm, so long as enough other batches from that refinery have lower sulfur, resulting in an average sulfur level of 30 ppm (the averaging standard) or lower, and no batch has sulfur content greater than 80 ppm (the cap limit). (CX 866 at 019-028).
218. The CARB Phase 2 RFG regulations establish two methods of compliance that provide alternatives to the flat and averaging limits: (1) the predictive model and (2) vehicle testing. The predictive model predicts emission levels of exhaust hydrocarbons, nitrogen oxides, and toxics based on the values of the eight gasoline properties covered by the Phase 2 regulations. (CX 53 at 012).
219. CARB’s predictive model has been defined as “as a set of three equations developed by CARB which predicts the change in exhaust hydrocarbon emissions, exhaust emissions of oxides of nitrogen, and the combined exhaust emissions of four toxic air contaminants.” The equations are mathematical and emissions are predicted as a function of the properties of gasoline. Properties in the predictive model include olefin levels, aromatics, T50, T90, and sulfur. (Eskew, Tr. 2864-2865).
220. If the emissions predicted by the model for a particular set of fuel properties are “equivalent” to (no greater than 1.004 times) the emissions prediction for a fuel that meets the CARB flat limits, the alternative set of fuel properties is allowable. (CX 53 at 012).
221. If a refiner complies with the regulations by use of the predictive model, as most refiners do, the values for each parameter in the predictive model are still bounded by the caps. But within these bounds, the refiner has flexibility to blend fuels so long as the resulting emissions, as predicted by the model, are comparable to the predicted emissions for the baseline CARB flat-limit fuel. (CX 866 at 028-032; CX 1709 at 016).
222. The regulations also offer the option for certification of an alternative gasoline formulation based on results of a vehicle emissions testing program. (CX 1709 at 016). For a variety of reasons, this option is unattractive to refiners and no refiner has ever sought approval under the vehicle testing option. (Venturini, Tr. 691).

II. The California Air Resources Board and Clean Fuels Efforts Prior to the Phase 2 Reformulated Gasoline Rulemaking.

223. The California legislature established the Air Resources Board (“CARB”) in 1967 to attain and maintain air quality standards, to conduct research into the causes of and solutions to air pollution, and to systematically attack the “serious problem” caused by motor vehicles. CARB’s responsibilities include setting and enforcing automobile

- emissions standards. (CX 1665 (Cal. Health & Safety Code §§ 39003, 39500 (1991))).
224. CARB is currently a department of the California Environmental Protection Agency. (Cal. Health & Safety Code § 39510 (2003)).
 225. CARB has responsibility for control of emissions from motor vehicles and the legislature directs it to coordinate, encourage, and review the efforts of all levels of government as they affect air quality for the state of California. (CX 1665 (Cal. Health & Safety Code §§ 39500, 39002 (1991))).
 226. The California legislature has designated CARB the “air pollution control agency for all purposes set forth in federal law.” In that role, CARB has responsibility to prepare the state implementation plan required by the Clean Air Act (42 U.S.C., Sec. 7401, *et seq.*). (CX 1665 (Cal. Health & Safety Code § 39602 (1991))).
 227. CARB in the 1980's and 1990's promulgated regulations on highly technical subjects – reformulated gasolines, diesel fuel low emission vehicles, consumer products, and the identification and control of toxic pollutants. (Venturini, Tr. 120-122).
 228. Statutes require CARB to engage in a wide array of non-rulemaking endeavors such as conducting studies and writing reports. Some of these requirements include a biennial report to the Legislature and the Governor on air quality conditions and on the status and effectiveness of air quality programs, (CX 1665 (Cal. Health & Safety Code § 39604 (1991))); assessing prospects for achieving state ambient air quality standards for a variety of pollutants (CX 1665 (Cal. Health & Safety Code § 39611 (1991))); and identifying toxic air contaminants (CX 1665 (Cal. Health & Safety Code § 39611 (1991))).
 229. Consequently, CARB employs primarily engineers, scientists, and others with technical expertise. (Kenny, Tr. 6498-6499; Venturini, Tr. 97; Fletcher, Tr. 6438-6440).
 230. During the Phase 2 rulemaking, the CARB Board had nine Board members. (CX 1665 (Cal. Health & Safety Code § 39510 (1991))). The CARB Board currently has eleven members. (Cal. Health & Safety Code § 39510 (2003)).
 231. The CARB Chairman in 1991, Jananne Sharpless, worked full-time on the Board. Other Board members served part-time. (CX 7063 (Sharpless, Dep. at 37); CX 1665 (Cal. Health & Safety Code § 39511(b))).
 232. CARB enjoys a world-wide reputation as a highly expert, cutting-edge leader in devising ways to enhance air quality. (Venturini, Tr. 97; Kenny, Tr. 6500-6501; Boyd, Tr. 6691; CX 1578).
 233. In the late 1980's CARB had considered alternative fuels as one way to reduce motor

vehicle emissions. (CX 1021 at 008; CX 786; Venturini, Tr. 118).

234. In 1987, the California legislature passed “AB 234,” which resulted in a panel to study the feasibility of mandating the use of alternative fuels, such as methanol, and cleaner fuel vehicles. The Advisory Board on Air Quality and Fuels had the responsibility to conduct an “in-depth study of the feasibility and necessity of using mandates to introduce cleaner, alternative fuels in California.” (CX 786; CX 1021; CX 1665 (Cal. Health & Safety Code §§ 43837, 43838 (1991))).
235. The AB 234 Advisory Board, also known as the Leonard Commission, included a diverse group of interests, including representatives from CARB and the oil and auto industries. This panel included Roger Beach, Unocal’s Senior Vice President at the time. (CX 1021 at 003-004, 008; Beach, Tr. 1744).
236. During the time of the AB 234 Advisory Board, California seriously considered methanol or M85 as an alternative fuel. (Boyd, Tr. 6694-6695; Beach, Tr. 1743-1744; CX 1665 (Cal. Health & Safety Code § 43837(b) (1991))).
237. During the time of the AB 234 panel, the California Energy Commission under Chairman Charles Imbrecht was viewed as a strong proponent of methanol, particularly or M85. The majority of the AB 234 Advisory Board viewed M85 as a viable, albeit more expensive, alternative to conventional gasoline; CARB, CEC, and the South Coast Air Quality Management District’s largest pilot project regarding alternative fuels addressed M85. (Boyd, Tr. 6697-6699; CX 1021 at 011-012).
238. The dialogue on alternative fuels, particularly related to the AB 234 Advisory Board, in the late 1980’s led to an awareness that refiners could produce much cleaner gasoline. (Venturini, Tr. 118; Beach, Tr. 1745).
239. The AB 234 Advisory Board reported to the California Legislature in 1989 that “[R]eformulated gasolines might also be able to contribute to improved air quality.” The Advisory Board found, however, that “research is only beginning and success is uncertain.” (CX 1021 at 012, 036).
240. In late 1988, the California legislature amended the California Clean Air Act to require CARB to take action to reduce harmful car emissions, including volatile organic compounds (“VOCs”), or hydrocarbon (“HC”) emissions, nitrogen oxides, particulate matter, carbon monoxide, and toxic air contaminants. (California Clean Air Act, A.B. 2595, § 34, 1988 Cal. Leg. Serv. 1568 (West) (codified at Cal. Health & Safety Code § 43018 *et seq.*); CX 52 at 008).
241. CARB, as part of its effort to make gasoline cleaner, implemented a two-part strategy. First, Phase 1, a “fairly simple rule” provided early emission reductions without requiring substantial capital investments by fuel producers. Then Phase 2 set forth a

comprehensive set of regulations for reformulated gasoline. (Venturini, Tr. 118-119; CX 52 at 006; CX 1267 at 002; CX 1665 (Cal. Health & Safety Code § 43018(d) (1991))).

242. CARB passed the Phase 1 RFG regulations in September 1990 and the adopted RFG regulations went into effect January 1, 1992. (CX 52 at 006; CX 785; Cal. Code Regs. Tit. 13 §§ 2251-2257 (1992)).
243. The Phase 1 regulations required the elimination of leaded gasoline, the addition of deposit control additives, and the reduction of Reid Vapor Pressure (“RVP”). These limited regulations required minimal refinery modifications. (CX 52 at 006; Cal. Code Regs. Tit. 13 §§ 2251-2257 (1992); CX 840).
244. The Phase 1 rulemaking also created for CARB staff the “baseline work . . . to identify the slate of possible fuel specifications that could be considered” for the Phase 2 regulations. (Fletcher, Tr. 6448; CX 840 at 019-020).
245. CARB’s Phase 2 regulated gasoline properties not addressed in the Phase 1 regulations, including T50, T90, olefins, oxygen, aromatics, sulfur, and benzene. (CX 816 at 014-025; Cal. Code Regs. Tit. 13 §§ 2251-2257 (1992)).

III. CARB's Phase 2 Reformulated Gasoline Rulemaking.

A. Overview of the Phase 2 RFG Rulemaking.

246. The California Clean Air Act added to California’s Health and Safety Code a provision directing CARB to “take whatever actions are necessary, cost-effective and technologically feasible in order to achieve, not later than December 31, 2000, certain reductions in three different types of pollutants. (CX 1665 (Cal. Health & Safety Code § 43018(b) (1991))).
247. The California Clean Air Act directed CARB to “adopt standards and regulations which will result in the most cost-effective combination of control measures on all classes of motor vehicles and motor vehicle fuel, including, but not limited to . . . reductions in motor vehicle exhaust and evaporative emissions [and] specification of vehicular fuel composition.” (CX 1665 (Cal. Health & Safety Code § 43018 (c) (1991))).
248. The California Clean Air Act directed CARB to hold workshops on the adoption of regulations related to vehicle fuel composition not later than January 31, 1991. It also directed the CARB board to consider adopting proposed regulations not later than November 15, 1991. (CX 1665 (Cal. Health & Safety Code § 43018(d)(3) (1991))).

249. To determine which fuel specifications to propose for the Phase 2 regulations, CARB first used the work done in Phase 1 rulemaking as a baseline slate of fuel specifications. CARB staff then appealed to “all sectors” to provide information and analyses about the impact of changing fuel specifications on motor vehicle emissions. CARB staff analyzed information provided and “mad[e] judgements about what appropriate fuels specifications could be to achieve emission reductions” in Phase 2. (Fletcher, Tr. 6448).
250. CARB’s internal regulatory work plan from January 1991 identifies that CARB staff “expect[ed] to achieve additional emission reductions by specifications on other gasoline parameters.” At that time CARB staff considered a number of gasoline parameters, including “oxygen content, type of oxygenate, olefin content, aromatic hydrocarbon content, distillation temperature distribution, RVP, sulfur, benzene, and potential precursors to 1, 3-butadiene.” (CX 785 at 001).
251. As of January 1991 CARB staff “d[id] not have sufficient information to establish precise specifications for Phase 2 reformulated gasoline.” Because the regulations would “likely contain specifications on gasoline properties that have been found to influence emissions,” CARB’s internal work plan made clear that it would consider regulations governing these specifications after studies became available that analyzed which gasoline parameters influence emissions. (CX 785 at 005).
252. CARB’s internal regulatory work plan from 1991 acknowledged multiple options should test results related to fuel properties and emissions prove inconclusive: (1) conduct more tests, which would likely delay the Phase 2 regulations into 1992; (2) “go to the Board with only a benzene specification;” or (3) “propose an approach similar to the one in the federal Clean Air Act.” (CX 785 at 007-008).
253. On May 23, 1991, CARB staff invited the public to a June 11, 1991 consultation meeting to discuss the Phase 2 specifications for reformulated gasoline. The workshop notice identified the specifications being considered and included a list of questions and answers related to the development of the gasoline specifications. (CX 492).
254. At the June 11, 1991 public workshop, CARB staff presented to the public the status of the regulation development and discussed associated issues with participants. (CX 1047; CX 793).
255. On August 1, 1991, CARB staff invited the public to an August 14, 1991 consultation meeting to discuss the Phase 2 specifications. The workshop notice provided a preliminary draft of the proposed regulation order for interested parties to review. (RX 184 at 012-051).
256. CARB staff expected in August 1991 to modify its draft proposals to reflect analyses including “forthcoming technical data.” (CX 803 at 001).

257. On October 4, 1991, CARB disseminated notice of a November 21-22, 1991 public hearing to consider adoption of the Phase 2 reformulated gasoline regulations. CARB staff also made available the Report and Technical Support Document detailing the proposal for Phase 2 regulations. (CX 767; CX 52; CX 5).
258. Mr. Fletcher, who supervised communications by CARB staff with the public, describes it as a “pretty extensive public process” throughout the year developing the Phase 2 regulations. (Fletcher, Tr. 6443).
259. CARB technical staff working on the Phase 2 regulations often briefed CARB management, including Mr. Simeroth, Mr. Venturini, and members of CARB’s executive staff, including Mr. Boyd, about the status of activities. (Fletcher, Tr. 6443-6444).
260. Mr. Fletcher worked towards the goals of the RFG regulations by “bringing together as much of the technical information on the response . . . of motor vehicles to motor vehicle fuels as we could.” CARB staff then “had to look at all of the other elements associated with the development of a regulation, such as cost and cost-effectiveness and other factors.” (Fletcher, Tr. 6445).
261. CARB worked with industry after the November 1991 issuance of mandatory specifications to develop a more flexible predictive model. CARB defined a predictive model generally as a set of mathematical equations that allows one to estimate the change in emission from motor vehicles that will occur when one or more selected fuel properties are changed. A predictive model is typically used to compare the emission associated with the use of one gasoline versus another gasoline. The California predictive model enabled a determination of whether an alternative Phase 2 RFG formulation provides the same emissions benefits as a fuel meeting the Phase 2 RFG specifications. (CX 53 at 028).
262. In April 1994 CARB issued proposed amendments to the Phase 2 RFG regulations that would permit use of a specified predictive model. (CX 53). The CARB board approved amendments to Phase 2, including a predictive model, on June 9, 1994. (CX 769). CARB subsequently published an analysis of the public comments regarding the predictive model amendments and a detailed statement of reasons for these amendments. (CX 54).

B. CARB Operated Under Significant Constraints During the Phase 2 Reformulated Gasoline Rulemaking.

1. The California Legislature Mandated that CARB Take Specific Actions to Improve Air Quality.

a. CARB Did Not Have Unbridled Discretion to Take Whatever Actions it Wished to Promote Cleaner Air.

263. Unocal’s representatives in the Phase 2 proceeding felt it was necessary to understand the “many requirements in the California Clean Air Act as well as other legislation which controls and drives what CARB does.” (Kulakowski, Tr. 4400).
264. CARB’s general mandate was to “execute,” not make, laws promoting cleaner air. (CX 1665 (Cal. Health & Safety Code § 39600 (1991)) (“ . . . the state board shall do such acts as may be necessary for the proper execution of the powers and duties granted to, and imposed upon, the state board by this division and by any other provision of law.”)).
265. CARB issued the Phase 2 regulation in “execution of the powers and duties granted to and imposed upon the Board by law.” (CX 817 at 002 (CARB Board Resolution regarding approval of Phase 2)).
266. CARB had to fashion Phase 2 within the “scope of authority conferred and in accordance with standards prescribed by other provisions of law.” (CX 7029 at 018 (Cal. Gov’t Code §11342.1 (1991))).
267. CARB, by statute, could not adopt the Phase 2 regulation unless it was “consistent and not in conflict with the statute and reasonably necessary to effectuate the purpose of the statute.” (CX 7029 at 020 (Cal. Gov’t Code § 11342.2 (1991))).

b. The California Clean Air Act Constrained CARB’s Discretion in the Phase 2 Reformulated Gasoline Rulemaking.

268. In late 1988, the California legislature amended the California Clean Air Act to require CARB to take action to reduce auto emissions. The legislation specifically required CARB to address new standards for automobile fuels and low-emission vehicles. (CX 52 at 008-009; 1988 Cal. Stat. 1568; (CX 1665 (Cal. Health & Safety Code § 43018(a) - (c) (1991))).
269. CARB viewed sections 43013 and 43018 of the Health and Safety Code as the most relevant directives regarding mobile sources. (Kenny, Tr. 6501; CX 1665 (Cal. Health & Safety Code §§ 43013(e), 43018(e) (1991))).
270. Section 43018 of the California Health & Safety Code specifically mandated that CARB take the following actions:
 - a. Take “necessary, cost-effective, and technologically feasible” actions to achieve “reduction in the actual emissions of reactive, organic gases of at least 55 percent, a reduction in emissions of oxides of nitrogen of at least 15 percent from motor vehicles” no later than December 31, 2000;
 - b. Take actions “to achieve the maximum feasible reductions in particulates,

carbon monoxide, and toxic air contaminants from vehicular sources”;

- c. Adopt standards and regulations that would result in “the most cost-effective combination of control measures on all classes of motor vehicles and motor vehicle fuel” including the “specification of vehicular fuel composition.”

(CX 1665 (Cal. Health & Safety Code § 43018 (1991)); CX 52 at 008-009; 1988 Cal. Stat. 1568).

- 271. CARB, in issuing the Phase 2 regulations, had to consider not only the pollution-reducing benefits of Phase 2, but also the “effect...on the economy of the state.” (CX 1665 (Cal. Health & Safety Code §§ 43013(e), 43018(e) (1991))).
- 272. The legislature left to CARB limited subsidiary discretion regarding determination of the gasoline properties to be regulated and the limits to be set for these properties. CARB’s discretion for the reformulated gasoline regulatory process also included matters such as developing alternative methods of compliance, effective dates, and enforcement procedures. (CX 1665 (Cal. Health & Safety Code § 43018 (1991)); CX 52 at 008-009; CX 10 at 196).
- 273. Costs were an integral element of the cost-effectiveness analysis conducted by CARB. In the California Clean Air Act, the legislature directed CARB to promulgate cost-effective regulations. (CX 1665 (Cal. Health & Safety Code § 43018 (1991))).
- 274. CARB in the Phase 2 Staff Report construed the statutes as requiring CARB to “to meet these emission reduction goals in a manner that provides flexibility for fuel producers to provide the ‘cleanest’ possible gasoline at the least cost to the consumer.” (CX 52 at 006).
- 275. The statute required CARB to take actions that would attain specific goals stated as reductions of “reactive organic gases of at least 55% and oxides of nitrogen of at least 15%.” (CX 1665 (Cal. Health & Safety Code §43018(b) (1991))).
- 276. The statute required CARB to reach attainment of those goals by a statutorily-mandated deadline – December 31, 1991. CARB also had to issue a reformulated fuel rule by a specific deadline – “not later than January 1, 1992.” (CX 1665 (Cal. Health & Safety Code §43018(b) (1991))).
- 277. In an implicit directive on how stringent the Phase 2 rule had to be, the statute specifically told CARB that it had to calculate the reductions of reactive organic gases and nitrous oxides against “the 1987 baseline year.” (CX 1665 (Cal. Health & Safety Code §43018(b) (1991))).

278. The statute directed that CARB could not decide to single out, or ignore, certain classes of vehicles or certain fuels. (CX 1665 (Cal. Health & Safety Code §43018(c) (1991)) (“[i]n carrying out this section, the state board shall adopt standards and regulations which will result in the most cost-effective combination of control measures on all classes of motor vehicles and motor fuel. ...”).
279. The statute directed what technologies CARB should deem most important in reducing mobile source emissions. The statute required CARB to address such measures as (1) reductions in *motor vehicle exhaust and evaporative emissions*, (2) reductions in emissions from in-use emissions from motor vehicles through *improvements in emission system durability and performance*, (3) requiring *the purchase of low-emission vehicles by state fleet operators*, and (4) specification of *vehicular fuel composition*. (CX 1665 (Health & Safety Code §43018(c) (1991))) (emphasis added).
280. The statute required CARB to address not only smog, but also to “take action to achieve the maximum feasible reductions in particulates, carbon monoxide, and toxic air contaminants from other sources.” (CX 1665 (Cal. Health & Safety Code §43018(b) (1991))).
281. CARB viewed the provisions of California Health and Safety Code sections 43013 and 43018 as mandatory directives that CARB was not “free to disregard.” (Kenny, Tr. 6507).
282. CARB’s General Counsel, Michael Kenny, viewed the legislative constraints in the case of Phase 2 to be “fairly specific. “[The California Clean Air Act] does tell us, for example, fairly specifically that we are to achieve 55 percent reductions in ROG, 15 percent reductions in NOx. It tells us fairly specifically where to hold workshops. It tells us specific dates by which we’re to achieve the board hearing.” (Kenny, Tr. 6677-6678).

c. CARB Officials Recognized that California Law Constrained CARB’s Discretion.

283. CARB’s General Counsel, Michael Kenny, during Phase 2 viewed CARB’s discretion as “severely constrained” by statutory mandates. (Kenny, Tr. 6671-6673).
284. CARB’s General Counsel during Phase 2 viewed CARB as “not operat[ing] within the same realm or context as a legislature operates within . . . the board’s staff’s activities were driven by technological, health and engineering judgments.” (Kenny, Tr. 6671-6673).
285. CARB’s Chairman during Phase 2, Jananne Sharpless, did not view CARB “policy” setting as an exercise of political discretion. Instead, CARB policy-making meant “coming up with strategies, directions, and implementation plans to carry out the laws established by the legislature” and “com[ing] up with strategies, directions,

- implementation plans to meet those goals.” (CX 7063 (Sharpless, Dep. at 46-47)).
286. CARB Chairman Sharpless viewed the legislature as setting basic policy. CARB set policy “within the framework of the law...[W]e don’t just go out and adopt policies that aren’t framed by the...legal mandates that we operate under.” (CX 7063 (Sharpless Dep. at 49)).
 287. CARB Chairman Sharpless also viewed CARB as having to exercise a great deal of technical analysis to make choices within the policy framework set by the legislature. (CX 7063 (Sharpless, Dep. at 46-47) (“I don’t see how you can make a technical decision without some framework if you want to use the word “policy” as a way to describe that framework . . .”); CX 7063 (Sharpless, Dep. at 52) (“Well, the point is policy is broad. Policy is established by law. There are sets of choices within those – that framework, and you do a heck of a lot of analysis to figure out which one of those choices is going to be the most effective at the least cost.”); CX 7063 (Sharpless, Dep. at 49) (Even a transportation control measure like limiting driving days per week would require “an awful lot of technical investigation before you figured out if that was even practical.”)).
 288. CARB Chairman Sharpless viewed CARB’s concern over “public acceptability” of measures to be executing statutory directives to implement successful programs, not as a determination of political popularity. (CX 7063 (Sharpless, Dep. at 50)).
 289. CARB’s General Counsel in 1991, now-Judge Michael Kenny, viewed CARB’s discretion as “different” from that of the legislature, in that “the board had an obligation to follow the legislative direction that was found in the Health and Safety Code. The board also had an obligation to follow the legislative direction that was found in the Government Code. The board could not disregard those legislative mandates. The board could utilize that expertise within the context of the legislative direction that was provided.” (Kenny, Tr. 6507-6508).
 290. CARB General Counsel Kenny’s view was that a major difference between legislative action and CARB action was CARB’s exercise of specialized expertise to solve problems. “The issue was really what expertise was going to come to bear on that regulation to ensure that in fact it complied with the additional requirements that the legislature had mandated and identified for us to consider.” (Kenny, Tr. 6537-6538). Mr. Kenny also noted that “[T]he Board did not operate within the same realm or context as a legislature operates within. We were severely constrained by our statutory mandates, and the board’s staff activities were driven by technological, health, and engineering judgments.” (Kenny, Tr. 6537-6538, 6672-6673).
 291. Section 11346 of the California Administrative Procedure Act refers to all administrative rulemaking in California as “quasi-legislative.” (CX 7029 at 041 (Cal. Gov’t Code § 11346 (1991)) (“It is the purpose of this article to establish basic minimum procedural

requirements for the adoption, amendment or repeal of administrative regulations. Except as provided in Section 111346.1, the provisions of this article are applicable to the exercise of any quasi-legislative power conferred by any statute theretofore or hereinafter enacted . . .”)).

292. Judge Michael Kenny, General Counsel of CARB during Phase 2, views the “quasi-legislative” term in Cal. Gov’t Code § 11346 as not implying in any way that CARB rulemaking was in the political arena. It “does not” mean that “it operates in a political manner.” (Kenny, Tr. 6535-6536).
293. Under the California APA all “regulations,” with limited exceptions, are promulgated pursuant to “quasi-legislative” procedures. “Regulation,” in turn, is broadly defined to include practically all acts of general application of administrative agencies, however technical or obviously non-political they may be. (CX 7029 at 012 (Cal. Gov’t Code § 11342(g) (1991)) (“‘Regulation’ means every rule, regulation, order, or standard of general application or the amendment, supplement, or revision of any rule, regulation, order, or standard adopted by any state agency to implement, interpret, or make specific the law enforced or administered by it, or to govern its procedure.”)).
294. Under the California APA “regulations” required to be promulgated under “quasi-legislative” procedures can even include mere manuals, bulletins, or guidelines. (CX 7029 at 029 (Cal. Gov’t Code § 1347.5) (1991)) (provided: “No state agency shall issue, utilize, enforce, or attempt to enforce any guideline, criterion, bulletin, manual, instruction, order, standard of general application, or other rule, which is a regulation as defined in Section 11342.600 unless the guideline, criterion, bulletin, manual, instruction, order, standard of general application, or other rule has been adopted as a regulation and filed with the Secretary of State pursuant to this chapter.”)).
295. CARB also is not in the legislative branch of government. Although CARB rules are subject to review of the Office of Administrative Law, OAL review does not apply to any “agency in the judicial or legislative departments of the state government” (CX 7029 at 012, 007-009 (Cal. Gov’t Code § 11340, 11340.1, 11342(a) (1991))).
296. CARB regulations that merely set forth test procedures for obtaining samples of motor fuel and blending components were promulgated pursuant to “quasi-legislative” procedures of the California APA. (Cal. Code Regs. Tit. 13 §§ 2296 - 2298 (2003)).
297. CARB regulations that merely set standardization and performance standards for portable fuel containers and spouts were promulgated pursuant to “quasi-legislative” procedures of Cal. Gov’t Code § 11346 *et seq.* (Cal. Code Regs. Tit. 13 §§ 2467 - 2467.8 (2003)).

2. The California Administrative Procedures Act Required Substantial Evidence for CARB’s Regulatory Actions.

298. California law required that CARB, before it could lawfully put the Phase 2 rule into effect, had to submit the rulemaking file to the Office of Administrative Law (“OAL”) for its approval. (CX 7029 at 007-011, 072-084 (Cal. Gov’t Code §11340, § 11349 (1991))).
299. The California legislature created the new Office of Administrative Law by a 1979 amendment to the California Administrative Procedures Act. The California legislature declared that the intent of establishing OAL was to “reduce the number of administrative regulations and to improve the quality of those regulations which are adopted.” (CX 7029 at 008 (Cal. Gov’t Code §11340.1 (1991))).
300. The Office of Administrative Law was authorized to block the issuance of the Phase 2 rule if the rulemaking record lacked “substantial evidence.” The term “substantial evidence” was defined as including, but not limited to, “facts, studies, and expert opinion.” (CX 7029 at 073-075 (Cal. Gov’t Code § 11349.1 (1991)) (authorizing OAL to disapprove regulations if they were not “necessary”); (CX 7029 at 072-073 (Cal. Gov’t Code § 11349(a) (1991) (the statute stating that “[n]ecessity’ means the record of the rulemaking proceeding demonstrates by substantial evidence the need for a regulation. For purposes of this standard, evidence includes, but it not limited to, facts, studies, and expert opinion.”)).
301. Private parties also could seek judicial review of the Phase 2 rule in California Superior Court. (CX 7029 at 084 (Cal. Gov’t Code §11350(a) (1991)) (stating that “any interested person may obtain a judicial declaration as to the validity of any regulation by bringing an action for declaratory relief in the superior court in accordance with the provisions of the Code of Civil Procedure.”)).
302. Parties challenging the Phase 2 rule in Superior Court also could base their claim on lack of “substantial evidence.” Parties could seek to invalidate agency rules on the grounds that “[the] agency’s determination that the regulation is reasonably necessary to effectuate the purposes of the statute . . . is not supported by substantial evidence.” (CX 7029 at 084 (Cal. Gov’t Code § 11350(b)(1) (1991))).
303. CARB technical and legal staff was responsible for assembling the substantial evidence for the Phase 2 rule. (Venturini, Tr. 90).
304. CARB staff viewed the “substantial evidence” test as one requiring a sound technical scientific basis for its work. (Venturini, Tr. 88). The Technical Support Document, Staff Reports, and Final Statements of Reasons accompanying CARB’s Phase 2 proposals contain hundreds of pages of highly technical scientific and economic analysis. (CX 5 (Technical Support Document); CX 52 (Staff Report for mandatory specifications); CX 10 (Staff Report); CX 53 (Predictive Model Staff Report); CX 54 (Predictive Model Final Statement of Reasons); Venturini, Tr. 88).

305. CARB staff applied rigorous scientific benchmarks in determining whether the Phase 2 rule should regulate specific gasoline properties. Tests had to be sound and constructed to control for the independent effects on emissions of the specific property. (CX 10 at 047 (CARB staff found the Auto/Oil study insufficient to support a T50 requirement because it was not designed to isolate T50's independent effects); Fletcher, Tr. 6449-6451; Fletcher, Tr. 6452).
306. CARB staff testified at the November 21-22, 1991 hearing where the Board approved Phase 2 that outside groups had contributed some \$30 million worth of testing to support the Phase 2 rule. (CX 773 at 014-015 (Robert Fletcher stating that “over 3500 vehicle emission tests which were conducted on several hundred vehicles . . . amounted to over \$30 million worth of testing”); CX 388 at 024 (presentation slide listing the Auto/Oil AQIRP, GM/WSPA/CARB Volatility Study, ARCO Clean Fuels Program, GM/CARB EC-X Test Program, Unocal Fuels Study, Chevron Fuels Study, and API RVP/Oxygenates Study)).
307. The Technical Support Document for Phase 2 cited reliance on over 70 different studies or articles authored by outside parties. (CX 5 at 168-173).
308. Robert Fletcher, a Phase 2 supervisor, considered Unocal’s study to constitute substantial evidence because it was “the first study and the only study that we had where you could specifically look at the benefits of T50 and knowing that you were seeing the benefits of T50 not influenced by other variables.” (Fletcher, Tr. 6471).
309. Unocal took the position in 1999 that CARB should not make the proposed increases of the T50 flat and averaging limits because such changes “are unsupported” and were not scientifically based. (Lamb, Tr. 1814-1815; CX 612 at 001).
310. CARB staff, on the cost side, also engaged in extremely intensive efforts to obtain from the refiners all the possible cost information they could obtain. (CCPF ¶¶ 962-1014).
311. CARB staff rejected desirable Phase 2 rule modifications for fear that CARB would not be able to demonstrate substantial basis that those provision were cost effective or had reasonable effects on the “economy of the state.” (CCPF ¶¶ 312-315).
312. CARB staff, for example, accepted a relaxed version of the T50 requirement than that proposed by some parties because “it would make it more difficult and more costly for refineries to meet other specifications, particularly the RVP limit.” (Venturini, Tr. 256-258).
313. Peter Venturini explained staff’s adoption of a less stringent T50 requirement on the basis that CARB rejected the stricter requirements proposed by auto companies’s association (“MVMA”) on the basis that, “[w]hile the MVMA proposal includes more stringent criteria for some gasoline properties and would achieve greater emissions reductions, it is

sufficiently less cost-effective to make the proposed specifications not justified at this time.” (CX 10 at 027).

314. CARB rejected GM’s suggestion of lower caps on sulfur, olefins, and T90 -- which would provide greater emissions benefits -- because of flexibility concerns. (CX 10 at 029). CARB also rejected GM’s lower-sulfur proposal because it “would have significantly increased the costs of producing Phase 2 reformulated gasoline.” (CX 10 at 034); *see also* (CX 10 at 029 (rejection of Ford proposals as “not cost-effective”); CX 10 at 045 (rejection of GM proposals on T90 as not “cost-effective”); Clossey, Tr. 5507-5509 (CARB accepted ARCO’s cost rationales for resisting a more stringent aromatics specification)).
315. CARB was sued in the 1990s on allegations that its decisions lacked “substantial basis.” (Kenny, Tr. 6524-6525).

3. The California APA Required CARB to Base its Regulations on an Extensive Record.

316. One of Michael Kenny’s duties as General Counsel was to ensure that CARB complied with the administrative rulemaking provisions of the California Administrative Procedures Act (“California APA”). Legal staff reviewed the record of rulemaking and technical staff’s explanatory documents to ensure that the Phase 2 proposal complied with all the requirements of the California APA. (Kenny, Tr. 6525-6526; CX 7029 at 007 (Cal. Gov’t Code §§ 11340 *et. seq.* (1991))).
317. CARB staff responsible for creating the Phase 2 regulation worked closely with CARB legal staff to ensure that staff adhered to the requirements of the California Administrative Procedures Act. (Venturini, Tr. 114-115).
318. The CARB legal office helped staff prepare the documents that set forth the substantial evidence for the Phase 2 and worked with staff to make sure the record was together. (Venturini, Tr. 114).
319. CARB in Phase 2, among other things, was required to provide notice of a proposed action, develop an evidentiary basis for regulations, solicit written comment from the public, conduct a hearing, if requested, and publish written findings. (CX 1665 (Cal. Health and Safety Code § 39601) (1991)); CX 7029 at 041-070 (Cal. Gov’t Code §§ 11346-11347.3 (1991))).
320. The California APA required CARB to establish an extensive written record, including, but not limited to, “[a]ll data and other factual information, any studies or reports, and written comments submitted to the agency in connection with the adoption, amendment...of the regulation.” (CX 7029 at 068 (Cal. Gov’t Code §11347.3 (1991))).

321. The Phase 2 rulemaking record that CARB submitted to the Office of Administrative Law for the mandatory specifications portion, alone, was over 3,000 pages of highly detailed reports, comments, and studies. The 3,800-plus pages did not include the text of all the numerous studies and other materials cited in CARB's technical reports nor, according to CARB's General Counsel at the time, did it need to. (CX 838); Kenny, Tr. 6635-6637).
322. CARB's October 1992 Final Statement of Reasons, alone, contained over 240 pages of small-type pages of explanation on how CARB resolved specific issues raised by commentors. (CX 10 (Oct. 1992 Final Statement of Reasons); (CX 7029 at 060 (Cal. Gov't Code 11346.7 (b) (1991) (final statement requirement))).
323. California's Government Code requires CARB to give advance notice of proposed actions. (CX 7029 at 048 (Cal. Gov't Code § 11346.4 (1991))).
324. The advance notice had to set forth the express terms of the action. (CX 7029 at 059 (Cal. Gov't Code §§ 11346.7(a) (1991))). CARB complied with this requirement. (CX 492; CX 1000).
325. Cal. Gov't Code § 11346.7 required CARB to include with its proposed rule an Initial Statement of Reasons including, among other things, "an identification of each technical, theoretical, and empirical study, report, or similar document, if any, on which the agency is relying in proposing the adoption, amendment, or repeal of a regulation." (CX 7029 at 060 (Cal. Gov't Code §§ 11346.7(a) (1991))).
326. CARB satisfied the Initial Statement of Reasons requirement in Phase 2 by issuing in October 1991 a Staff Report over 130 pages long and an accompanying Technical Support Document ("TSD") over 300 pages long. (CX 52 (Oct. 1991 Staff Report); CX 5 (Oct. 1991 Technical Support Document)). CARB also issued a Staff Report for the Phase 2 Amendments to include a predictive model in April 1994. (CX 53).
327. In this instance, the California Clean Air Act explicitly required CARB Board to hold a public hearing on its Phase 2 regulation. (CX 1665 (Cal. Health & Safety Code § 43018(d)(3))(" . . . Hearings of the state board to consider adoption of proposed regulations pursuant to this subdivision shall be held not later than November 15, 1991.")).
328. The California APA required CARB to keep a transcript of those hearings. (CX 7029 at 068-069 (Cal. Gov't Code § 11347.3(a)(7) (1991)) ("The file shall include . . . a transcript, recording or minutes of any public hearing connected with the adoption, amendment, or repeal of the regulation.")). CARB included in the Phase 2 rulemaking file transcripts of, among other events, the two-day public hearing in November 21-22, 1991 where the Board approved the Phase 2 specifications, and the public hearing on June 9, 1994 where the Board approved the Phase 2 Predictive Model. (CX 773, CX 774

(November 21-22, 1991 hearings); CX 769 (June 9, 1994 hearing)).

329. The California APA, Government Code § 11346.8, required CARB, when conducting public hearings of any sort, to allow oral as well as written statements, and authorized the representative of CARB at such hearings to administer oaths. (CX 7029 at 062 (Cal. Gov't Code § 11346.8 (1991))).
330. Throughout the regulatory process, CARB solicited and accepted written comments from the public. CARB also held numerous workshops in which informal comments were received. (CX 793; CX 274; CX 1000).
331. The California APA, Government Code § 11346.7, required CARB to issue a Final Statement of Reasons that, among other things, set forth “any data or any technical, theoretical or empirical study, report, or similar document on which the agency is relying in proposing the adoption or amendment of a regulation which was not identified in the initial statement of reasons” and “a summary of each objection or recommendation made regarding the specific adoption, amendment or repeal proposed, together with an explanation of how the proposed action has been changed to accommodate each objection or recommendation, or the reasons for making no change.” (CX 7029 at 060 (Cal. Gov't Code §§ 11346.7(b)). CARB complied with this requirement in the Phase 2 RFG rulemaking. (CX 10 (Oct. 1992 Final Statement of Reasons on Phase 2 mandatory specifications); CX 54 (April 1995 Final Statement of Reasons on Phase 2 Predictive Model))).
332. The Final Statement of Reasons, as described by one of its authors, is organized by subject category of all the comments received about the proposed regulations. Each comment had listed after it the name of the organization, company, or individual that made the comment. CARB staff “prepared detailed technical response to justify the technical view” in relation to each comment, and this response appears in the Final Statement of Reasons after the summarized comment. (Courtis, Tr. 5755; CX 10).
333. The California APA, Government Code §§ 11340 and 11340.1, had established an Office of Administrative Law to oversee rulemaking and review rules for “necessity, authority, clarity, consistency, reference, nonduplication,.” and to enforces certain record-of-decision requirements. (CX 7029 at 007-011, 072-084 (Cal. Gov't Code §§ 11340, 11340.1, 11349 (1991))).
334. CARB transmitted the rulemaking file for the Phase 2 mandatory specifications to OAL on October 2, 1992. (CX 838 at 001).
335. CARB non-legal staff understood that the Office of Administrative Law, by statute, had the authority to disapprove the Phase 2 regulation if it failed to follow the procedures or meet criteria set forth in the California Administrative Procedures Act. (Venturini, Tr. 113-115; Kenny, Tr. 6526).

336. General Counsel Michael Kenny with his legal staff reviewed the Phase 2 package before it was sent to OAL. Michael Kenny had the authority to withhold the approval needed to forward that package to OAL if it lacked substantial evidence. (Kenny, Tr. 6526-6527). Executive Officer Boyd also had veto authority over sending the Phase 2 package to OAL. (Kenny, Tr. 6526-6527).
337. Peter Venturini, the Chief of the CARB division responsible for reformulated gasoline regulations, also reviewed the Phase 2 package before it was sent to OAL. Mr. Venturini had the authority to withhold the approval needed to forward that package to OAL if it lacked substantial evidence on the record. (Kenny, Tr. 6526-6527).
338. The Phase 2 RFG regulations were approved by the Office of Administrative Law on November 16, 1992, after a determination that the regulations met the standards of the California Administrative Procedures Act. (CX 1811).
339. Tom Jennings of the CARB General Counsel's Office took action to officially close the public comment period on September 15, 1992, and the rulemaking record on November 16, 1992. (CX 1815 at 019).
340. The Office of Administrative Law, on November 16, 1992, approved the Phase 2 mandatory specifications as having been adopted in a manner complying with the California Administrative Procedures Act. (CX 1811; Venturini, Tr. 297).

4. CARB Routinely Engaged in Highly Complex Scientific and Economic Analysis.

341. CARB in 1991 was comprised principally of scientists, engineers, and other persons with technical backgrounds. (Kenny, Tr. 6498-6499; Venturini, Tr. 83-84).
342. California statutes required in 1991 that the nine CARB Board members be chosen to reflect a mix of specialized expertise in automotive, medical, agricultural and other specialized backgrounds. (CX 1665 (Cal. Health & Safety Code §39510 (1991)); Kenny, Tr. 6499; CX 7063 (Sharpless, Dep. at 42-43)).
343. CARB's Stationary Source Division, which led the development of reformulated gasoline regulations, had approximately 100 staff members in 1991, almost all of whom were scientists, engineers, or other people with technical backgrounds. (Venturini, Tr. 83-84).
344. CARB is an organization recognized internationally for its technical and professional expertise and for its leadership and control of air pollution. (Venturini, Tr. 96-97).
345. CARB's Executive Officer Mr. Boyd, well before the Phase 2 rulemaking, had made it

one of his objectives to solidify CARB's technical prowess and place as number one in the air quality business. (Boyd, Tr. 6704-6705).

346. As stated by Judge Michael Kenny, CARB's General Counsel in 1991, "The ARB's reputation is an international reputation. The ARB is viewed as the preeminent if not the eminent air quality agency around the world." (Kenny, Tr. 6500-6501). Executive Officer Boyd believed that CARB's staff by 1991 "had established themselves...as probably the most competent and progressive air quality agency in the nation." (Boyd, Tr. 6691).
347. Peter Venturini, the lead manager of the Phase 2 project, viewed the work of his staff as not "political" because they were "a group of scientists, engineers, technical people, professional backgrounds" and they were "charged with doing the best technical and scientific work" they could. (Venturini, Tr. 96-97).
348. Judge Kenny, CARB's General Counsel in 1991, viewed truthful factual input by outside parties as indispensable to CARB, given its highly technical mission. (Kenny, Tr. 6530-6531).
349. CARB valued the technical credibility of its regulations as very important to its work. (Venturini, Tr. 96-97). CARB, in its hiring practices, therefore looked for employees who could understand, translate, and interpret technical information. (Venturini, Tr. 83).
350. CARB viewed its reputation for technical accuracy among members of the regulated community as indispensable to its success. This had been CARB's culture for decades before the issuance of Phase 2. (Venturini, Tr. 98).
351. CARB's emphasis on technical qualifications of staff was necessitated by its statutory mission. CARB, for example, had to compile detailed data on air quality in each air basin of the state and "adopt test procedures to measure compliance with...emission standards." (CX 1665 (Cal. Health & Safety Code § 39607 (1991))).
352. CARB, pursuant to statutory directive, was required to designate, with the assistance of a scientific review panel, which substances were toxic air contaminants, and to identify the exposure level, "if any," below which humans would suffer "no significant adverse health effects." (CX 1665 (Cal. Health & Safety Code § 39662 (1991))).
353. CARB, pursuant to statutory directive, had to evaluate and control toxic air contaminants, utilizing "the best available scientific evidence gathered from the public, private industry, the scientific community, and federal, state, and local agencies, and that the scientific research on which decisions related to health effects are based should be reviewed by a scientific review panel and members of the public. (CX 1665 (Cal. Health & Safety Code § 39650 (1991))).

354. CARB, pursuant to statutory directive, was required to assess, every year, compliance with air quality standards in each air basin in the state on a pollutant-by-pollutant basis. (CX 1665 (Cal. Health & Safety Code § 39608 (1991))).
355. CARB, pursuant to statutory directive, was required to report on the feasibility of using “air quality models and other analytical techniques” to gauge the relative effectiveness of various emission control measures. (CX 1665 (Cal. Health & Safety Code § 39609 (1991))). CARB had to identify tools for accurate measurement, including “emission inventories, pollutant characterization, ambient air monitoring, and air quality models.” (CX 1665 (Cal. Health & Safety Code § 39610 (1991))).
356. CARB, pursuant to statutory directive, was required to analyze “the available options for monitoring and assessing current levels of exposure to . . . toxic air contaminants in urban areas,” taking into consideration “the technical feasibility and costs” of each option. (CX 1665 (Cal. Health & Safety Code § 39668 (1991))).
357. CARB, pursuant to statutory directive was required to determine “the categories, numbers, and relative contribution of present or anticipated sources of [each toxic air contaminant], including mobile, industrial, agricultural, and natural sources.” (CX 1665 (Cal. Health & Safety Code § 39665 (1991))).
358. CARB in the mobile sources area alone, was required to understand a wide array of different technologies. The California Clean Air Act required CARB to assess regulatory options for, among other things, “vehicular fuel specifications for aromatic content, diesel fuel quality, light-duty vehicle exhaust emission standards”...“heavy-duty and medium duty vehicle emissions”...“detergent content, emissions from off-highway vehicles, vehicle fuel composition, emissions from construction equipment and farm equipment, motorcycles, locomotives, utility engines” and “marine vessels.” (CX 1665 (Cal. Health & Safety Code § 43018(d) (1991))).

a. Unocal Knew that CARB Made Decisions Based on Technical Merit Rather than Political Considerations.

359. Unocal has admitted that CARB’s mandate requires it to be a “scientific” rather than “political” organization. Unocal’s head of refining during the Phase 2 proceeding wrote to CARB’s Chairman: “You are in a unique position to influence the future of California. In my mind, the fundamental question you face on all the issues before you is whether or not clean air is a scientific or a political concept. If the regulatory systems are the product of compromises with the most vocal advocacy groups rather than the product of the scientific merits of particular issues, then the jobs of many Californians are at risk.” (CX 344; CX 7062 (Schmale, Dep. at 73-74)).
360. Roger Beach, then President of Unocal Refining and Marketing, in an article publicly commended CARB in 1991 for taking a “scientific approach” with its fuel regulations, in

contrast to the supposed EPA “political specification” for reformulated gasoline that lacked technical support. (CX 1578 at 001-002; Beach, Tr. 1679-1681). Mr. Beach recognized that CARB “takes pride in building its regulations on a strong technical foundation. I commend CARB for its efforts to maintain scientific credibility.” (CX 1578 at 001; Beach Tr. 1679-1681).

361. Dennis Lamb, Unocal’s principal representative in the CARB Phase 2 process, stated in formal comments to CARB: “[w]e do believe there is a fairness and scientific integrity and technical equity.” (CX 34 at 007; CX 774 at 029-031; Lamb, Tr. 2084-2085).
362. A Unocal scientist explained in late 1990 to Wayne Miller, supervisor of the 5/14 project, that in instances where “CARB admitted they do not have sufficient technical data to support” a particular specification, “CARB will hold off on this issue pending new compelling data.” (CX 165 at 004).
363. Dennis Lamb of Unocal in 1990 also recognized that CARB prided itself on the science it employed in developing its regulations and was “more inclined to listen and more readily accessible to California companies making scientific arguments.” (Lamb, Tr. 2154; CX 194 at 003).
364. Dr. Jessup of Unocal observed that CARB was focused on science. (Jessup, Tr. 1296). Unocal employees believed that CARB wanted to get the science right. (Jessup, Tr. 1296; Lamb, Tr. 2386).
365. According to Unocal participants, at the June 1991 meeting with CARB, Unocal gave CARB good scientific data, independent of political agendas. (Jessup, Tr. 1297). Unocal presented CARB with scientific results, and Dr. Jessup believed that the facts would speak for themselves. (Jessup, Tr. 1297-1298).
366. Unocal considered the release to CARB of emissions results from the 5/14 Project to fit within a strategy of persuading CARB to base the regulation on “good, solid, sound science.” (CX 7065 (Stegemeier, Dep. at 82-83)).
367. Unocal in its press materials credited CARB as having formulated the Phase 2 regulation “[b]ased on “the best available data.” (CX 366 at 003; Lane, Tr. 3031, 3090).
368. Mr. Lamb knew CARB prided itself on the science it employed in developing its regulations. (Lamb, Tr. 2154).
369. Mr. Lamb believed throughout the Phase 2 proceedings that CARB had an interest in getting the science right for the regulations. (Lamb, Tr. 2386).
370. Mr. Lamb thought Unocal and the 5/14 project had the science right and Unocal wanted to show CARB good science. Lamb wanted to be sure that Unocal provided good

science so that CARB could base its regulations on good science. (Lamb, Tr. 2296, 2351-2352).

b. Participants in the Phase 2 Reformulated Gasoline Rulemaking Process Had a Technical Focus.

371. Unocal at the time of Phase 2 had a government affairs department with lobbyists. (Kulakowski, Tr. 4403).
372. However, Dennis Lamb was not a registered lobbyist, even though Unocal management had designated him as the “one guy” to speak for Unocal on fuels issues matters. (Lamb, Tr. 2154, 2148). Nor was Mr. Lamb’s regulatory group part of Unocal’s government affairs office. (Kulakowski, Tr. 4403).
373. Michael Kulakowski was not a registered lobbyist. (Kulakowski, Tr. 4403).
374. Peter Venturini, at the time he interacted with Dennis Lamb and Michael Kulakowski of Unocal, did not understand them to be lobbyists of any kind. (Venturini, Tr. 205).
375. CARB’s Stationary Source Division, which led the Phase 2 effort, also had no politicians or lobbyists on its staff. (Venturini, Tr. 83-84).
376. On the refiner side generally, it was scientists and engineers who interacted with CARB during the development of the RFG regulations. (Clossey, Tr. 5346-5347).
377. ARCO also had determined that the activities of its Clean Fuels Task Force did not trigger lobbying disclosure requirements under state law. (Clossey Tr. 5427-5428).

c. Refiners Provided CARB With Scientific and Technical Information.

378. All of CARB staff’s 85 meetings with refiner representatives in Phase 2 involved technical discussion rather than a “discussion of politics” or discussion of “non-technical” matters. (Venturini, Tr. 196-197; CX 1267 at 003-008 (reciting the 85 meetings)).
379. Interactions between industry, including ARCO's Clean Fuels Task Force members, with CARB "was almost always scientific discussions about the state of the research." (Clossey, Tr. 5348).
380. Dennis Lamb’s communications with CARB for Unocal dealt with scientific facts. He interacted mostly with CARB’s technical staff. (Lamb, Tr. 1824).
381. Unocal wanted to provide CARB with good scientific data. (Beach, Tr. 1681; Jessup, Tr.

- 1296-1297). Unocal provided specific, detailed and technical comments to CARB relating to the proposed specifications. (Lamb, Tr. 2078, 2292; CX 33 at 003-020). Mr. Lamb wanted to be sure that Unocal provided good science so that CARB could base its regulations on good science. (Lamb, Tr. 2351-2352).
382. Unocal's researchers understood that Unocal paid them to "come up with good scientific facts." Dr. Croudace of Unocal defined one element of "good scientific data" to be its independence from political agendas. (Croudace, Tr. 426, 428).
383. When asked on cross examination about stakeholders "lobbying" CARB regarding specifications, Mr. Curtis, a key CARB staff person responded, "I think the...companies asked for changes for various technical reasons. I don't know if they did lobbying or not." (Curtis, Tr. 5908-5909).
384. In official company releases, Unocal has described the CARB rulemaking process as follows: "As part of its rulemaking process, CARB gathered information from industry members, environmentalists, consumers and scientific leaders. Based on the best available data, the agency formulated its specifications for Phase 2 gasolines". (CX 401 at 013 (Unocal's Governor Wilson Briefing: RFG Patent); CX 399 at 003, 008 (Draft Materials on Unocal's RFG Patent); CX 367 at 002; Lane, Tr. 3031). "The Phase 2 requirements reflect CARB's assessment of data provided by a vast array of interested groups, including environmentalists, scientists and consumers, as well as by Unocal and other refiners." (CX 599 at 007).
385. ARCO representatives, based on experience, believed that "if information was provided to CARB that didn't have a sound scientific basis to support it, then CARB would either reject it outright or would make clear that further information was necessary before they could use that information in the development of the regulations." (Clossey, Tr. 5351-5352).
386. Industry participants understood that during the development of the RFG regulations, "the process was scientifically based." (Clossey, Tr. 5351).
387. CARB staff viewed Unocal's June 20, 1991 presentation of its 5/14 research to CARB as a technical presentation not involving any political subjects. (Venturini, Tr. 196-198).
388. ARCO had considered three options for addressing the threat of an M85 mandate – (1) choose to do nothing, (2) pursue a solution through political challenges, or (3) develop sound scientific information to show that gasoline could compete with M85. (Clossey, Tr. 5337-5338). ARCO "chose the technical process and we stuck with it throughout." (Clossey, Tr. 5338).
389. ARCO found CARB staff to be "extremely professional and thoroughly scientifically based and founded . . . set a standard" for "the free-flowing analysis that occurred

amongst the industry and the staff.” (Clossey, Tr. 5400).

390. ARCO’s representative viewed the Phase 2 regulatory process “a highly technical, highly scientific process, with a tremendous amount of peer review.” (Clossey, Tr. 5421). ARCO found CARB staff to be tough but fair and always open to hear new ideas and suggestions as long as the work can be shown to be technically correct.” (Clossey, Tr. 5399-5400; RX 187 at 002).
391. Timothy Clossey of ARCO viewed the Phase 2 environment as one where “technical fact was control. If you wanted to convince the CARB staff of some conclusion, you needed to have the scientific basis to go behind it.” (Clossey, Tr. 5422).
392. WSPA members perceived in mid-November 1991 that CARB staff gave “thorough review of our data and our support for the alternative.” (CX 7057 (McHugh, Dep. at 89)).
393. CARB was interested in having good information, good solid technical information, about which gasoline properties would influence emissions. CX 7076 (Youngblood, Dep. at 32-33)
394. Auto/Oil conducted research work “to look at the effect of properties in a phase program” with the intent of passing on “good scientific information” to both CARB and federal regulators. (CX 7076 (Youngblood, Dep. at 33)). Auto/Oil did not present speculative information to CARB. Auto/Oil presented scientific information based on experimental work or other analyses. (CX 7076 (Youngblood, Dep. at 33)).
395. Even Texaco’s advocacy efforts *vis a vis* legislators on Phase 2 was not based on the idea that individual legislators could successfully pressure CARB to adopt desired positions. Mr. McHugh didn’t think they [legislators] “could have influenced the decision.” (CX 7057 (McHugh, Dep. at 38-39, 56, 78-79)).
396. Texaco’s advocacy efforts also assumed that CARB ultimately would make its decision on the scientific merits. Gavin McHugh’s purpose in meeting with the Governor’s staff, for example, was to “make our case on the merits and the science, the analysis, the cost/benefits of the WSPA proposal.” (CX 7057 (McHugh, Dep. at 29-30)). According to Mr. McHugh, they “spent a lot of time, lot of technical analysis to make sure they had that information so they could benefit from that information in making a decision on which direction to go on the regulation.” (CX 7057 (McHugh, Dep. at 59-62); RX 95 at 002-004).

d. CARB Managers Believed Sound Science Should Govern the Phase 2 Rulemaking.

397. James Boyd served as CARB Executive Officer through both Democratic and Republican

administrations in California. (Boyd, Tr. 6703 - 6704).

398. CARB management did not view partisan politics as playing a role in CARB's work. According to Executive Officer Boyd, "one of the beauties of the air quality program in California was the incredible public support and the totally bipartisan or nonpartisan approach that was taken to the issue of air quality, so to me partisan politics played no role in our activities. And I think some of that is exemplified by the fact that we could cross over party lines and yet continue to do – continue to do our work." (Boyd, Tr. 6705).
399. CARB, unlike in the political arena, could not lawfully take action based on mere personal relationships or favors by lobbyists. (Kenny, Tr. 6671-6672).
400. CARB kept the Governor's Office abreast of key developments in the Phase 2 proceeding. However, CARB management did not expect the Governor's Office to intervene to decide key issues. (Boyd, Tr. 6745-6747, 6846-6847 (Executive Officer Boyd explaining that a briefing paper to the Governor's Office did not mean CARB expected the Governor to "intervene" or "pull strings"))).
401. In 1991 and 1997 Gavin McHugh was a registered lobbyist for Texaco. (CX 7057 (McHugh, Dep. at 11-14, 21)).

5. CARB Wanted to Preserve its Credibility and International Reputation for Technical Expertise.

402. As stated by the lead manager of CARB Phase 2, "[o]ur whole system, the whole integrity of our regulatory process would just collapse if it were okay for people to use our regulatory process to gain an unfair competitive advantage. It just wouldn't work." (Venturini, Tr. 862-863).
403. CARB is an organization recognized internationally for its technical and professional expertise and for its leadership and control of air pollution. (Venturini, Tr. 96-97).
404. Executive Officer Boyd, well before the Phase 2 project, had made it one of his objectives to solidify CARB's technical prowess and place as number one in the air quality business. (Boyd, Tr. 6704 - 6705).
405. As stated by Judge Michael Kenny, CARB's General Counsel in 1991, "The ARB's reputation is an international reputation. The ARB is viewed as the preeminent if not the eminent air quality agency around the world." (Kenny, Tr. 6500-6501). Executive Officer Boyd believed that CARB's staff by 1991 "had established themselves...as probably the most competent and progressive air quality agency in the nation." (Boyd, Tr. 6691).

406. Another reason that CARB need institutional credibility was the sheer magnitude cost of some of its regulations, necessitating the “buy in” of regulated parties. According to Peter Venturini, CARB in Phase 2 was proposing a measure “that could impact California’s refineries to the tune of maybe \$5 billion or more, a regulation that could impact the consumer of ten or more cents per gallon . . . That is why we had so many meetings, so many discussions with not only the oil industry but the auto industry and others, because we knew basically we had one shot to get this right.” (Venturini, Tr. 108-109).
407. CARB demonstrated on numerous occasions this sensitivity to public perception that CARB might knowingly act unfairly. For example, Chairman Sharpless at the November 21-22, 1991 Board hearing also stated that small refiners reaping “windfall profits” were a matter of concern to the Board. (CX 773 at 084).
408. CARB in the later predictive model report similarly cited competition issues as material. (CX 53 at 014 (Explains that CARB gave refiners a more lenient approach on the predictive model so that would remain equitable among refiners); CX 53 at 054 (The report devoted a separate section to “Impacts on Competitiveness” and stressed that all large refiners will be treated alike)).

D. CARB Had an Obligation to Minimize the Costs of the Phase 2 Reformulated Gasoline Regulations.

1. California Law Required CARB to Consider the “Effect on the Economy of the State” and Take “Cost Effective” Measures in Developing the Regulations.

409. CARB, in developing motor vehicle fuel specifications, had to consider the “effect of the standards and regulations on the economy of the state.” (CX 1665 (Cal. Health & Safety Code §§ 43013(e), 43018(e) (1991))).
410. The legislature directed CARB to adopt measures and take actions that it deemed “cost effective.” (CX 1665 (Cal. Health & Safety Code §§ 43013(a), 43018(b)-(c) (1991))).
411. The legislature directed CARB to adopt standards and regulations to result in “most cost-effective *combination* of control measures.” (CX 1665 (Cal. Health & Safety Code § 43018(c) (1991))) (emphasis added).
412. CARB staff, consistent with statutory directives, issued a Phase 2 Technical Support Document and Staff Report that analyzed at length estimated compliance costs and cost to the consumer, in both absolute terms and as comparisons with other measures in terms of dollars/ton of emissions reductions. (CX 5 at 137-142, 148; CX 52 at 071-077).
413. The November 22, 1991, CARB Resolution confirmed that the Board considered cost to

the consumer and economic impacts of the regulation. The Board found that “the economic impacts of the reductions are warranted in light of the public health benefits associated with the regulations.” (CX 817 at 005-007; CX 817 at 003 (referring to Resolution 90-59 endorsing Phase 2 to “define the ‘cleanest’ possible gasoline . . . at the lowest cost to the consumer”)).

414. CARB staff, now and in Phase 2, had great concern about the impact of CARB’s actions on the economy of the state, particularly, the impact on the consumer. CARB has addressed these issues in all of its regulatory programs and staff conducted relevant analyses in the Phase 2 rulemaking. (Venturini, Tr. 96).
415. CARB staff recognized the important objective of meeting emission reduction goals in a manner that provided the cleanest possible gasoline at the least cost to the consumer. (Venturini, Tr. 200-201; CX 52 at 006).
416. CARB technical staff evaluated the costs to refiners and consumers as a part of considering “the effect of the standards and regulations on the economy of the state,” as required by California Health and Safety Code § 43018(e). (CX 1665 (Cal. Health & Safety Code §§ 39003, 39500 (1991)); Venturini, Tr. 203-205).

2. CARB Sought to Develop Regulations that Minimized the Cost to Consumers.

417. The ultimate cost of the regulation in absolute terms and the size of the cost increase consumers contributed to CARB staff’s concern about costs. CARB staff expected Phase 2 to add at least \$5 billion to the cost of producing gasoline, and more than ten cents per gallon. (Venturini, Tr. 108-109).
418. The sensitivity to cost concerns contributed to CARB staff’s belief that, according to Mr. Venturini, “we had one shot to get this right. We knew that it was important to get it right because it would be very difficult to come back and undo it after we’ve asked the refineries to make this investment.” (Venturini, Tr. 109).
419. The CARB Board found in November 1991 that the Phase 2 regulations would result in an increase of the cost of gasoline between 12 cents and 17 cents per gallon. (CX 817 at 007).
420. CARB staff recognized that the cost of meeting Phase 2 standards “will ultimately be borne by the consumers of gasoline in California.” (CX 10 at 027; Venturini, Tr. 166-167). Mr. Venturini believed at the time of the Phase 2 rulemaking, based on experience with previous regulations, that the costs of Phase 2 would more likely be passed on to consumers rather than absorbed by refiners. (Venturini, Tr. 166-167).

E. CARB Sought to Avoid Taking Regulatory Action That Would Adversely

Impact Competition.

421. In 1991 CARB had a general policy not to confer monopolies on any industry. (Kenny, Tr. 6511-6512)
422. CARB viewed the “economy of the state” provision as, among other things, a directive to avoid granting monopolies. (Kenny, Tr. 6511-6512; CX 1665 (Cal. Health & Safety Code §§ 43013(e), 43018(e) (1991))).
423. In 1991 CARB had an unwritten policy “not to confer monopolies on any industry.” (Kenny, Tr. 6511-6512).
424. CARB’s Board and staff expressed concern about competitive impact numerous times before, during, and after the November 1991 Board hearing where Phase 2 was initially approved. (CCPF ¶¶ 1350-1435).
425. In certain areas, the statute laid out more explicit duties with respect to how CARB should preserve competition. Section 43635 of the California Health & Safety Code, for example required cross-licensing of pollution control devices for used motor vehicles in circumstances where only one such device had been certified in a given subclass. (CX 1665 (Cal. Health & Safety Code § 43635) (1991))).
426. CARB in the Phase 2 rule making had acted in accordance with this statutory directive, giving smaller refiners regulatory relief to preserve “some degree of competition in the marketplace.” The Final Statement of Reasons stated: “Elimination of the small refiner segment of the California refining industry would result in job losses and would likely have anti-competitive effects because small refiners provide some degree of competition in the gasoline market. We have concluded that it is preferable to tailor our regulations in a way that minimizes the likelihood that some firms will be put out of business, especially when the costs of compliance are higher for these companies than for the rest of the industry.” (CX 10 at 136).
427. CARB cited the “economy of the state” provision as the authority for its small refiner exception. (CX 10 at 135).
428. CARB in its October 1992 Final Statement of Reasons stated that CARB's adoption of the small refiner exemption reflected CARB's desire not to "reduce competition in the gasoline market and [cause] an ultimate increase in gasoline prices.” (CX 10 at 187).
429. In its rulemaking documents, CARB stated that all gasoline types should be treated equally because the costs will be borne by consumers. (CX 10 at 027).
430. Chairman Sharpless at the November 1991 Board hearing stated, “I’m all for the competition that you [small refiners] provide. There’s also the issue of how we enforce

such a thing, the competitive issue, and several others.” (CX 773 at 347).

431. Chairman Sharpless at the November 1991 Board hearing also was concerned that the major refiners, too, not be unduly disadvantaged by the small refiner exception, stating, “I would only comment that the competition equation cuts both ways. By recognizing the difficulty of small refiners . . . it does give you a competitive advantage in the market, and not necessarily, if the majors are going to have to go out and do major capital construction costs, are they going to be able to totally recoup somehow, because you’re keeping prices down through your competition. So, I think the difficulty that this Board is going to have to face in dealing with the small refinery issue is how to balance these competition issues. I, for one, do not want to see small refiners go out of business because of this regulation.” (CX 774 at 060-061).

432. Chairman Sharpless at the November 1991 Board hearing also echoed the refiners’ concern about equitable competition among competing alternative fuels. (CX 773 at 278).

F. CARB Sought to Avoid Taking Regulatory Action That Would Adversely Affect Supply of Reformulated Gasoline.

433. The CARB Board and staff both considered, as part of their cost inquiry in Phase 2, how the regulation would affect the supply and demand of gasoline in California. (Kenny, Tr. 6517-6518).

434. CARB viewed maintaining adequate supply of gasoline as a very important consideration in the Phase 2 rulemaking. In balancing emission reductions and cost to consumer, CARB staff sought to ensure that refiners could produce sufficient quantities of gasoline to meet demand. (Venturini, Tr. 263-264).

435. CARB staff recognized that although gasoline could come from outside California if California refiners did not meet demand, even if a non-California refiner had interest in making California reformulated gasoline, it would typically result in higher cost. (Venturini, Tr. 264-265).

436. CARB staff believed that it could not propose a Phase 2 regulation if the cost of the regulation induced even one major refiner to reduce its participation in the California gasoline market. According to Mr. Venturini, “We needed all of them on board.” (Venturini, Tr. 263).

437. To Robert Fletcher, a Phase 2 supervisor, maintaining adequate supply was an aspect of satisfying the “feasibility” requirement in § 43018 of the Health & Safety Code. (Fletcher, Tr. 6446-6447; CX 1665 (Cal. Health & Safety Code § 43018(b)(1991)) (“Not later than January 1, 1992, the state board shall take whatever actions are necessary, cost-effective, and technologically feasible.”)).

438. CARB staff “wanted to be sure when 1996 comes that the California refiners would be ready to produce clean fuels for the state of California.” CARB staff also tracked implementation because “we wanted to be sure that we assisted the California refineries through the process of preparing for the production of clean fuels.” (Courtis, Tr. 5723-5724).
439. CARB had concern that refiners might not fully invest in the California gasoline market if cost was too high, resulting in inadequate supply. As Mr. Venturini testified: “Refineries were going to have to decide first off if they were going to invest in those costs.” (Venturini, Tr. 262-263).
440. CARB staff believed that it could not propose a Phase 2 regulation if even one major refiner reduced its participation in the California gasoline market. As Mr. Venturini explained: “We needed all of them on board. we could have had a significant supply shortfall.” (Venturini, Tr. 263).
441. A further reason that CARB staff was concerned about the cost of Phase 2 was that foreign importers and refiners outside California would not replace lost supply if a current refiner reduced its participation in the California market. As Mr. Venturini explained: “There is ability to bring gasoline from imports, but that typically, because of the distance and so forth, is at a higher cost. And also it was uncertain how many of the refineries outside would be interested in making this fuel.” (Venturini, Tr. 264-265).
442. Factors considered by CARB staff to develop the Phase 2 regulations included technical feasibility, one aspect of which was preventing the interruption of supply and considering public acceptability. (Fletcher, Tr. 6446-6447).
443. As a part of the inquiry into costs of the Phase 2 regulations, CARB Board and staff both considered how the regulation would affect the supply and demand of gasoline in California. (Kenny, Tr. 6517-6518).
444. Knowing that CARB’s RFG regulations would affect the amount of fuel produced, fuel availability was a “very critical component” of CARB staff’s review in order to avoid fuel shortages. Mr. Courtis kept abreast of supply and production levels for gasoline in California. CARB staff obtained information on gasoline production from both the California Energy Commission and other sources. They also looked at the demand for California-produced fuels. (Courtis, Tr. 5722).
445. The Phase 2 regulations required the California refining industry to provide CARB staff with detailed information on the implementation plans associated with the regulations. The information included “what do they do, what their plans are in how much fuel they will be producing, and so on.” Refiners provided the information in decreasing intervals as implementation approached – yearly, then every six months, then in shorter intervals.

Refiners in California complied with the requirements and requests to provide such information. (Courtis, Tr. 5723-5724, 5726).

446. CARB staff became aware of supply and production issues during the Phase 2 implementation for two reasons described by Mr. Courtis. First, “[w]e wanted to be sure when 1996 comes that the California refiners would be ready to produce clean fuels for the state of California.” CARB staff also tracked implementation because “we wanted to be sure that we assisted the California refineries through the process of preparing for the production of clean fuels.” (Courtis, Tr. 5723-5724).
447. CARB created a team within the fuels section to assist California refiners to expedite permitting “so as to smooth the way towards production of Phase 2 gasoline.” Courtis and others on this team talked with local authorities about the benefits of the Phase 2 RFG regulations, including providing detailed information on the local benefits of the regulations. “The overall objective was to work together with the California refining industry to smooth their path in producing reformulated gasoline so we would be able to assure that when 1996 come we’ll have clean reformulated gasoline produced in California at the daily supplies.” (Courtis, Tr. 5724-5725, 5728-5729).
448. Unocal knew that CARB had concerns about the potential supply of Phase 2 fuel. Dennis Lamb of Unocal recognized that CARB’s concerns with supply “grew over time.” (Lamb, Tr. 1917-1918, 1945; Jessup, Tr. 1297 (one of Unocal’s inventors also aware of CARB supply concerns)).
449. CARB expressed concerns at the March 1995 meeting with Unocal about how the ‘393 patent might affect supply. (Lamb, Tr. 2046-2047).
450. According to Unocal, anything that could affect the volume of Phase 2 gasoline produced “should have concerned CARB to assure a successful implementation of the program.” (Kulakowski, Tr. 4489).

IV. Unocal Developed Emissions Research to Obtain a Competitive Advantage.

A. Unocal Recognized the Impact of the Regulatory Process on Its Business, and Participated in this Process to Gain Competitive Advantage.

1. Unocal Responded to Financial Pressures and to the Threat of Mandates for Alternative Fuels Such as Methanol.

451. As President of Unocal’s Refining and Marketing Division, Unocal’s Roger Beach participated in efforts to persuade regulators not to impose alternative fuels upon California. (Beach, Tr. 1743-1744). Mr. Beach was a member of the AB 234 study group, which looked at the possibility of mandates for methanol-based fuel. (Beach, Tr.

- 1744). As a result of the study group, California decided not to impose the use of methanol-based fuel but to examine reformulated gasoline. (Beach, Tr. 1745).
452. In 1989, Unocal was aware that there was a lot of discussion about replacing gasoline in California with methanol. (Jessup, Tr. 1195; Croudace, Tr. 515).
453. As reflected in internal memoranda, Unocal understood that M85 – an alternative fuel comprised of 85% methanol and 15% gasoline – posed a real threat, as it was being seriously considered as an alternative fuel in 1989. (CX 123 (stating that data on any clean gasoline would be measured against M85); CX 125 (discussing the “methanol steamroller” and also expressing Roger Beach’s preference to be regulated on good data)).
454. In the 1980s, Unocal was in financial distress. In 1984, T. Boone Pickens engaged in an attempt to takeover Unocal. (Beach, Tr. 1652). To avoid the takeover, Unocal bought back about \$50 million shares , which resulted in a lawsuit between Unocal and Pickens’ company, Mesa. (Beach, Tr. 1653).
455. As a result of the takeover attempt, Unocal incurred about \$4 billion in new debt. (Beach, Tr. 1653). This forced Unocal’s debt rating down – from Aa1 to Baa1. (Beach, Tr. 1653).
456. In ensuing years, Unocal scaled back its structure and cut back the number of employees as it sold of assets. (Beach, Tr. 1653-1654).

2. Unocal Considered Fuel Emissions Research Done by Others Insufficient for Its Purposes.

457. Unocal became involved in Auto/Oil because the company was critical of EPA regulations including specific fuel formulations “without any scientific basis whatsoever.” (CX 7065 (Stegemeier, Dep. at 115-117)).
458. Dr. Jessup reviewed the ARCO Chemical work on oxygen content in 1989 and considered it “seriously flawed from the scientific standpoint.” (CX 121 at 002; Jessup, Tr. 1198-1199). As Dr. Jessup’s contemporaneous notes state, “ARCO says T90, not T50, will control emissions.” (CX 587 at 012; Jessup, Tr. 1199-1200).
459. In a May 24, 1989 proposal to his management, Dr. Jessup relayed his fear that legislative mandates would “greatly affect the refining business” and that these mandates “are most often based on highly emotional arguments and have little good scientific basis.” (CX 121 at 001; Jessup, Tr. 1197). As Dr. Jessup testified, “At the time, having read the literature, there wasn’t much of a scientific basis to get through.” (Jessup, Tr. 1197). At the time, there was no systematic study of the combined effects of fuel variables on vehicle emissions. (Jessup, Tr. 1201). Dr. Jessup therefore proposed that Unocal “should be gathering good scientific data, independent of political agendas.” (CX

121 at 002; Jessup, Tr. 1198).

460. In an October 20, 1989 Unocal Technical Memorandum, a researcher recommended initiating an “aggressive program for the development of a proprietary reformulated gasoline. The resources allocated for a proprietary program should be greater than a combined auto/oil investigation. Our influence in a combined study is quite diluted and is not geared to meet our unique requirements.” (CX 139 at 001, 003).
461. In late 1989, Unocal proposed to Auto/Oil a plan for a fuels test program that would assess the effect on automotive exhaust emission of 10 fuel properties. Auto/Oil instead chose to pursue another test design with fewer parameters. (CX 142; Croudace, Tr. 621-624, 628-630, 566-567).
462. Dr. Alley forwarded to Mr. Stegemeier in November 1990 a memorandum explaining that the 5/14 Project “was designed to mesh and extend the Auto/Oil work.” The memorandum also identified the goal of “giving Unocal more understanding and flexibility, hopefully leading to a competitive advantage.” (CX 201 at 002; CX 7041 (Alley, Dep. at 154-155)).

3. Unocal Recognized the Potential Licensing Value of Emissions Research.

463. Dr. Croudace testified at trial that, for employees of Unocal’s Science and Technology Division, that it “was pretty much our sole purpose” to make money for the company. (Croudace, Tr. 461-462).
464. As early as 1989, Unocal considered ways to obtain competitive advantage through the use of emissions results relating to low-emissions fuels. Early that year, Unocal considered a proposed joint research project with General Motors to study very low-emission automobiles. (Croudace, Tr. 514; CX 493). In a memorandum dated January 23, 1989, Dr. Croudace stated that:

The benefit of this joint study to Unocal would be twofold. First, it would allow us to continue to produce petroleum-based gasolines in the future that would compete in the marketplace with alternative fuels like methanol. Second, it would allow Unocal to be the first to develop a low-emission petroleum based fuel which could allow us to patent these products and force all other gasoline marketers to license our technology. (CX 493 at 002; Croudace, Tr. 526).

465. As president of Unocal’s Science and Technology Division, Mr. Lipman had responsibilities related to licensing of Unocal technology. (CX 7053 (Lipman, Dep. at 39)). Mr. Lipman was responsible for executing “license agreements with other companies to license Unocal technology to them.” (CX 7053 (Lipman, Dep. at 40)).

466. According to Mr. Lipman, Unocal licensed proprietary information. (CX 7053 (Lipman, Dep. at 41)). Unocal never licensed anything that was non-proprietary. (CX 7053 (Lipman, Dep. at 41)).
467. When asked if he had ever licensed non-proprietary information, Mr. Lipman testified that he was “not sure how we could license something that was not proprietary” because “if we did not have exclusive right to a process or technology I don’t know why we would have the right to license something that we didn’t have exclusive rights to.” (CX 7053 (Lipman, Dep. at 41)).
468. Unocal had licensing agreements of a variety of types: giving an outside company rights to use technology developed and patented by Unocal; giving a company rights to use a Unocal technology as well as consultation related to use of the technology; formulas to manufacture catalysts developed and patented by Unocal. (CX 7053 (Lipman, Dep. at 40)).
469. Unocal had success licensing technology: “at various times almost every major oil company and minor oil company had licensed one of our patents.” (CX 7065 (Stegemeier, Dep. at 34)).
470. Unocal filed a patent application on its detergent additives and believed that it would allow Unocal to license its technology in the future. (CX 114 at 002).
471. In June 1989, Unocal was contemplating a way to use the additive regulations to its advantage: “Under the guidance of senior management directing the divisions and the new established corporate view towards the regulations, Unocal can set in motion coordinated efforts towards influencing and taking best advantage of regulations.” (CX 124 at 002).
472. During a meeting with Roger Beach in July 1989, Unocal managers “expressed [their] conviction that CARB will definitely mandate the use of additives in both diesel fuel and gasoline.” (CX 1215 at 001). At that meeting, there was “a consensus that Unocal should interact directly with CARB prior to implementation of such regulations.” (CX 1215 at 001).

4. Unocal Recognized the Need to Both Conduct Research and Participate in the Regulatory Process.

473. One of the motivations for the 5/14 Project was to show that gasoline could be as clean burning or cleaner burning than methanol. (Jessup, Tr. 1195).
474. By October 1989, Unocal recognized that CARB was heading towards regulation of reformulated gasoline, not alternative fuels such as methanol. (CX 139 at 001). Unocal management was informed in October 1989 that a CARB official at a workshop

“declared it was his opinion that reformulated gasoline will be the ultimate winner.” (CX 139 at 001-003).

475. Mr. Mallett agreed with others at Unocal that Unocal should have an aggressive program for the development of a proprietary reformulated gasoline. (CX 7055 (Mallett, Dep. at 74); CX 139 at 001 (“Unocal should take this indirect endorsement of gasoline as a cue for starting an aggressive program for the development of a proprietary reformulated gasoline.”)).
476. Unocal knew in 1989 that regulation of gasoline was inevitable. (Jessup, Tr. 1195). In Dr. Jessup’s view, regulation was an “unstoppable roller coaster.” (Jessup, Tr. 1195). When he “saw the train coming,” Dr. Jessup proposed that Unocal invest in an experimental program to investigate the effects of gasoline composition on emissions. (Jessup, Tr. 1195).
477. Mr. Stegemeier emphasizes the difficulty Unocal faced when it thought that CARB and EPA would mandate certain fuel formulations that, in some cases, “would make us pay our competitors for the right to use their technology.” Mr. Stegemeier viewed the research leading to Unocal’s reformulated gasoline patents as a way that Unocal was “protecting ourselves from another regulatory burden.” (CX 7065 (Stegemeier, Dep. at 40-41)).
478. Mr. Stegemeier wanted Unocal to provide accurate, precise, and truthful information to regulators. He considered it important to use good science to provide regulators with a foundation upon which to base regulations. (CX 7065 (Stegemeier, Dep. at 65-66)).
479. Mr. Stegemeier considered the release of emissions results from the 5/14 project to CARB to fit within a strategy of persuading CARB base regulations on “good, solid, sound science, which we had done ourselves.” (CX 7065 (Stegemeier, Dep. at 82-83)).
480. Mr. Mallett reflected in a 1989 memorandum that Roger Beach told him that he, “would rather be regulated on good data than on something capricious.” Mr. Mallett agrees with this sentiment. (CX 125 at 002; CX 7055 (Mallett, Dep. at 86-87)).

B. Unocal Created a Fuels Issues Team to Decide How to Take Advantage of New Regulations.

481. On June 6, 1989, Dr. Croudace wrote to his boss, Mr. Mallett, to ask “Can Unocal Use New Regulations To Our Advantage?” (CX 124). Dr. Croudace recommended the creation of a “task force” comprised of “high level management” drawn from “all levels of the corporation” so that Unocal could take “full advantage” of the new regulations:

To take full advantage of legislation it is important that the company makes its policy positions at very high levels so that all levels of the corporation are working together on the issues. A task force should be set up at the outset of discussions on new product regulations. This task force would include representatives from all divisions of the company that the regulation affects. Also included in this group would be high level management so that work between division[s] can be coordinated.

(CX 124 at 004).

482. In November 1989, Mr. Beach, the head of Unocal's Refining and Marketing Division, recognized that regulators were "proposing and implementing actions that impact almost every aspect of light oil specification." (CX 474). Unocal had to assemble a cross-functional team that would "get out in front of the issues" and "influence external forces." (CX 474; Lamb, Tr. 2106). The reference to "external forces" meant state and federal regulators. (Lamb, Tr. 2108-2109).
483. Unocal created the Fuels Issues Team in part because of the pending and future governmental regulations that would affect how Unocal produced its products. (Lamb, Tr. 2107).
484. Fuels Issues Team had a goal to bring together representatives from the various divisions of the company affected by state and federal regulations. (Lamb, Tr. 2108).
485. Mr. Beach appointed Mr. Lamb to assume the leadership of the Fuels Issues Team. The Team drew members from refining, marketing, science and technology departments. (CX 540; CX 474; Beach, Tr. 1675; Lamb, Tr. 2106).
486. At the end of December 1989, the Fuels Issues Team included Mr. Lamb, Mr. Kulakowski, Mr. Mandlekar, Dr. Miller, and Mr. Taylor. The team had a list of more than twenty "team 'consultants' or people [to] seek advice and help from or that should be kept informed." (CX 149 at 001-002).
487. In his role as leader of the Fuels Issues Team, Mr. Lamb reported directly to Mr. Beach concerning the activities of the Fuels Issues Team. Mr. Beach held Mr. Lamb accountable for reporting Fuels Issues Team activities. (Lamb, Tr. 2110).
488. Mr. Beach assigned Mr. Lamb as the "'one guy' to speak for Unocal" on Fuels Issues Team issues. (CX 585 at 013).
489. By forming the Fuels Issues Team, Mr. Beach sought close coordination between the

Science and Technology Division and the Refining and Marketing Division in order to turn the “challenges” of government regulations “into opportunities.” (CX 540; CX 474; Beach, Tr. 1676). By “opportunities,” Mr. Beach meant discontinuities or advantages that would put Unocal in a better competitive posture. (Beach, Tr. 1677). This included obtaining a patent that would cover at least some of the gasoline mandated by CARB regulations. (Beach, Tr. 1678).

490. The Fuels Issues Team mission included, as of January 1990, “anticipate issues; gather market and political intelligence; consolidate and integrate best thinking; . . . utilize the integrated perspective of the Refining and Marketing Division and Science and Technology; formulate policy/strategy options and recommendations with a focus on the high ground of environmental image.” (CX 154 at 004).
491. In January 1990 The Fuel Issues Team identified “CARB proposals” as a major issue for the group. (CX 154 at 001).
492. The Fuels Issues Team in January 1990 received a report of the proposals CARB outlined at a public hearing on December 14, 1989. (CX 154 at 002). This presentation identified that CARB’s clean fuels requirement may include “reformulated gasoline if emission-based performance standards met.” (CX 154 at 013).
493. Dr. Miller had a role on the Fuels Issues Team to keep it apprised of the progress and status of the 5/14 Project. Dr. Miller also kept the Fuels Issues Team apprised of the progress of the Auto/Oil testing. (Miller, Tr. 1376-1377; CX 195; CX 154 at 002).
494. Mr. Lipman believed that Science and Technology could help Mr. Lamb by providing an explanation and understanding of the 5/14 research and the Auto/Oil research. Mr. Lipman also understood that Science and Technology employees had been asked questions on different strategies to determine emissions under various fuel conditions. (CX 7053 (Lipman, Dep. at 38-39)).

C. Unocal’s Reformulated Gasoline Research: the “5/14 Project.”

1. Unocal Initiated Fuel Emissions Research In Response to Impending Reformulated Gasoline Regulations.

495. Unocal had concern that regulations would force Unocal to spend huge amounts of money to change its refineries and that the regulations would not lead to cleaner air, resulting in Unocal having to go through the process again. (Jessup, Tr. 1155).
496. Dr. Jessup had an original goal for the fuels experiments to “know the truth of the matter” as to what properties of gasoline to vary and what compositions to make that to have a fuel with lower emissions. (Jessup, Tr. 1155).

497. In the fall of 1989, Dr. Jessup and Dr. Croudace proposed to their management, including Dr. Alley and Dr. Miller, a research program to measure the effects of gasoline compositions and properties on automotive engine emissions. (CX 142 at 001-002, 007).
498. Drs. Jessup and Croudace in late 1989 sought to figure out how to change gasoline properties to minimize three major categories of automotive engine emissions: carbon monoxide (CO), nitrogen oxide (NOx) and unburned hydrocarbons (HC). (CX 142 at 003, 009). They knew that this research, if successful, could be used to make reduced-emissions reformulated gasoline. (CX 142 at 003-004).
499. Dr. Jessup and Dr. Croudace designed a study to independently isolate the effects of ten gasoline properties and components on these three categories of emissions (CO, NOx, and HC). (CX 142 at 004; CX 186 at 002-005).
500. The ten properties that Unocal's scientists chose to study were the T10 distillation point, T50 distillation point, T90 distillation point, Reid Vapor Pressure, paraffin content, olefin content, aromatics content, MTBE (oxygen) content, Research Octane Number, and Motor Octane Number. (CX 142 at 004; CX 186 at 002-005).
501. The distillation points of gasoline (T10, T50, T90) are the temperatures at which a specified volume of gasoline evaporates. T10 is the temperature at which ten percent of the gasoline will evaporate, T50 the temperature at which 50% will evaporate, and T90 the temperature at which 90% will evaporate. (CX 1709 at 013; CX 617 at 021, col. 18, ll. 29-35 ('393 patent); CX 186 at 009).
502. Reid Vapor Pressure (RVP) refers to the volatility of gasoline (the partial pressure of gasoline when heated to 100° F in a sealed container). (CX 617 at 021, col. 18, ll. 43-54 ('393 patent)).
503. Olefins, paraffins and aromatics are the three hydrocarbon components of gasoline, and are typically measured by their percentage volume. (CX 1709 at 003-004; Wirzbicki, Tr. 964, 1085-1086).
504. Octane is a traditional engine performance specification that measures gasoline's ability to resist auto-ignition or "engine knock" in use. (CX 1709 at 012).
505. Research Octane Number (RON) and Motor Octane Number (MON) are two different components of octane measurements. (CX 1709 at 012-013).
506. MTBE is a component that adds oxygen content to gasolines. (CX 142 at 005; CX 1709 at 015).
507. Although other industry members had studied the impact of varying some of these gasoline properties or components on vehicle emissions, they had not isolated the effect

of each individual property or component or studied such a large number of them. (CX 186 at 005-006).

2. Unocal Scientists Performed Experiments to Determine the Effects of Gasoline Properties on Automobile Exhaust Emissions.

508. Unocal pursued a proprietary emissions research project. Beginning in January 1990, Unocal scientists from the company's Science and Technology Division – Peter Jessup and Michael Croudace – conducted the first of three separate test programs to determine the effects of certain gasoline properties on emissions. (CX 585; CX 107; Jessup, Tr. 1154-1155; 1158).
509. The emissions research conducted by Drs. Jessup and Croudace consisted of a one-car test followed by a ten-car test, with additional tests done thereafter. (Jessup, Tr. 1154-1155). This research later became known by the name "5/14 Project," which was shorthand for all of Unocal's emissions research relating to reformulated gasoline. (Croudace, Tr. 526-527).
510. Drs. Jessup and Croudace sought to design their study to independently isolate the effects of ten gasoline properties and components on these three categories of emissions (CO, NOx, and HC). (CX 142 at 004; CX 186 at 002-005).
511. Drs. Jessup and Croudace began conducting the one-car test in January 1990. They substantially completed the one-car study by the end of March 1990, and expected to complete the testing and data analysis by June 1990. (Jessup, Tr. 1154-1155, 1158; CX 163 at 001).
512. This first one-car study tested fifteen test fuels with a wide range of ten fuel properties by combusting them in a 1988 Oldsmobile Regency automobile to determine their emissions outputs. A "check" fuel was used as a control in every fifth run. (CX 186 at 006-007; CX 617 at 016, col. 7, 1.60 - col. 8, 1.68; Jessup, Tr. 1154-1155).
513. Drs. Jessup and Croudace then regressed the emissions outputs for the test fuels against ten gasoline property variables using a commercially-available computer program. (CX 617 at 016, col. 8, ll. 46-57; CX 186 at 009). The computer program produced a set of simple linear equations that show the correlations between the emissions outputs and the property variables. (CX 186 at 002,009; CX 617 at 015, col. 5, ll. 36-37; 016, col. 8, ll. 57-61).
514. After performing a statistical check of their data, Drs. Jessup and Croudace determined that "the equations accurately define the scientific phenomena at work within normal realms of variabilities." (CX 617 at 017-018, col. 9, 1.1 - col. 11, 1.13).
515. Drs. Jessup and Croudace were "absolutely amazed" and "blown away" by what they

- saw by simply looking at the data from the one-car test data. They saw changes in emissions of up to 300% just by changing the fuel. By comparison, the maximum effect of changing fuel parameters shown by the Auto/Oil study was only 25%. (Jessup, Tr. 1156). By simply plotting the data from the one-car test, Dr. Jessup was able to see tremendous variations in emissions. (Jessup, Tr. 1157).
516. Prior to looking at the one-car test data, Drs. Jessup and Croudace had no idea that their experiments would show such dramatic results. (Jessup, Tr. 1156-1157).
 517. This initial discovery of what properties affected emissions in the one-car test was the basis for the invention in all five of Unocal's RFG patents. (Jessup, Tr. 1158).
 518. Unocal later (in May 1990) conducted a second set of tests on a fleet of 10 cars at the Southwest Research Institute ("SwRI"). (Jessup, Tr. 1161; CX 617 at 018, Col. 11-12).
 519. In the ten-car test, Drs. Jessup and Croudace ran fifteen test fuels in six recent-model automobiles and four pre-1990 but post-1980 technology cars. (CX 617 at 018, col. 11, 1.14 - col. 12, 1.15). Drs. Jessup and Croudace tested the fuels in the same way as in the one-car study, except that the control fuel was used in every sixth run and the standardized Federal Test Procedures were followed exactly. (CX 617 at 018, col. 11, 1.53 - col. 12, 1.15).
 520. Drs. Jessup and Croudace then plotted the CO, NO_x, and HC "emission data" from the ten-car test in graphs. From these graphs, they found that it was "clearly evident" that the "general effect of a given fuel is the same for different vehicles, with only the magnitude of the effect varying." (CX 617 at 018, col. 11, 1.45 - col. 12, 1.15).
 521. Unocal's scientists then analyzed the ten-car study data using the same computer program they used in the one-car study, searching, as they did before, for an equation for each car correlating emissions with fuel properties. (CX 617 at 018, col. 12, ll. 60-65).
 522. The equations generated for each car in the ten-car test were not exactly the same, but the "data overall validated the fact that the most important factors as shown in...[the equations they developed from the one-car study] proved almost universally most significant for each automobile." (CX 617 at 018-019, col. 12, 1.65 - col. 13, 1.6).
 523. In support of the results of the one-car study, "from the data in" Unocal's ten-car study "it can be seen that for automobiles in general that decreasing any of [T50, olefins, RVP or T10] will have a positive effect, especially for any large population of automobiles." (CX 617 at 019, col. 13, ll. 59-62; 010-012).

a. Unocal's Research Showed the Relationships Between Key Gasoline Properties and Automobile Emissions.

524. The research showed specific directional relationships between exhaust emissions of carbon monoxide, hydrocarbons, nitrogen oxides, and a number of chemical and physical properties of gasoline including RVP, distillation properties (T10, T50, T90), chemical composition (olefins, paraffins, and aromatics), and octane. (CX 617 at 013 (Col. 1-2)).
525. From the test data, Drs. Jessup and Croudace discovered a set of gasoline properties that affect emissions, which particular emissions were affected by those properties, how the properties simultaneously affected emissions, and how to modify the gasoline using those properties to adjust emissions from an automobile. (Jessup, Tr. 1158-1159). Drs. Jessup and Croudace thus discovered how to simultaneously reduce all three types of tailpipe emissions – HC, CO and NOx. (Jessup, Tr. 1159). Thus, their invention was, in part, “a set of properties and what directions to move those properties” to reduce emissions “and what the interrelationships are” between those properties and emissions. (Jessup, Tr. 1159-1160).
526. From the data in the one-car study, which was later confirmed by the ten-car study, Drs. Jessup and Croudace were able to identify “the key gasoline properties that, when adjusted properly in gasoline blends, reduce gross output of regulated emissions from modern engines.” (CX 186 at 002, 006-007 (7/10/90 Invention Disclosure); CX 617 at 013, col. 1, ll. 41-58).
527. This initial discovery from the one-car test became the basis for the invention in all five of Unocal’s RFG patents. (Jessup, Tr. 1158).
528. According to Dr. Croudace, “the invention is in fact showing directionally how to change properties within a motor fuel to produce certain effects from emissions.” (Croudace, Tr. 453). In other words, Drs. Jessup and Croudace learned “how to make low emission gasoline.” (CX 186 at 002–003, 006-007).
529. While Dr. Croudace disagreed with the statement at trial, he gave sworn testimony in 1996 that the patent is “a directional patent.” (Croudace, Tr. 456-457).

b. Unocal’s Research Showed that Reducing T50 Significantly Reduces Emissions.

530. Drs. Jessup and Croudace discovered that decreasing T50 is of primary importance in reducing both CO and HC emissions. (Jessup, Tr. 1227; CX 617 at 015, col. 5, 1.31 - col. 6, 1.50; CX 1792 at 104-109). The effect of T50 on emissions had not been studied before. (Jessup, Tr. 1227).
531. Mr. Wirzbicki, Unocal’s Chief Patent Counsel subsequently represented to the PTO in a filing he signed on April 27, 1995 in the application that lead to the ‘567 patent that “one of applicants’ main discoveries” is that “T50 has a strong effect on exhaust hydrocarbon emissions.” (CX 1792 at 109, 104-109; Wirzbicki, Tr. 1008-1009).

532. According to Dr. Jessup, by simply looking at figure 1 in the patent (which is “a graph of CO emission values for 22 different fuels tested in six different automobiles” (CX 617 at 014)) and the fuel properties in table 5 of the patent, (CX 617 at 018) you can tell that T50 is “the one really big factor” influencing emissions. (Jessup, Tr. 1191-1192; CX 617 at 018 (Table 5)).

c. Unocal’s Study Determined Specific Directional Relationships Between Fuel Properties and Emissions.

533. In addition to discovering the effect of T50 on CO and HC emissions, Drs. Jessup and Croudace uncovered several other relationships between fuel properties and emissions as well. For example, they found that decreasing RVP is of primary importance, and decreasing T10 and olefin content are of secondary importance, for reducing NOx emissions. (CX 617 at 013, col. 2, ll. 21-29).

534. The data from Unocal’s tests showed that decreasing T50 and increasing paraffin content are most effective for reducing CO emissions, and decreasing T90 has a lesser impact on reducing those emissions. (CX 617 at 015, col. 6, ll. 12-28).

535. The data from Unocal’s tests showed that decreasing both olefin content and RVP are most effective for reducing NOx emissions, although decreasing T10 and increasing paraffin content also reduces NOx emissions to a lesser extent. (CX 617 at 015, col. 6, ll. 28-31).

536. Unocal’s scientists found that HC emissions can be most practically reduced by decreasing olefins and/or T50, and that increasing RON is a less practical way to reduce such emissions. (CX 617 at 015, col. 6, ll. 46-50).

537. The seven properties that Unocal’s research data from its one-car study showed to affect emissions are T50, olefin content, T90, T10, paraffin content, RVP and RON. (CX 617 at 015).

538. Unocal’s scientists found that any combination of the gasoline properties they identified can be increased or decreased as described, and the greater any individual property is changed in the directions indicated, the better the result. (CX 617 at 015, col. 6, ll. 51-63; 020 at col. 15, ll. 1-28).

539. As Unocal later represented in its patents, it was “evident” from the “data” in Dr. Jessup and Dr. Croudace’s one-car and ten-car experiments that T50 is the most important variable for reducing CO and HC emissions, and RVP is the most important variable for reducing NOx, with olefin content and T10 having secondary importance. (CX 617 at 016, col. 7, ll. 49-55).

d. Unocal Discovered Mathematical Equations Demonstrating the Directional Relationships Between Gasoline Properties and Automobile Emissions.

540. Drs. Jessup and Croudace developed equations from their one-car study, and confirmed them in their later ten-car study, that demonstrate of the directional relationships they discovered. (CX 617 at 015-018; CX 186 at 002-003).

541. These equations with numeric coefficients from Unocal's one-car study are:

$$\begin{aligned} \text{Carbon Monoxide} &= +0.00937 * (\text{D-86 Distillation 50\% Point in } \circ\text{F}) \\ &+0.00133 * (\text{D-86 Distillation 90\% Point in } \circ\text{F}) \\ &-0.00828 * (\text{Vol.\% Paraffins}) \end{aligned}$$

$$\begin{aligned} \text{Nitrogen Oxide} &= +0.00503 * (\text{Vol.\% Olefins}) \\ &-0.00060 * (\text{Vol.\% Paraffins}) \\ &+0.00087 * (\text{D-86 Distillation 10\% Point in } \circ\text{F}) \\ &+0.0159 * (\text{RVP in psi}) \end{aligned}$$

$$\begin{aligned} \text{Hydrocarbon} &= +0.00245 * (\text{Vol. \% Olefins}) \\ &- 0.00104 * (\text{Research Octane Number}) \\ &+0.00109 * (\text{D-86 Distillation 50\% Point in } \circ\text{F}) \end{aligned}$$

(CX 186 at 002; CX 617 at 015, col. 5, ll. 36-37; 016, col. 8, ll. 57-61 ('393 patent)).

542. Equations 4, 5 and 6 in Unocal's patents are the equations containing the numerical coefficients from the one-car study. (CX 617 at 015, col. 5, ll. 35-67); *see also* (CX 618, CX 619, CX 620, CX 621; Wirzbicki, Tr. 881, 994-995).

543. Dr. Jessup and Dr. Croudace also developed equations with letter variables in lieu of numerical coefficients from their one-car study, later confirmed by their 10-car study. These are:

$$\begin{aligned} \text{Carbon Monoxide} &= +K1 * (\text{D-86 Distillation 50\% Point in } \circ\text{F}) \\ &+K2 * (\text{D-86 Distillation 90\% Point in } \circ\text{F}) \\ &-K3 * (\text{Vol.\% Paraffins}) \end{aligned}$$

$$\begin{aligned} \text{Nitrogen Oxide} &= K4 * (\text{Vol.}\% \text{ Olefins}) \\ &\quad -K5 * (\text{Vol.}\% \text{ Paraffins}) \\ &\quad +K6 * (\text{D-86 Distillation 10\% Point in } \circ\text{F}) \\ &\quad +K7 * (\text{RVP in psi}) \end{aligned}$$

$$\begin{aligned} \text{Hydrocarbon} &= K8 * (\text{Vol. } \% \text{ Olefins}) \\ &\quad -K9 * (\text{Research Octane Number}) \\ &\quad +K10 * (\text{D-86 Distillation 50\% Point in } \circ\text{F}) \end{aligned}$$

These are Equations 1, 2, and 3 in Unocal's patent. (CX 617 at 015, col. 5, ll. 35-67); *see also* (CX 618, CX 619, CX 620, CX 621; Wirzbicki, Tr. 881, 994-995).

544. Unocal's equations show that to minimize a given type of emissions, one should minimize fuel variables with positive coefficients and maximize fuel variables with negative coefficients. (CX 186 at 002, 007).
545. For example, Unocal's equations show that to minimize CO emissions, one should minimize T50 and decrease paraffins. (CX 186 at 002; CX 617 at 015; col. 5, 1.31 - col. 6, 1.31).
546. The size of the coefficients in Unocal's equations then shows the magnitude of the impact of the particular fuel property. (CX 186 at 002). The exact size of the coefficients is fixed depending on the particular car that is combusting the gasoline. (CX 617 at 018, col. 6, ll. 31-67).
547. Despite some differences between individual cars, Unocal's scientists found in their 10-car study that the fuel properties they identified in their one-car study as having the greatest impact on emissions "proved almost universally most significant for each automobile." (CX 617 at 018-019, col. 12, 1.65 - col. 13, 1.6). In other words, the same magnitudes indicated by the coefficients in Unocal's one-car study apply to their ten-car study as well.
548. Unocal later provided the equations in their patent, with letter variables and with the coefficients for an average of a pool of ten cars to CARB. (CX 386 at 001-002).
549. As Drs. Jessup and Croudace admitted in their patents and patent application, their one-car and ten-car equations provide those skilled in the art with the directional relationships outlined above, and show "how to lower the reductions of not just CO, NOx, or hydrocarbons, but also of any combination thereof." (CX 617 at 015-016, col. 5, 1.36 - col. 7, 1.45; CX 1788 at 023-027; CX 617 at 015, col. 6, 1.1, col. 6, 1.51, col. 6, 1.64).

e. Unocal's Research Showed That A "Predictive Model" Could Be Used to Predict Emissions Associated with A Given Formula of Gasoline.

550. Dr. Jessup and Dr. Croudace discovered, as they later informed CARB in the June 20, 1991 Unocal presentation to CARB, that: “Very simple linear equations can be used to predict emissions reductions.” (CX 24 at 039).
551. Dr. Jessup admits that Unocal’s equations provide a “predictive model” that allows one to predict emissions through mathematical equations. (Jessup, Tr. 1165-1166).
552. Unocal referred to the mathematical equations developed by Dr. Croudace and Dr. Jessup as “our predictive model” because these mathematical equations predict resulting emissions output (Croudace, Tr. 491-492; Lamb, Tr. 1995-1996). Dr. Croudace and Dr. Jessup later characterized their development of “practical mathematical models of tailpipe exhaust emissions.” (CX 1424 at 021 (1992 SAE Paper); Croudace, Tr. 503).
553. One of the lessons of the 5/14 Project was that one could directionally predict emissions based on controlling gasoline properties such as T50. (Lamb, Tr. 1998). These directional relationships were embodied and reflected in mathematical equations developed from the 5/14 Project. (Lamb, Tr. 1998-1999).
554. Drs. Jessup and Croudace have stated that their equations “predict[] emissions results” for any given fuel in a particular car, and can be used on a large scale to “calculate emissions from standard fuel properties...” (CX 186 at 002-003).

f. Unocal’s Research Data Showed How to Make and Use Low Emissions Gasoline.

555. From Unocal’s 5/14 research data, one can identify, make and use reduced emissions gasolines, as well as predict the emissions of any given gasoline fuel. Unocal’s inventors, Drs. Jessup and Croudace, understood that the data they discovered are sufficient to allow one to implement these numerous practical applications of their research. (CX 186 at 002-003; CX 171 at 001, 050-056; Jessup, Tr. 1162-1172; CX 617 at 019, col. 13, 1.62 - col. 14, 1.2).
556. Dr. Jessup and Dr. Croudace also stated that the low emission fuel that could be produced using their research “is most easily defined in the form of the formulas” from their study. (CX 186 at 002). They later explained these facts to their management and in the patents they obtained on the practical applications of the 5/14 research results. *See, e.g.*, (CX 186 at 002-003; CX 171 at 001, 050-056; Jessup, Tr. 1162-1172; CX 617 at 019, col. 13, 1.62 - col. 14, 1.2).
557. Dr. Jessup admitted that even charts plotting the data from the one-car study “show what the invention is” and “where the new compositions of gasoline are.” (Jessup, Tr. 1170-1172; CX 171 at 056).

558. To get to “the new compositions of gasoline”, according to Dr. Jessup, one adjusts the gasoline properties “against any starting point you want” -- such as the then-average gasoline fuel (the “Auto/Oil average fuel”) -- in accordance with the directional relationships that Drs. Jessup and Croudace discovered. (Jessup, Tr.1164, 1166-1167, 1171-1172; CX 171 at 050-056); *see also* (Jessup, Tr. 1254-1255). As Dr. Jessup admitted, “[T]hat’s the forerunner to many of the [patent] claims.” (Jessup, Tr. 1164, 1166-1167, 1171-1172; CX 171 at 050-056).
559. Unocal’s patent application also later explained that one adjusts gasoline properties to reduce automotive emissions – *e.g.*, as compared to the emissions levels of a “typical” unleaded gasoline fuel at the time of the patent application (such as the Auto/Oil average fuel) (CX 1788 at 049), or as compared to the results achievable with other fuels. (CX 1788 at 019).
560. Drs. Jessup and Croudace have admitted that their “*equation allows one to determine how to make low emission gasoline.*” (CX 186 at 003) (emphasis added).
561. Drs. Jessup and Croudace have conceded that by using their equations with “standard linear program blending programs,” a refinery could make “low emitting fuels.” (CX 186 at 002).
562. Unocal’s patents make clear that “from the data in” Unocal’s ten-car study “it can be seen that for automobiles in general that decreasing any of [T50, olefins, RVP or T10] will have a positive effect [on emissions], especially for any large population of automobiles.” *See, e.g.*, (CX 617 at 019, col. 13, ll. 59-62; 010-012). They continue, “In turn, it can be appreciated that the preferred fuels of the invention [in the patent] will be prepared (*e.g.*, by appropriate blending in a refinery) so as to decrease each of [T50, olefins, RVP or T10]...” (CX 617 at 019, col. 13, 1.62 - col. 14, 1.2).

D. The Highest Levels of Unocal Management Recognized the Importance of Unocal’s Emissions Research to the Company.

1. Unocal Scientists Presented Their Research to Roger Beach, President of the Refining and Marketing Division, on May 11, 1990.

563. In a May 2, 1990 memorandum, Roger Beach called a number of his staff to attend a presentation of the research results from the work of Drs. Jessup and Croudace and to “discuss what UNOCAL should do with this data.” (CX 172 at 001; Beach, Tr. 1667-1668).

564. On May 11, 1990, Unocal scientists Peter Jessup and Michael Croudace, accompanied by management of Unocal's Science and Technology Division, gave a presentation on their emissions research results to Roger Beach, then-President of Unocal's Refining and Marketing Division, and other management of that division in an effort to obtain funding for additional research. (CX 172; CX 175 at 001; Lamb, Tr. 1841).
565. Drs. Jessup and Croudace's manager, Dr. Miller, and the head of the Fuels Issues Team, Denny Lamb, were among the participants at the May 11, 1990 meeting. (CX 172; CX 175 at 001).
566. At the May 11, 1990 meeting, Dr. Jessup explained the invention that he and Dr. Croudace had discovered. (Beach, Tr. 1668). Mr. Beach was "very excited" by what he saw, and the company soon thereafter authorized funds for additional testing. (Beach, Tr. 1668).
567. The May 11, 1990 briefing of Unocal's Science and Technology Group was in line with common industry practices for group managers to conduct briefing sessions in order to fully understand the content of a presentation before making a formal presentation to senior management. (CX 7065 (Stegemeier, Dep. at 71)).

2. Unocal's Executive Committee Received a Presentation of the Emissions Research, Which Became Known as the "5/14 Project," on May 14, 1990.

568. On May 14, 1990, Drs. Jessup and Croudace presented the results of their emissions research to Unocal's Executive Committee. (Croudace, Tr. 458-461; Lamb, Tr. 1827; CX 7065 (Stegemeier, Dep. at 32, 74-75)).
569. The research presented at the May 14, 1990 Executive Committee meeting became known as the "5/14 Project." (Beach, Tr. 1750; CX 176; CX 181).
570. The Executive Committee is Unocal's top management committee. Members include Unocal's Chairman and Chief Executive Officer, Chief Financial Officer, Chief Legal Officer, and four Senior Vice Presidents with responsibilities for the Chemicals, Exploration and Production, Refining and Marketing, and Corporate Development Divisions. (CX 7065 (Stegemeier, Dep. at 025-028, 031-032, 084); CX 179 at 001; CX 614 at 034).
571. Participants to the May 14, 1990 Unocal Executive Committee meeting included, but were not limited to, Richard Stegemeier, Roger Beach, Neil Schmale, Denny Lamb, Wayne Miller, Michael Croudace, Peter Jessup. (CX 175; Lamb, Tr. 1827; CX 7065 (Stegemeier, Dep. at 75); Beach, Tr. 1668; Croudace, Tr. 458-459).
572. The May 14, 1990 meeting was a big event for Dr. Croudace and Dr. Jessup. (Croudace,

- Tr. 460). In his entire career at Unocal, Dr. Jessup has only made two or three presentations to such a committee. (Jessup, Tr. 1163).
573. In the May 14, 1990 presentation to the management committee, Dr. Jessup explained the inventions that he and Dr. Croudace had discovered from the one-car test data. (CX 171 at 001). Based on that data, Dr. Jessup explained that T50 was the most important variable for HC emissions. (Jessup, Tr. 1164-1165; CX 171 at 042). He also listed T50 first among the most important gasoline factors. (Jessup, Tr. 1165; CX 171 at 043). Further, based on the data from the one-car test, Dr. Jessup told the Unocal management committee that one can “predict emissions through a mathematical equation”, i.e., through a predictive model. (Jessup, Tr. 1165-1166).
574. As Dr. Jessup admits, the charts of the one-car data that he showed to the Executive Committee “show what the invention is” and “where the new compositions of gasoline are.” (Jessup, Tr. 1170-1172).
575. Drs. Jessup and Croudace recommended the Unocal Executive Committee to “[t]ake the results of this current study” to CARB. (CX 171 at 007; Jessup, Tr. 1162-1164).
576. Mr. Stegemeier, the then Chairman and CEO of Unocal, had a positive reaction to the presentation made by the Science and Technology Division to the Executive Committee regarding the company’s emissions research. (CX 7065 (Stegemeier, Dep. at 32, 86)).
577. The 5/14 project generated considerable excitement at Unocal. (Beach, Tr. 1668). 76 Products Company President Beach was “bowled over” and “very excited” by Drs. Jessup and Croudace’s presentation. (Beach, Tr. 1668). Denny Lamb thought the May 14, 1990 presentation was “exciting,” and believed that Unocal should do more research. (Lamb, Tr. 2179).
578. One of the recommendations presented at the May 14, 1990 Executive Committee meeting was to “[t]ake the results of this current study to the EPA and CARB.” (Lamb, Tr. 2180; CX 172 at 020). A decision was made to not to take the results to EPA and CARB “because with a one-car study, that wasn’t enough evidence to be convincing with a regulatory body.” (Lamb, Tr. 2180).
579. Based on the presentation, Roger Beach agreed that his Refining and Marketing Division would sponsor the filing of a patent application based on the 5/14 Project. (Beach, Tr. 1751-1754). He also agreed that his division would fund additional emissions research. (Beach, Tr. 1668-1669).
580. Beach knew when he approved the filing of the patent application that a cash flow stream might result from royalties or licensing fees for use of the patent. (Beach, Tr. 1701, 1763).

581. Mr. Stegemeier and Mr. Beach instructed to have Unocal's in-house study confirmed by Southwest Research Institute to, in Mr. Stegemeier's estimation, "lend credibility to the data." (CX 7065 (Stegemeier, Dep. at 75, 77)).
582. On May 23, 1990 Unocal's Board of Directors, including Roger Beach and Richard Stegemeier, formally approved additional funding for this research. (CX 179 at 001; Beach, Tr. 1669; CX 172; Lamb, Tr. 2042-2044; CX 176; CX 181).

3. Unocal Senior Management had the Knowledge, Experience, and Interest to Recognize the Importance of Unocal's 5/14 Research.

583. Mr. Stegemeier served as Unocal's Chief Executive Officer and Chairman of the Board until 1994. (CX 7065 (Stegemeier, Dep. at 5)).
584. Mr. Stegemeier has a background as a research engineer. He has had seven patents in his name. At one point in his career at Unocal, Mr. Stegemeier served as the President of Unocal's Science and Technology Division and led activities regarding patents in that position. He also became aware of Unocal's policies regarding intellectual property. (CX 7065 (Stegemeier, Dep. at 6-9)).
585. Mr. Stegemeier always had an interest in the operations of Unocal's Science and Technology Division: "I'm interested in technology as a valuable part of a corporation's business." (CX 7065 (Stegemeier, Dep. at 15)).
586. As a regular practice, Mr. Lipman sent a monthly report to the president of Unocal detailing the activities of the Science and Technology Division of Unocal. (CX 7053 (Lipman, Dep. at 5); CX 593). These types of reports provided upper management with "a brief overview of activities that were going on in the Science and Technology division without having to call a meeting to go over them." (CX 7053 (Lipman, Dep. at 47)).
587. Mr. Schmale has experience working for Unocal as both an attorney and as a petroleum engineer. The Research Department of Unocal reported to Mr. Schmale from 1988 to 1991. (CX 7062 (Schmale, Dep. at 6, 8-9)).

4. Unocal's Executive Committee Approved Funding for Further Research in Late May 1990 and Monitored the Progress of the 5/14 Project.

588. The May 14, 1990 presentation to the Executive Committee led to several significant follow-up decisions. First, a patent application would be filed for the results of the 5/14 project. (Beach, Tr. 1753-1754). Second, Unocal authorized Drs. Jessup and Croudace to continue their emissions research, and provided them with an additional \$765,000.00. (CX 176). Third, Unocal decided that the results of the emission research should be kept secret. (Lamb, Tr. 2044).

589. Unocal's Refining and Marketing Division, of which Roger Beach was President, became the corporate sponsor of the 5/14 Project. (Beach, Tr. 1669).
590. At the May 14, 1990 presentation to Mr. Stegemeier, Unocal's then CEO and Chairman of the Board, Mr. Lamb made handwritten notes on an internal Unocal document. (CX 172; Lamb, Tr. 2042-2044). Mr. Lamb's handwritten notes reflect that there was a "presentation to R. Stegemeier 5-14," and that one of the outcomes of this presentation was a decision to "proceed with research, more cars, 750M." (CX 172; Lamb, Tr. 2043). Mr. Lamb understood that "\$750,000" had been approved, as reflected by the handwritten notes he made at the meeting on May 14, 1990. (Lamb, Tr. 2043-2044).
591. Dr. Alley had the role of getting money for the 5/14 Project. He also followed the project "fairly carefully" to see that the researchers kept the goal in mind. (CX 7041 (Alley, Dep. at 19)).
592. Dr. Alley prepared an Authority for Expenditure for the 5/14 Project. A memo dated May 21, 1990, from Dr. Alley to Mr. Lipman states that the "money will be used for an extended reformulated gasoline program" to measure FTP emissions in ten cars using 15 test gasolines. (CX 176 at 001, 002; CX 7041 (Alley, Dep. at 133); CX 7053 (Lipman, Dep. at 19)).
593. Mr. Beach had discretion to authorize a \$765,000 expenditure. Even given Mr. Beach's authority, the Executive Committee of the Board of Directors reviewed all expenditures and as Chief Executive Officer, Mr. Stegemeier had an interest in how the money was being spent. (CX 7065 (Stegemeier, Dep. at 26, 71-72)).
594. Unocal's Chief Executive Officer, Mr. Stegemeier, personally approved additional funding for the 5/14 project: "Mr. Stegemeier approved an expanded test program after a presentation on May 14." (CX 181).
595. In 1990, Mr. Lipman understood that Mr. Stegemeier had an interest in researching reformulated gasoline because a number of budget-type presentations had been made to Mr. Stegemeier. (CX 7053 (Lipman, Dep. at 19-20)).
596. Mr. Schmale and Mr. Lipman signed the Authority for Expenditure for the reformulated gasoline emission test program at the Southwest Research Institute. When he signed this document, Mr. Schmale would have had backup information explaining the request for \$765,000. (CX 176; CX 7062 (Schmale, Dep. at 20-21); CX 7053 (Lipman, Dep. at 20-21)).
597. Mr. Stegemeier and other members of Unocal's Executive Committee formally approved an expenditure of \$765,000 for additional testing for the 5/14 Project. (CX 179 at 001; Beach, Tr. 1669; CX 7065 (Stegemeier, Dep. at 75)).

598. After obtaining additional funding on May 23, 1990, using the same test design as the initial research project, Unocal conducted a second set of tests on a fleet of 10 cars at the Southwest Research Institute ("SwRI"). This testing was completed in the fall of 1990. (Jessup, Tr. 1161; CX 617 at 018, Col. 11-12).
599. As discussed above, the "data" from the 10-car study "overall validated the fact that the most important factors as shown in...[the equations they developed from the one-car study] proved almost universally most significant for each automobile." (CX 617 at 018-019, col. 12, 1.65 - col. 13, 1.6).
600. In support of the results of the one-car study, "from the data in" Unocal's ten-car study "it can be seen that for automobiles in general that decreasing any of [T50, olefins, RVP or T10] will have a positive effect, especially for any large population of automobiles." (CX 617 at 019, col. 13, ll. 59-62; 010-012).
601. The 10-car study also identified one additional property, aromatics, that had appeared to Unocal to have a minor effect on the hydrocarbons emissions. Unocal believed increasing aromatics decreased HC emissions. (CX 24 at 022). Unocal's patents, however, while discussing the 10-car study, its results, and the directional relationships that Unocal discovered, did not mention the effect of aromatics. *See e.g.*, (RX 793 at 017, col. 7).
602. Unocal's management kept their CEO, Mr. Stegemeier, apprised of the progress of the 5/14 Project. (CX 201 at 001; CX 217 at 001; Miller, Tr. 1384-1385).
603. On September 17, 1990, the Executive Committee held a meeting at which there was a discussion of the 5/14 project. Among those in attendance at this Executive Committee meeting were Richard Stegemeier, Unocal's CEO and Chairman of the Board at the time; Roger Beach, Unocal President of the Refinery and Marketing Division; and Denny Lamb. (CX 194).
604. After a Refining and Marketing strategic issues presentation to the Executive Committee on September 17, 1990, Richard Stegemeier, Unocal's CEO and Chairman of the Board, discussed the "5/14" emissions research project. (CX 194).
605. Mr. Lipman had several meetings to discuss the progress of the 5/14 project. (CX 7053 (Lipman, Dep. at 26-27)).
606. In the spring of 1991, Unocal directed another set of confirmatory tests, known as the SwRI/NIPER study. The study involved a fleet of 13 vehicles, which tested fuels made in Unocal's refineries and compared those fuels to fuels made by other companies. (Jessup, Tr. 1162) These tests focused on the practicability of using the 5/14 results to produce RFG in Unocal's Los Angeles refinery. (CX 238).

607. The term “5/14 Project” became “shorthand for all the testing work” that Unocal conducted relating to emissions research including the one car test, ten car test, and thirteen car test. (Croudace, Tr. 526-527 (“Q: What is it shorthand for, sir? A: It was the time that we had approval to go on with the ten and thirteen car test. The one car had been completed by that time. But we just in general refer to that, to the work, in a very short way as 5/14.”)).

V. Unocal Recognized the Connection Between the Licensing Value of its Emissions Research and Reformulated Gasoline Regulations.

608. Unocal’s efforts to obtain competitive advantage from its 5/14 research results were consistent with Unocal’s corporate culture of exploiting its intellectual property rights. For example, Unocal explored and considered ways to obtain competitive advantage from CARB’s Phase 1 RFG regulations. On March 2, 1990, an internal Unocal memorandum recognized that CARB would require the a phase out of leaded gasoline with the implementation of Phase 1 RFG regulations, and that “THIS MAY BE AN EXCELLENT OPPORTUNITY FOR UNOCAL TO EXPLOIT FOR HUGE PROFITS WITH VALVE-SAVER.” (CX 165 at 004-005; Croudace, Tr. 524) (emphasis in original).

609. Valve Saver was a proprietary technology that was owned by Unocal. (Croudace, Tr. 521-522). Dr. Croudace was one of the inventors on the Valve-Saver patent. (Croudace, Tr. 522).

610. Dr. Croudace testified at trial that, for employees of Unocal’s Science and Technology Division, that it “was pretty much our sole purpose” to make money for the company. (Croudace, Tr. 461-462).

611. There were discussions within Unocal in the 1990-91 time frame regarding the potential value of patents from the 5/14 Project. (Miller, Tr. 1369-1370).

612. The potential licensing value of Unocal’s RFG technology was recognized by management and by employees outside of the Science and Technology division as “one of the most lucrative licensing opportunities [the] company has ever seen.” Indeed, while the results and potential use of the 5/14 Project results were shrouded in “great secrecy,” internal discussions continued concerning the potential licensing strategy and the influencing of regulators. (CX 3004).

613. In the months following the conclusion of the 5/14 research project and the filing of the patent application, Croudace’s patent strategy, first reflected in company documents in 1989, resurfaced. Unocal personnel repeatedly proposed using the research from the 5/14 Project to influence CARB regulators to make Unocal’s specifications required in the industry. (CX 219; CX 194 at 002; CX 203 at 012; CX 207; CX 188 at 003; CX 217).

614. On or about October 2, 1990, Dennis Lamb sent an internal Unocal memorandum to Roger Beach and Steven Lipman entitled "5/14 Information Strategy." This internal memorandum discussed the September 17, 1990 meeting and attached a proposed response to questions posed by Richard Stegemeier, Unocal's CEO and Chairman of the Board. Dennis Lamb transmitted [cc:ed] this memo to other members of Unocal management including S.K. Alley, D.E. D'Zurilla, J.W. Ichord, J.W. Miller, and F.L. Walker. (CX 194).
615. By October 2, 1990 suggestions had been made within Unocal "that the information from 5/14 should be taken immediately upon confirmation to both EPA and CARB in an effort to have the specifications adopted reflect the 5/14 conclusions." (CX 194 at 002).
616. By October 2, 1990, Unocal management understood that "Timing may not allow the opportunity to impact the Clean Air Act or EPA with 5/14." (CX 194 at 003). But Unocal management understood that "Timing is favorable to influence CARB." (CX 194 at 003).
617. By October 2, 1990, Unocal management understood that "For Unocal, CARB will be the dominating agency." (CX 194 at 003).
618. In October 1990, Unocal management, specifically Denny Lamb, wanted to maximize the "competitive advantage" resulting from the 5/14 research findings. (CX 194 at 003).
619. In an October 2, 1990 internal Unocal memorandum, Denny Lamb advocated maintaining the secrecy of the 5/14 research findings. (CX 194 at 003).
620. In October 1990, Unocal management wanted to preserve all opportunities to obtain a competitive advantage from the 5/14 research findings. In an October 2, 1990 internal Unocal memorandum, Denny Lamb stated: "If 5/14 provides a cleaner more cost effective product than any specified formula and equal emissions provisions are workable, Unocal would have at least two compliance options (i.e., The specified formula or the 5/14 formula) and an opportunity for competitive advantage." (CX 194 at 003).
621. In an October 2, 1990 internal Unocal memorandum, Denny Lamb expressed the concern that: "If Unocal is successful in convincing regulators 5/14 is correct it could become the specified formula and Unocal would just have one option and no opportunity for competitive advantage." (CX 194 at 003).
622. In an October 2, 1990 internal Unocal memorandum, Denny Lamb urged the company to maintain secrecy of the 5/14 research project in order to see how events unfolded in order maximize the potential for competitive advantage. Lamb advocated to higher level management: "Maintain secrecy of 5/14 findings until air quality benefits and cost

effectiveness are assured and appropriate opportunities for certification or substitution are determined.” (CX 194 at 003).

623. On October 18, 1990, Wayne Miller updated the Fuels Issues Team on the status of the 5/14 Project. (CX 195 (Internal Unocal Memorandum, Lamb to Miller, Mandelkar and Taylor, October 3, 1990)). At that Fuels Issues Team meeting, Unocal management also provided updates on CARB regulations and the [federal] Clean Air Act. (CX 195).
624. Drs. Jessup and Croudace pointed out that “Unocal could push other companies into olefin reductions which Unocal would not have to do. This will give us a competitive edge by making our competitor’s product more costly.” (CX 210 at 004; Jessup, Tr. 1216). At the time, Unocal had one refinery that produced no olefins and one that did not produce many; thus, Unocal was already able to produce low-olefin gasoline. (Jessup, Tr. 1216-1217).
625. On November 16, 1990, Dr. Jessup, Dr. Croudace and Dr. Miller and other members of the Science & Technology Fuels group presented preliminary results from the 5/14 project to Roger Beach and his staff. (CX 200; CX 201; CX 202; CX 203; CX 208). Participants to this presentation included Richard Stegemeier, Denny Lamb, Roger Beach, Peter Jessup, Michael Croudace and Arun Mandelkar. (CX 202).
626. Unocal saw the 5/14 Project as affecting its “next steps,” including its “Interim Marketing Strategy,” its CARB “Compliance Strategy,” and its “Regulatory Positions.” (CX 202).
627. The memorandum providing notice of the November 16, 1990 meeting was sent to Unocal management, including Denny Lamb, Roger Beach, and Don D’Zurilla. (CX 202; Lamb, Tr. 2114-2115). This meeting took place, and Unocal senior managers, including Mr. Beach, were informed of the progress of the 5/14 Project. (Lamb, Tr. 2115).
628. One of the reasons for the November 16, 1990 meeting was to facilitate discussion on the next steps for the 5/14 project. (Lamb, Tr. 2115-2116). Slides dated November 16, 1990, entitled “Product Specifications For Low Emissions Gasolines: Results From the 5/14 Project” (CX 203 at 001) suggest that a “Next Step[.]” for Unocal would be to “Show Emissions Work To Regulators – Make Unocal Specifications Required In The Industry.” (CX 203 at 012). This set of slides was shown at the presentation (Lamb, Tr. 2116), and includes several slides that Drs. Miller and Jessup presented to Unocal’s operating group on a number of occasions. (Miller, Tr. 1380; CX 203). Moreover, Dr. Miller reviewed these slides before they were presented. (Miller, Tr. 1382).
629. Mr. Lipman understood that the proposed specifications for low emissions gasoline in the November 16, 1990 presentation detailed those specifications Unocal felt would meet standards likely to be imposed by CARB. The “Proposed Specifications” of RFG

presented to Unocal management were: (1) T50 less than or equal to 205° F and greater than 180°F; (2) olefins of 0% by volume; and (3) RVP of 7.5 psi. (CX 7053 (Lipman, Dep. 29-30); CX 203 at 004). Not coincidentally, Claim 1 of the patent application filed a month later covered these proposed specifications inasmuch as it claimed gasolines with a T50 no greater than 215° F and an RVP equal of no greater than 8.0 psi. (CX 1788 at 051 ('393 patent file history)).

630. On November 20, 1990, Dr. Jessup gave a presentation to Mr. Beach, which included some of the same charts of the ten-car data that are found in the patent. (Jessup, Tr. 1203-1205; CX 205). In that presentation, Dr. Jessup told Mr. Beach that the ten-car test confirmed the findings from the one-car test. (Jessup, Tr. 1205; CX 205 at 022).
631. In presentation to Mr. Beach on November 20, 1990 (about one month before Unocal filed its patent application), Dr. Jessup stated that, in two areas, Unocal had “generated data on emissions effects that no one else know about that could yield a competitive advantage.” (CX 205 at 022; Jessup, Tr. 1206, 1209). These were (1) “NO_x reductions based on olefin content and volatility” and (2) “[d]istillation 50% point [(T50)] and olefin content effects on HC and CO emissions.” (CX 205 at 022; Jessup, Tr. 1206-1207). Dr. Jessup emphasized that T50 is the most influential parameter affecting HC emissions. (Jessup, Tr. 1208).
632. Dr. Jessup’s November 20, 1990 presentation to Roger Beach was obviously significant; Dr. Jessup has only given about three presentations to Mr. Beach in his entire career at Unocal. (Jessup, Tr. 1207). At the time of the presentation, Dr. Jessup was already working with Mr. Wirzbicki on the patent application. (Jessup, Tr. 1210).
633. In December 1990, the scientists’ proposals were being discussed in internal meetings that involved personnel outside of Unocal’s Science and Technology Division. In an email that discussed the inventors’ December 11, 1990 memorandum (CX 3005), an employee of the Technology and Sales Licensing Group described the 5/14 Project as “one of the most lucrative licensing opportunities this company has ever seen” and recited the inventors’ “conservative figure of \$114 million per year in royalties” from Unocal’s maintenance of a “proprietary position” on gasoline compositions that would be mandated for reduced emissions fuels. (CX 3004 at 001; Croudace, Tr. 532-535).

A. In Memos Circulated to Unocal Management Throughout 1989 and 1990, Unocal Recognized the Value of Having Every Gallon of Gasoline Covered by A Patent.

634. This email reflected discussions during an internal Unocal meeting involving the Technology and Sales Licensing Group and confirmed the view that the 5/14 Project represented “a tremendous opportunity to . . . significantly impact the corporations [sic] bottom line.” (CX 3004 at 001).

635. On December 10, 1990, Drs. Jessup and Croudace highlighted the substantial licensing revenues Unocal could earn by influencing regulators to promulgate specifications for RFG that correspond to Unocal's 5/14 project:

It would be in the best interest of Unocal to input into and help shape regulations made by the EPA and the CARB by December 17, 1990, or we will be stuck with a costly and unnecessary T90 specification for our gasolines. We propose showing the Auto/Oil analysis committee our analysis of their data which concludes that driveability index (DI), not T90, is the key variable influencing CO and HC exhaust emissions. Regulations based on driveability index will leave the door open for Unocal to use our results from the 5/14 project, that is, that T50 is the true key variable for exhaust CO and HC emissions reductions. This would keep our NOx knowledge under wraps for the moment.

Setting a regulation based on driveability index rather than T90 leaves the door open for other oil companies to use our gasoline formulas through licensing agreements. Potential royalties from such agreements are as high as \$114,000,000/year (\$0.001/gallon) in the United States alone. This is far more than could be gained from any other competitive advantage. To this end we have applied for a patent based on the 5/14 results, and have a good chance of getting it.

We must make a presentation to the Auto/Oil analysis committee by December 17, 1990, which is when the Auto/Oil committees are scheduled to release to the CARB and EPA their mistaken analysis of the data that implicates T90's importance. Once the results are presented it will be a long uphill struggle to convince the regulatory bodies that the results are in error.

(CX 210; CX 3005).

636. On December 11, 1990, two days before Unocal filed its patent application on the 5/14 Project, Jessup and Croudace highlighted to their superiors the substantial licensing revenues Unocal could earn by influencing regulators to promulgate reformulated gasoline specifications based on its 5/14 invention. (CX 3005; CX 210).
637. On December 11, 1990, Drs. Jessup and Croudace again urged Unocal management to use the 5/14 project to "influence regulators" and tap the "competitive advantage" and "licensing" potential of Unocal's "patent for low emissions fuels, based on the 5/14 project." (CX 210 at 003). The authors recognized that licensing agreements "are only possible" if competitors know about Unocal's technology and if regulators embrace it:

At your request, we have examined reasons for publishing Unocal's 5/14 results. Bear in mind the patent for low emissions fuels, based on the 5/14 project, will be sent to the patent office on 12/12/1990, thus the basic ideas will be protected. Also we are looking for a competitive advantage. * * *

Once the patent is issued then Unocal can seek licensing agreements with our competitors. These agreements are only possible if the other companies know about our low emission gasoline products. We must publish to influence regulators and advertise the Unocal advantage. These licensing agreements could be worth 10's of millions of dollars every year, far more than any other competitive advantage could yield.

For example, 114,000,000,000 gallons of gasoline were sold in the United States in 1988. A \$0.001/gallon royalty on all that product would yield \$114,000,000 per year in fees.

(CX 210 at 003-004; CX 3005 at 002-003).

638. As Dr. Jessup testified, the fact that he signed the December 11, 1990 memorandum from Dr. Croudace and him to Dr. Miller demonstrates that he agreed with the content of the memorandum. (Jessup, Tr. 1211-1212).
639. This December 11, 1990 memorandum co-authored by Drs. Jessup and Croudace to Dr. Miller – the manager of Dr. Jessup's group as well as a number of other groups – and copied to Dr. Alley, Mr. Lamb, Mr. Plumbley, and patent counsel, the two co-inventors informed their management that regulations, promulgated by either CARB or the EPA, "based on driveability index will leave the door open for Unocal to use our results from the 5/14 project, that is, that T50 is the true key variable for exhaust CO and HC emissions reductions." (CX 210 at 002; Jessup, Tr. 1212-1214, 1218-1219). They continued, "Setting a regulation based on driveability index rather than T90 leaves the door open for other oil companies to use our gasoline formulas through licensing agreements. Potential royalties from such agreements are as high as \$114,00,00/year (\$0.001/gallon) in the United States alone. This is far more than could be gained from any other competitive advantage. To this end we have applied for a patent based on the 5/14 results, and have a good chance of getting it." (CX 210 at 002; Jessup, Tr. 1214-1215).
640. As Drs. Jessup and Croudace explained, the EPA and CARB could "falsely believe that T90 . . . is the main gasoline property influencing CO and HC exhaust emissions." (CX 210 at 003) (emphasis original). Unocal's analysis, however, showed that "T50 is the main factor influencing CO and HC emissions." (CX 210 at 003). Thus, Drs. Jessup and

Croudace suggested that Unocal seek to influence the regulators to ensure that driveability index (which includes T50 as one of three variables) be included in any regulation. (CX 210 at 003). They proposed that Unocal “only disclose our distillation information in the form of a driveability index . . . rather than T50 so that we retain secrecy of our data.” (CX 210 at 003). Thus, this memorandum demonstrates that Unocal knew that so long as T50 were part of any gasoline regulation, Unocal’s patents would cover gasolines made pursuant to those regulations and Unocal could extract royalty payments from the other refiners. (CX 210 at 002-004).

B. In Memos Circulated to Unocal Management Throughout 1989 and 1990, Unocal Employees Described Plans to Make Unocal Research Required in the Industry.

641. Drs. Jessup and Croudace concurred in the objective to influence the RFG regulations. In November of 1990, Drs. Jessup and Croudace presented their latest emissions research results and recommended that Unocal “Show emissions work to regulators, make Unocal specifications *required* in the industry.” (CX 203 at 012) (emphasis added).
642. In another November 1990 memorandum, Dr. Croudace pressed the need to use the results of the 5/14 project to influence CARB “NOW:”

SUBJECT: Unocal’s Advantage from The 5/14 Project will be gone in Six Months.

Two key variables identified in the 5/14 project (RVP and T50) effecting tailpipe emissions will be uncovered by CARB in a study to be completed by April 1, 1991. CARB then intends to regulate these variables in the Phase 2 gasoline specifications that will be written by September 1991. If we intend to use our results from the 5/14 study in the marketplace and/or influence CARB we have to use our information NOW! * * * *

CARB, in concert with WSPA and GM, has initiated an emissions study to determine the effect of varying RVP and driveability index on a 23 car fleet It is inevitable from this study that CARB will see the effect of two of these key variables, identified in the 5/14, and will regulate them.
IF WE INTEND TO USE 5/14 TO OUR ADVANTAGE, IT
MUST BE USED NOW!

(CX 207).

643. The November 1990 memorandum authored by Dr. Croudace, dated a month prior to the filing of the patent application, was specifically copied to Greg Wirzbicki, Unocal’s

Chief Patent Counsel. (CX 207).

C. In the Spring of 1991, Unocal's Senior Management Knew That a "Pot of Gold" Could Result From Unocal's Issued Patents Based on the 5/14 Project.

644. Unocal internal business documents from 1991 refer to the licensing potential of patents based on Unocal's 5/14 project, as well as the use of the results to influence CARB. (CX 2; CX 238 at 020; CX 219; CX 223).
645. In January 1991, Unocal management understood that one of the "Ways to Use 5/14" research results was to "Influence CARB rules." (CX 219 at 012).
646. Dr. Jessup created a 4 foot by 8 foot "pot of gold" poster board (CX 2) for an "in-house poster session." (Jessup, Tr. 1235). The poster was used to show Unocal management the work that Dr. Jessup was doing in the Science and Technology Division. (Jessup, Tr. 1236). Dr. Jessup actually stood in front of the poster and used it to explain the 5/14 Project. (Jessup, Tr. 1236). At the time, Dr. Jessup expected that the patent from the 5/14 Project would be of some commercial value. (Jessup, Tr. 1236). The board placed that value at \$.01 per gallon or \$1,000,000,000 per year. (CX 2).
647. On the "pot of gold" poster, Dr. Jessup estimated that Unocal could achieve \$100 million a year from introducing reformulated gasoline in the market and cost saving at its Los Angeles refinery. (Jessup, Tr. 1241-1242; CX 2). But he estimated a \$1 billion per year royalty stream from licensing the patents from the 5/14 Project. (Jessup, Tr. 1242; CX 2). As Dr. Jessup admitted, the \$1 billion number was put on the poster for management to see. (Jessup, Tr. 1242).
648. The "pot of gold" poster recounts the history of the 5/14 Project. (Jessup, Tr. 1237). It includes graphs from the SwRI emissions test data (the ten-car study). (Jessup, Tr. 1237-1238). It includes frequency charts from the one-car tests. (Jessup, Tr. 1238-1239). It also refers to the results of the Unocal program, which were that it defined key fuel properties that reduce regulated tailpipe emissions, developed a series of equations that predict emissions from key fuel physical properties (one the aspects of the invention), and patent pending formulations (referring to the patent-application). (Jessup, Tr. 1240; CX 2).
649. Jessup created the "pot of gold" poster in or about May 1991, prior to the presentation to CARB of the 5/14 Project. Jessup's notes relating to a draft outline of the presentation to CARB indicates that the proposed presentation to CARB would include some of the same information detailed on the poster. (CX 245).
650. As Dr. Jessup admitted, the "pot of gold" poster board contains bar charts that he later showed to CARB. (Jessup, Tr. 1239, 1285 (stating that CX 24 at 044-046 "are the same frequency charts that we looked at yesterday at CX 2")). He also admitted that the poster

refers to the possibility of Unocal introducing an interim RFG, which was abandoned prior to June 1991. (Jessup, Tr. 1240-1241). Further, a layout of slides that Dr. Jessup created during preparations for the meeting with CARB, states that the CARB presentation should include “results ala poster,” by which Dr. Jessup was referring to the bar charts on the “pot of gold” poster. (CX 245; Jessup, Tr. 1248-1249).

651. Dr. Jessup put the “pot of gold” image on the poster; he “thought it was a nice touch.” (Jessup, Tr. 1242).
652. Dr. Jessup ensured that his manager, Dr. Miller, reviewed the “pot of gold” poster before it was used. (Jessup, Tr. 1243).
653. Dr. Miller participated in the creation of the “pot of gold” poster board. (Miller, Tr. 1425; CX 2). He was involved in setting the \$1 billion figure on that board, which is based on a 1 cent/gallon royalty. (Miller, Tr. 1427; CX 2). Originally, the figure was higher because of a higher cent/gallon royalty. (Miller, Tr. 1428). Working with the inventors, Dr. Miller (their supervisor at the time) reduce the number to make it “more credible.” (Miller, Tr. 1428).
654. The \$1 billion revenue stream depicted on the “pot of gold” poster board was more than 10% of Unocal’s overall revenues in 1990. (Miller, Tr. 1429).
655. Mr. Neil Schmale, one of Unocal’s senior management, examined the “pot of gold” poster and saw the \$1,000,000,000 royalty number. (Jessup, Tr. 1236; CX 2).
656. Mr. Wirzbicki, Unocal’s Chief Patent Counsel also attended the Science and Technology Division open house in which Dr. Jessup and Dr. Croudace had a posterboard with respect to their invention. (Wirzbicki, Tr. 933). Mr. Wirzbicki recalled that the posterboard had a dollar sign and a number on it. (Wirzbicki, Tr. 933-934).
657. At the open house, Drs. Jessup and Croudace called Mr. Wirzbicki’s attention to the posterboard. (Wirzbicki, Tr. 933).
658. Drs. Jessup and Croudace told Mr. Wirzbicki at the open house that Mr. Schmale, a member of the Unocal Executive Committee, had seen the poster board. (Wirzbicki, Tr. 933-934).
659. Although there were a number of other poster boards during the presentation to Mr. Schmale, Dr. Miller could not recall any in his area that displayed a value greater than a million dollars, let alone a billion. (Miller, Tr. 1455).
660. In another presentation (hand dated 5/1/91), Dr. Jessup indicated that potential uses of the 5/14 Project included: “Influence Regulations”; “Increased Market Share For Unocal Gasolines”; “Increased Profits For Unocal Gasolines”; and “License Technology”(which

referred to licensing the patents from the 5/14 Project and under which he suggested a 1 cent/gallon royalty). (CX 238 at 018; Jessup, Tr. 1221-1223).

661. In that same 5/1/91 presentation, Dr. Jessup wrote that “5/14 Project Equations are valid and proven” and “Now is the time to publish and to influence CARB.” (CX 238 at 020; Jessup, Tr. 1225-1226). He went on to state, “Huge licencing [sic] income potential exists,” which Dr. Jessup believed to be true at time. (CX 238 at 020; Jessup, Tr. 1226). A different presentation also dated 5/1/91 contains these same statements. (CX 239 at 008; Jessup, Tr. 1227-1228).
662. When Mr. Beach saw the statement that a “[h]uge licencing [sic] potential exist[s]” for the 5/14 Project, he found it “exceedingly interesting.” (Beach, Tr. 1695; CX 239 at 008). Mr. Beach believed that there was a sufficient probability of potential licensing income that it made the prospect “rather interesting.” (Beach, Tr. 1695-1696).
663. Though he tried to deny it at trial, prior testimony shows that Mr. Beach understood as of May 1991 that Unocal’s patent application represented a potentially huge licensing opportunity. (Beach, Tr. 1696-1697). On cross-examination, Mr. Beach admitted that if the patent issued, it could impact Unocal’s profitability. (Beach, Tr. 1698).

VI. Unocal Determined That Competitive Advantage Could Best Be Achieved Through Use of the Regulatory Process.

A. Unocal’s Researchers Led An Early Push to Influence Regulations By Publicizing the Results of Their Research.

664. Unocal’s efforts to obtain competitive advantage from its 5/14 research results were consistent with Unocal’s corporate culture of exploiting its intellectual property rights. Unocal management encouraged Unocal employees to develop ways to profit from development and exploitation of intellectual property rights. (CCPF ¶¶ 463-472).
665. An August 6, 1990 memorandum authored by Mr. Lamb set forth some of the goals of Unocal’s Clean Fuels Strategy. One of the goals of this strategy was to achieve competitive advantage. Another goal was to influence regulations. (CX 188 at 002; Lamb, Tr. 2111-2112). Mr. Lamb sent the memorandum to Dr. Miller, with copies to Mr. Beach, Mr. Beach’s senior staff, and Dr. Kess Alley, Unocal’s Vice President of Science and Technology. (CX 188; Lamb, Tr. 2111).
666. By August 1990, Unocal personnel, including Denny Lamb, understood that reformulated gasoline regulations were on their way. (Lamb, Tr. 2112; CX 188 at 001 (“California will mandate that all gasoline be reformulated in 1996.”)). In the August 6, 1990 memorandum, Mr. Lamb attached a list of possible fuel specifications that might be mandated by federal and state regulators, including a table listing potential worst case

- specifications. (CX 188 at 004; Lamb, Tr. 2113-2114).
667. As the leader of the Fuels Issues Team, Mr. Lamb understood that Unocal needed to account for the inevitability of the regulations and take action to ensure that Unocal could take the best advantage of these impending regulations. (Lamb, Tr. 2112).
668. Members of the Science and Technology fuels group presented preliminary results from the 5/14 project to Roger Beach and his Refining and Marketing Division staff on November 16, 1990. (CX 200; CX 201; CX 202; CX 203; CX 208). Participants to this presentation included Richard Stegemeier, Denny Lamb, Roger Beach, Peter Jessup, Michael Croudace and Arun Mandlekar. (CX 202). The memorandum providing notice of this meeting went to Unocal management, including Denny Lamb, Roger Beach, and Don D’Zurilla. (CX 202; Lamb, Tr. 2114-2115).
669. Unocal senior managers, including Mr. Beach and Mr. Lipman, received information on the progress of the 5/14 Project at a November 16, 1990 meeting. (Lamb, Tr. 2115; CX 7053 (Lipman, Dep. at 26-27)). The presentation to Mr. Beach and his staff illustrated how the 5/14 Project affected Unocal’s “next steps,” including its “Interim Marketing Strategy,” its CARB “Compliance Strategy,” and its “Regulatory Positions.” (CX 202; Lamb, Tr. 2115-2116).
670. Slides dated November 16, 1990, entitled “Product Specifications For Low Emissions Gasolines: Results From the 5/14 Project” suggest that a “Next Step[]” for Unocal would be to “Show Emissions Work To Regulators – Make Unocal Specifications Required In The Industry.” (CX 203 at 012). This set of slides was shown at the presentation (Lamb, Tr. 2116), and includes several slides that Drs. Miller and Jessup presented to Unocal’s operating group on a number of occasions. (Miller, Tr. 1380; CX 203). Moreover, Dr. Miller reviewed these slides before they were presented. (Miller, Tr. 1382).
671. Drs. Jessup and Croudace concurred in the objective to influence the RFG regulations. In November of 1990, Drs. Jessup and Croudace presented their latest emissions research results and recommended that Unocal “Show emissions work to regulators, make Unocal specifications *required* in the industry.” (CX 203 at 012) (emphasis added).
672. Mr. Lipman understood that the proposed specifications for low emissions gasoline in the November 16, 1990 presentation detailed those specifications Unocal felt would meet standards likely to be imposed by CARB. The “Proposed Specifications” of RFG presented to Unocal management were: (1) T50 less than or equal to 205° F and greater than 180° F; (2) olefins of 0% by volume; and (3) RVP of 7.5 psi. (CX 7053 (Lipman, Dep. 29-30); CX 203 at 004). Not coincidentally, Claim 1 of the patent application filed a month later covered these proposed specifications inasmuch as it claimed gasolines with a T50 no greater than 215° F and an RVP equal of no greater than 8.0 psi. (CX 1788 at 051 (‘393 patent file history)).

673. In November 1990, Dr. Jessup gave a presentation to Mr. Beach, which included some of the same charts as in the patent of the ten-car data. (Jessup, Tr. 1203-1205; CX 205). In that presentation, Dr. Jessup told Mr. Beach that the ten-car test confirmed the findings from the one-car test. (Jessup, Tr. 1205; CX 205 at 022).
674. In a presentation to Mr. Beach in November 1990, Dr. Jessup stated that, in two areas, Unocal had “generated data on emissions effects that no one else know about that could yield a competitive advantage.” (CX 205 at 022; Jessup, Tr. 1206, 1209). These were (1) “NOx reductions based on olefin content and volatility” and (2) “[d]istillation 50% point [(T50)] and olefin content effects on HC and CO emissions.” (CX 205 at 022; Jessup, Tr. 1206-1207). Dr. Jessup emphasized that T50 is the most influential parameter affecting HC emissions. (Jessup, Tr. 1208).
675. Dr. Jessup’s November 20, 1990 presentation to Roger Beach was obviously significant; Dr. Jessup has only given about three presentations to Mr. Beach in his entire career at Unocal. (Jessup, Tr. 1207). At the time of the presentation, Dr. Jessup was already working with Mr. Wirzbicki on the patent application. (Jessup, Tr. 1210).
676. In November 1990 memorandum, Dr. Croudace pressed the need to use the results of the 5/14 project to influence CARB “NOW:”

SUBJECT: Unocal’s Advantage from The 5/14 Project will be gone in Six Months.

Two key variables identified in the 5/14 project (RVP and T50) effecting tailpipe emissions will be uncovered by CARB in a study to be completed by April 1, 1991. CARB then intends to regulate these variables in the Phase 2 gasoline specifications that will be written by September 1991. If we intend to use our results from the 5/14 study in the marketplace and/or influence CARB we have to use our information NOW! * * * *

CARB, in concert with WSPA and GM, has initiated an emissions study to determine the effect of varying RVP and driveability index on a 23 car fleet It is inevitable from this study that CARB will see the effect of two of these key variables, identified in the 5/14, and will regulate them.
IF WE INTEND TO USE 5/14 TO OUR ADVANTAGE, IT
MUST BE USED NOW!

(CX 207).

677. On December 11, 1990, Drs. Jessup and Croudace highlighted the substantial licensing revenues Unocal could earn by influencing regulators to promulgate specifications for

RFG that correspond to Unocal's 5/14 project:

It would be in the best interest of Unocal to input into and help shape regulations made by the EPA and the CARB by December 17, 1990, or we will be stuck with a costly and unnecessary T90 specification for our gasolines. We propose showing the Auto/Oil analysis committee our analysis of their data which concludes that driveability index (DI), not T90, is the key variable influencing CO and HC exhaust emissions. Regulations based on driveability index will leave the door open for Unocal to use our results from the 5/14 project, that is, that T50 is the true key variable for exhaust CO and HC emissions reductions. This would keep our NOx knowledge under wraps for the moment.

Setting a regulation based on driveability index rather than T90 leaves the door open for other oil companies to use our gasoline formulas through licensing agreements. Potential royalties from such agreements are as high as \$114,000,000/year (\$0.001/gallon) in the United States alone. This is far more than could be gained from any other competitive advantage. To this end we have applied for a patent based on the 5/14 results, and have a good chance of getting it.

We must make a presentation to the Auto/Oil analysis committee by December 17, 1990, which is when the Auto/Oil committees are scheduled to release to the CARB and EPA their mistaken analysis of the data that implicates T90's importance. Once the results are presented it will be a long uphill struggle to convince the regulatory bodies that the results are in error.

(CX 3005; CX 210 at 002).

678. On December 11, 1990, Drs. Jessup and Croudace again urged Unocal management to use the 5/14 project to "influence regulators" and tap the "competitive advantage" and "licensing" potential of Unocal's "patent for low emissions fuels, based on the 5/14 project." (CX 210 at 003; CX 3005 at 002). The authors recognized that licensing agreements "are only possible" if competitors know about Unocal's technology and if regulators embrace it:

At your request, we have examined reasons for publishing Unocal's 5/14 results. Bear in mind the patent for low emissions fuels, based on the 5/14 project, will be sent to the patent office on 12/12/1990, thus the basic ideas will be protected. Also we are looking for a competitive advantage. * * *

Once the patent is issued then Unocal can seek licensing agreements with our competitors. These agreements are only possible if the other companies know about our low emission gasoline products. We must publish to influence regulators and advertise the Unocal advantage. These licensing agreements could be worth 10's of millions of dollars every year, far more than any other competitive advantage could yield.

For example, 114,000,000,000 gallons of gasoline were sold in the United States in 1988. A \$0.001/gallon royalty on all that product would yield \$114,000,000 per year in fees.

(CX 210 at 003-004; CX 3005 at 002-003; Jessup, Tr. 1212-1215, 1218-1219).

679. As Drs. Jessup and Croudace explained, the EPA and CARB could “falsely believe that T90 . . . is the main gasoline property influencing CO and HC exhaust emissions.” (CX 210 at 003) (emphasis original). Unocal’s analysis, however, showed that “T50 is the main factor influencing CO and HC emissions.” (CX 210 at 003). Thus, Drs. Jessup and Croudace suggested that Unocal seek to influence the regulators to ensure that driveability index (which includes T50 as one of three variables) be included in any regulation. (CX 210 at 003). They proposed that Unocal “only disclose our distillation information in the form of a driveability index . . . rather than T50 so that we retain secrecy of our data.” (CX 210 at 003). Thus, this memorandum demonstrates that Unocal knew that so long as T50 were part of any gasoline regulation, Unocal’s patents would cover gasolines made pursuant to those regulations and Unocal could extract royalty payments from the other refiners. (CX 210 at 002-004).
680. As Dr. Jessup testified, the fact that he signed the December 11, 1990 memorandum from Dr. Croudace and him to Dr. Miller demonstrates that he agreed with the content of the memorandum. (Jessup, Tr. 1211-1212; CX 210; CX 3005).

B. Unocal Pursued a Patent Based on the 5/14 Project.

1. Unocal Management Decided to Pursue a Patent.

a. Unocal’s Senior Management Approved Pursuing a Patent in May 1990.

681. Roger Beach knew from the very beginning that Unocal would seek a patent on the 5/14 Project because the people on the 5/14 Project sought permission from him to apply for a patent. (Beach, Tr. 1700). Mr. Beach understood at the time that if the patent were granted and upheld, it could result in a cash-flow stream as a result of license fees. (Beach, Tr. 1700-1701).

682. At the May 14, 1990 meeting, Roger Beach agreed that the Refining and Marketing Division would sponsor the filing of a patent application based on the 5/14 Project. (Beach, Tr. 1753-1754).
683. Within Unocal, the Refining and Marketing Division was also referred to as the 76 Division. (Beach, Tr. 1676).

b. Unocal Scientists Filed An Invention Disclosure in July 1990.

684. Unocal employees in 1990 filed a “Disclosure of Invention” (colloquially called a “conception”) to inform management of an invention. The Disclosure of Invention served as a basis for a Unocal management committee-- the Patent Conception Committee-- to evaluate whether to file a patent application on the invention. (Wirzbicki, Tr. 874).
685. On June 29, 1990, Dr. Jessup and Dr. Croudace filed a Disclosure of Invention memorandum with Unocal’s Patent Department based on the one-car study they had completed at that point. (CX 186 at 002 (7/10/90 Croudace & Jessup invention disclosure); Wirzbicki, Tr. 879-880).
686. Dr. Jessup and Croudace’s Disclosure of Invention was the patent conception for “the invention that later became the five Unocal patents.” (Wirzbicki, Tr. 880).
687. Dr. Jessup and Dr. Croudace’s Disclosure of Invention described “the key gasoline properties that, when adjusted properly in gasoline blends, reduce gross output of regulated emissions from modern engines.” (CX 186 at 002, 009 (7/10/90 Croudace & Jessup invention disclosure)). It was based on their one-car study of running test fuels through a 1988 Oldsmobile Regency. (CX 186 at 006-007 (7/10/90 Croudace & Jessup invention disclosure)).
688. The Disclosure of Invention states: “The following patent conception discloses key gasoline properties that, when adjusted properly in gasoline blends, reduce gross output of regulated emissions from modern engines. The fuel product is most easily defined in the form of the formulas shown below.”

$$\begin{aligned} \text{Carbon Monoxide} &= - 0.00828 * (\text{Vol.}\% \text{ Paraffins}) \\ &+ 0.00937 * (\text{D-86 Distillation 50\% Point in } ^\circ\text{F}) \\ &+ 0.00133 * (\text{D-86 Distillation 90\% Point in } ^\circ\text{F}) \end{aligned}$$

$$\begin{aligned} \text{Nitrogen Oxide} &= + 0.00503 * (\text{Vol.}\% \text{ Olefins}) \\ &- 0.00060 * (\text{Vol.}\% \text{ Paraffins}) \\ &+ 0.00087 * (\text{D-86 Distillation 10\% Point in } ^\circ\text{F}) \\ &+ 0.0159 * (\text{RVP in PSI}) \end{aligned}$$

$$\begin{aligned} \text{Hydrocarbon} &= + 0.00245 * (\text{Vol.\% Olefins}) \\ &\quad - 0.00104 * (\text{Research Octane Number}) \\ &\quad + 0.00109 * (\text{D-86 Distillation 50\% Point in } ^\circ\text{F}) \end{aligned}$$

(CX 186 at 002 (7/10/90 Croudace & Jessup invention disclosure); Jessup, Tr. 1172-1174).

689. The equations in the Disclosure of Invention show the relationships between certain properties of gasoline and automotive emissions. (Wirzbicki, Tr. 881). For example, the equations show that to reduce hydrocarbon and carbon monoxide automotive emissions, one should reduce the 50% distillation temperature (T50). (CX 186 at 002 (7/10/90 Croudace & Jessup invention disclosure)). The mathematical equations to predict emissions are therefore an aspect of the Unocal invention. (Jessup, Tr. 1174-1175).
690. Dr. Jessup and Dr. Croudace’s Disclosure of Invention states that the relationships they discovered had many practical applications. (CX 186 at 002-003 (7/10/90 Croudace & Jessup invention disclosure)). First, it states that by using the equations in the standard refinery linear program blending programs, a refinery could maximize its output of “low emitting fuels.” (CX 186 at 002 (7/10/90 Croudace & Jessup invention disclosure); Jessup, Tr. 1175).
691. According to the invention disclosure, “[t]he equations are totally unexpected results because thus far no one has published or patented results showing tailpipe emission reductions through controlling the gasoline properties listed above. Conventional wisdom says that only 90% distillation point, aromatics, olefins, and oxygen content effect emissions.” (CX 186 at 003; Jessup, Tr. 1180-1181). The disclosure goes on to state, “To date there are very limited published studies examining the effect of fuel composition and physical properties on vehicle emissions. Most work has focused on the effect including oxygenates in gasolines has on vehicle emissions. Outside the oxygenate studies there is very limited work examining other gasoline composition and physical property effects.” (CX 186 at 005). As Dr. Jessup admitted, conventional wisdom at the time did not include using a separate, independent specification for T50. (Jessup, Tr. 1181).
692. Dr. Jessup and Dr. Croudace explained in their invention disclosure that their equations “allow[] one to determine how to make low emission gasoline.” (CX 186 at 003 (7/10/90 Croudace & Jessup invention disclosure)) (emphasis added).
693. The Disclosure of Invention itself is entitled, “A New Method for Blending Conventional Gasoline Fuel Components Into Low Emission / Reformulated Gasolines.” (CX 186 at 002 (7/10/90 Croudace & Jessup invention disclosure)).
694. The Disclosure of Invention also states that there are a “multitude” of uses for the equations they discovered, including allowing one to identify gasoline blends where “all

fuel would have low emissions,” and to “run a refinery or change a refinery to reduce overall emissions potential of the gasoline pool.” (CX 186 at 003).

695. Drs. Jessup and Croudace also conceded in their Disclosure of Invention that by using their equations with “standard linear program blending programs,” a refinery could make “low emitting fuels.” (CX 186 at 002).
696. The Disclosure of Invention also states that the equations “predict[] emissions results” for any given fuel in a particular car. (CX 186 at 003). The equations can also be used on a large scale to “determine the emission characteristics of any gasoline formulation” and to “calculate emissions from standard fuel properties...” without running expensive time consuming emissions tests. (CX 186 at 002-003).
697. Dr. Jessup and Dr. Croudace’s Disclosure of Invention also recognizes that ARCO’s EC-1 fuel did not show the directional relationships Dr. Jessup and Dr. Croudace discovered. (CX 186 at 004 (7/10/90 Croudace & Jessup invention disclosure)).
698. The Disclosure describes ARCO’s EC-1 as designed “specifically to reduce emissions in pre-1975 non-catalyst equipped vehicles through limitations to the fuel’s RVP, aromatic and olefin level while using a prescribed level of oxygenate.” The Disclosure then underscores that “[e]xtrapolation of emission results from the pre-1975 fleet to modern engines is not meaningful.” (CX 186 at 004 (7/10/90 Croudace & Jessup invention disclosure)).
699. Around the time of the invention disclosure, Dr. Jessup knew that by using contour charts of the data from the one-car test, you can determine whether specific compositions will result in lower emissions. (Jessup, Tr. 1167). These charts, therefore, show part of the Unocal invention. (Jessup, Tr. 1168).
700. As Dr. Jessup admitted, contour charts of the one-car data “show what the invention is” and “where the new compositions of gasoline are.” (Jessup, Tr. 1170-1172).

c. Unocal Management Recognized the Importance of a Potential Patent.

i. Unocal’s Conception Committee Gave the Invention an “A” Rating.

701. Unocal’s Conception Committee in 1990 was comprised of the management of Unocal’s Science and Technology Division, including:
 - a. the President of Unocal’s Science and Technology Division (Steve Lipman);
 - b. the Science and Technology Division’s Vice President in charge of fuels, catalysts, and lubes development (Starling Kess Alley);

- c. Unocal's Chief Patent Counsel or Patent Counsel (Greg Wirzbicki);
- d. other Vice Presidents and managers in the Science and Technology Division;
- e. and a science advisor to the President of the Division.

(Wirzbicki, Tr. 874-877; CX 661 at 001; (CX 7041 (Alley, Dep. at 49-50); Miller, Tr. 1360-1361).

- 702. Unocal's patent department in 1990 was part of its Science and Technology Division. (Wirzbicki, Tr. 877).
- 703. Dr. Miller did not recommend that Unocal pursue patents for many of the inventions made by Unocal, but he did personally recommend to Greg Wirzbicki (Unocal's chief patent counsel) that Unocal pursue a patent regarding the 5/14 Project. (Miller, Tr. 1357-1357).
- 704. In fact, Dr. Miller told Mr. Wirzbicki that patenting the 5/14 invention would be worth "a lot of money" to the company. (Miller, Tr. 1356, 1359-1360)
- 705. Mr. Wirzbicki had become Unocal's Chief Patent Counsel in August 1989. As Chief Patent Counsel, he was in charge of all patent matters for Unocal, except for licensing. Mr. Wirzbicki also had those same duties before his title changed to Chief Patent Counsel. (Wirzbicki, Tr. 871).
- 706. Mr. Wirzbicki remained Unocal's Chief Patent Counsel from August 1989 through the time of trial in this matter. (Wirzbicki, Tr. 871, 878). Mr. Wirzbicki in 1995 also became the head of the patent licensing attorneys, such as John Kane. (Wirzbicki, Tr. 872).
- 707. The Conception Committee ranked each Disclosure of Invention with either an "A," "B," "C" or "TS" ("trade secret") or "publish" designation. (Wirzbicki, Tr. at 878-879).
- 708. If a Disclosure of Invention was given a trade secret designation, then no patent application would be filed on that disclosure. (Wirzbicki, Tr. 875).
- 709. Unocal's Conception Committee met on August 23, 1990, to discuss Dr. Jessup and Croudace's Disclosure of Invention.(CX 661 at 001 (8/13/90 Wirzbicki memo to Lipman, et al.); Wirzbicki, Tr. 875; CX 7053 (Lipman, Dep. at 11-12)).
- 710. The Conception Committee gave Conception Number 90112, assigned to the patent for reformulated gasoline, an "A" priority, the highest priority accorded to a patent concept. (CX 661 at 003; Wirzbicki, Tr. 881-884). The "A" rating meant that patent department should begin the patent application process ("patent prosecution") for the invention.

(Wirzbicki, Tr. 879; Croudace, Tr. 458).

711. Mr. Lipman, the President of Unocal's Science and Technology Division, and Mr. Wirzbicki, Unocal's Chief Patent Counsel, among others, further discussed Dr. Jessup and Croudace's Disclosure of Invention at the subsequent staff meeting of the Science and Technology Division prior to filing the patent application. (CX 7053 (Lipman, Dep. at 15); Wirzbicki, Tr. 883-884; CX 661 at 003).
712. The result of the staff meeting was that Dr. Jessup and Croudace's Disclosure of Invention would be given the highest rating (an "A"). (Wirzbicki, Tr. 884).
713. Unocal's Chief Patent Counsel, Mr. Wirzbicki, was "very excited about the invention" at the time that the Conception Committee rated it an "A." (Wirzbicki, Tr. 884).
714. Mr. Wirzbicki viewed the invention as "an incredible breakthrough" at the time of the Conception Committee rankings (Wirzbicki, Tr. 884), and he told Unocal management and his research group about his views before the patent issued. (Wirzbicki, Tr. 897).

ii. The Process Used to Prosecute the Patent Demonstrates Unocal's Recognition of the Importance of the Invention.

715. Unocal's Chief Patent Counsel, Mr. Wirzbicki, assigned himself to handle the patent prosecution for the invention. (Wirzbicki, Tr. 882-883, 871; Croudace, Tr. 458). He considered it to be one of the "perks" of his position to assign that work to himself. (Wirzbicki, Tr. 883). Mr. Lipman understood that Mr. Wirzbicki had been assigned this Conception prior to the August 23, 1990 meeting of the Conception Committee. (CX 7053 (Lipman, Dep. at 13-14)).
716. Mr. Wirzbicki eventually prosecuted all five Unocal RFG patents. (CX 617; CX 618; CX 619; CX 620; CX 621; Wirzbicki, Tr. 873).
717. On September 18, 1990, Dr. Alley (a Vice President in Unocal's Science and Technology Division and one of the members of the Conception Committee), wrote in an internal memorandum to Mr. Wirzbicki that he had spoken to Roger Beach about "the advisability of filing a patent application" on the Disclosure of Invention related to the 5/14 Project. Dr. Alley wrote, "Mr. Beach is in favor of getting all the coverage we can on this work." By this, Dr. Alley understood Mr. Beach to mean to "cover it thoroughly to the extent that we have the data." Dr. Alley perceived that the patent application had significance to Mr. Beach because, at least in part, "it was part of our program to keep Unocal competitive." (CX 193; CX 7041 (Alley, Dep. at 137-139); Wirzbicki, Tr. 897-899).
718. According to Dr. Alley, Mr. Beach wanted the patent applications regarding the

emissions data to cover the 5/14 results “thoroughly to the extent that we have the data.” (CX 7041 (Alley, Dep. at 138); CX 193).

719. At the time, of Dr. Alley’s September 18, 1990 memorandum regarding Mr. Beach’s input on filing a patent on the 5/14 Project invention, Mr. Beach was in charge of Unocal’s refining division as President of Unocal’s Refining and Marketing Division. While Mr. Wirzbicki at first did not know who Mr. Beach was, he found out in 1990 after he received Dr. Alley’s letter, and understood Mr. Beach to be one of the individuals who “ran the company from an overall perspective” (Wirzbicki, Tr. 898-899, 1038, 1040).
720. Dr. Alley copied September 18, 1990 memorandum regarding Mr. Beach’s input on filing a patent on the 5/14 Project invention, to Mr. Lipman, the President of Unocal’s Science and Technology Division, and Dr. Miller, a manager under Dr. Alley in charge of the fuels group. (CX 193 at 001 (9/18/90 Alley memo to Wirzbicki); Wirzbicki, Tr. 898-899).
721. Mr. Wirzbicki received Dr. Alley’s memorandum on or about September 20, 1990. (Wirzbicki, Tr. 898).
722. It was “not common” for Mr. Wirzbicki to receive memos of this sort from Unocal management regarding what he should do in trying to get a patent. (Wirzbicki, Tr. 898-900).
723. It was “[a]bsolutely not” common for Roger Beach to be directly involved in patent applications. (Beach, Tr. 1704).
724. At the end of 1990, Roger Beach knew that Unocal was planning to file a patent application on the 5/14 Project. (Beach, Tr. 1760-1761).
725. Unocal placed great weight on this patent application. For example, compared to the types of prior art searches done in other cases, the “set of prior art searches” that Unocal performed for the patent application that lead to the ‘393 patent was “very high, very great amount, an unusual amount.” (Wirzbicki, Tr. 928-930).

d. Unocal Filed a Patent Application on December 13, 1990.

726. On December 13, 1990, Mr. Wirzbicki filed the first patent application, Application No. 07/628,488, on Dr. Jessup and Croudace’s reformulated gasoline invention. (CX 1788 at 013-076, 078 (‘393 patent file history); Jessup Tr. 1182). Unocal was the assignee of the patent application. (Wirzbicki, Tr. 907-908; CX 1788 at 077-082).
727. The patent application describes the directional relationships between eight fuel properties and three types of tailpipe emissions that were derived from the 5/14 research project. Specifically, the patent application detailed the following properties whose

regulation would tend to reduce emissions: RVP, T10, T50, T90, olefin content, aromatic content, paraffin content, and octane. (CX 1788).

2. Unocal's Scientists and Co-Inventors Aided the Chief Patent Counsel's Preparation and Prosecution of the Patent Application.

728. Dr. Jessup knew as of September 1990 that Unocal was going to file a patent application for his invention. (Jessup, Tr. 1182). He also knew that Unocal's Patent Conception Committee had given the patent disclosure an A rating. (Jessup, Tr. 1182).
729. Drs. Jessup and Croudace participated closely with Mr. Wirzbicki in drafting the initial patent application:
- a. they reviewed the draft patent application before it was filed, (Wirzbicki, Tr. 915);
 - b. signed an oath stating that they "reviewed and understand the contents of the above-identified specification, including the claims . . ." (CX 1788 at 075-076; Wirzbicki, Tr. 915-916);
 - c. worked with Mr. Wirzbicki to develop the claims in the application. (Wirzbicki, Tr. 914-915); and
 - d. provided Mr. Wirzbicki with the figures printed in the drawings section of the specification of the patent application. (Wirzbicki, Tr. 919-920).
 - e. Dr. Jessup and Dr. Croudace also helped Mr. Wirzbicki with all of the technical aspects of the '393 patent application process. (Wirzbicki, Tr. 919).
730. Mr. Wirzbicki understood that he had a "duty of good faith and candor to the Patent & Trademark Office" in prosecuting "the patents that are at issue in this case." (Wirzbicki, Tr. 941). He understood that he always has a duty of good faith and candor to "tell the truth" to the Patent Office. (Wirzbicki, Tr. 941).
731. Mr. Wirzbicki believed that Dr. Jessup and Dr. Croudace also understood that they had a duty of good faith and candor to the Patent & Trademark Office when they made statements to the Patent Office. (Wirzbicki, Tr. 941-942).
732. Mr. Wirzbicki gave the Patent Office truthful and accurate information to the best of his ability. (Wirzbicki, Tr. 942).
733. At various times between December of 1990 and the end of 1991, Drs. Jessup and Croudace helped Mr. Wirzbicki search for prior art. (Wirzbicki, Tr. 920). For example, "gasoline that matched one of the compositional claims before the invention date" would

be “prior art.” (Wirzbicki, Tr. 920-921).

734. Among other things, Dr. Jessup ran a computer program to compare the properties of gasolines listed in a database for gasoline that existed prior to the date of Dr. Jessup and Croudace’s invention to the properties of the compositions claimed in Unocal’s original patent application. (Wirzbicki, Tr. 925-929; CX 1788 at 319-323). Mr. Wirzbicki reported the specifications of the fuels that had properties that “matched” those in the patent claims to the PTO. (Wirzbicki, Tr. 925-929).

3. Unocal Knew That the Scientists’ Invention Had Significant Value and Intended to Enforce its Proprietary Rights.

735. Dennis Lamb, the key liaison with CARB, knew that Unocal would file a patent application and learned of the actual application soon after it was filed. Dr. Miller informed Lamb of the filing of the patent application. (Lamb, Tr. 1824-1825).

736. Mr. Lamb understood that the patent application represented a proprietary opportunity. (Lamb, Tr. 1825).

737. Prior to filing the patent application, Mr. Wirzbicki told Dr. Jessup that he was “pretty excited” because the invention was “a pretty astounding result” – it was “something out of the ordinary.” (Jessup, Tr. 1182).

738. From the time of the filing of the Unocal patent application, Unocal anticipated litigation related to the patent. (Beach, Tr. 1699).

739. “[F]rom the time [he] started prosecuting the patent application in December 1990,” Unocal’s Chief Patent Counsel, Mr. Wirzbicki believed that “one of the viable options was to license the patent and obtain royalties for Unocal if the patent was approved.” (Wirzbicki, Tr. 932-933).

740. The “basis” for Mr. Wirzbicki’s belief in 1990 that there might be litigation surrounding what eventually became the ‘393 patent was that he “suspected that this might be an important invention.” (Wirzbicki, Tr. 932).

741. Similarly, Drs. Jessup and Croudace “expressed an interest during the prosecution of the ‘393 patent in obtaining royalty income from their invention.” (Wirzbicki, Tr. 933).

742. From the time he first submitted the initial patent application on Dr. Jessup and Croudace’s invention in 1990, Unocal’s chief patent counsel, Mr. Wirzbicki, “believed the invention was going to be converted into a patent.” (Wirzbicki, Tr. 930).

743. Indeed, as early as 1990, Mr. Wirzbicki had “great confidence that [he] would get a patent.” (Wirzbicki, Tr. 930).

744. Mr. Wirzbicki had substantial experience with patent prosecution. By the time he started prosecuting the Unocal reformulated gasoline patents, Mr. Wirzbicki had been preparing and prosecuting patent applications for Unocal since 1974. (Wirzbicki, Tr. 872-873). He has personally prosecuted or supervised the prosecution of “hundreds of patent applications.” (Wirzbicki, Tr. 872-873).
745. At the time he filed the original patent application in 1990, Mr. Wirzbicki also knew that in his experience, the average length of time to obtain a patent was three years. (Wirzbicki, Tr. 931).
746. Mr. Wirzbicki thus “felt confident” that – although the patent application process would take some time -- the PTO would eventually issue a patent from the application he filed in December 1990. (Wirzbicki, Tr. 930-931).
747. Drs. Jessup and Croudace echoed Mr. Wirzbicki’s confidence. On December 11, 1990, the day after Mr. Wirzbicki filed the original patent application, Drs. Jessup and Croudace stated in a memorandum that “[W]e have applied for a patent based on the 5/14 results, and have a good chance of getting it. . . .” (CX 210 at 002 (Jessup and Croudace memo to Miller 12/11/90)).
748. Drs. Jessup and Croudace sent this memorandum to their supervisor, Wayne Miller, head of Unocal’s fuels group. Their memo was copied to the patent department, Denny Lamb (Unocal’s representative to CARB), and Dr. Alley, among others. (CX 210 at 002 (Jessup and Croudace memo to Miller 12/11/90)).
749. Dr. Croudace personally came to believe that Unocal could generate great revenues as a result of his invention. (Croudace, Tr. 461).
750. Unocal management and employees outside of the Science and Technology division recognized the potential licensing value of Unocal’s RFG technology as “one of the most lucrative licensing opportunities [the] company has ever seen.” Indeed, according to a December 1990 memo written an employee of Unocal’s Process Technology Licensing group, while the results and potential use of the 5/14 Project results were shrouded in “great secrecy,” internal discussions continued concerning the potential licensing strategy and the influencing of regulators. (Croudace, Tr. 532, 534; CX 3004).
751. Dr. Miller knew of discussions within Unocal in the 1990 to 1991 time frame regarding the potential value of patents from the 5/14 Project. (Miller, Tr. 1369-1370).
752. On November 20, 1991, Mr. Wirzbicki received the first office action from the patent examiner related to the application that lead to the ‘393 patent. (CX 1788 at 215-231; Wirzbicki, Tr. 1148).

753. The office action Mr. Wirzbicki received on November 20, 1991 gave an initial rejection of the pending claims. CX 1788 at 215-231; (Wirzbicki, Tr. 1147-1148). For example, the examiner pointed out “some typos in the sense that [he] didn’t have the phrase ‘unleaded gasoline fuel’ in all of the claims” – a “small thing” that “was at least important enough for her that she then rejected the claims based on that phraseology.” (Wirzbicki, Tr. 1146-1147).
754. In Mr. Wirzbicki’s experience, it was “very common for the PTO to issue as a first office action a rejection of all the claims in the patent application.” (Wirzbicki, Tr. 1146-1147).
755. Similarly, in Mr. Wirzbicki’s experience, “it’s only one case in 15 where a patent application that later becomes a patent is just allowed without any rejection at all.” (Wirzbicki, Tr. 1147).
756. To the best of his knowledge, Mr. Wirzbicki did not give a report of the this office action rejecting the pending claims to anyone. Mr. Wirzbicki did not make a written report, and does not recall telling anyone that he had received the office action. (Wirzbicki, Tr. 1148-1149).
757. The rejection did not stop the patent prosecution process. As discussed in greater detail below, Mr. Wirzbicki figured out what the examiner “didn’t like about the application” and, on March 9, 1992, he made arguments and amendments to address it. (Wirzbicki, Tr. 1146-1147); CX 1788 at 233-243; CX 1788 at 245-283).
758. Moreover, the November 20, 1991 office action also indicated that the examiner accepted the affidavits that Drs. Croudace and Jessup filed to show that they “made a gasoline including characteristics as claimed” prior to June 1990. (CX 1788 at 216).
759. Upon learning that Unocal had been issued a patent on reformulated gasoline, Mr. Schmale was generally pleased. He understood of the significance of the patent with respect to potential licensing fees. (CX 7062 (Schmale, Dep. at 69)).

C. Unocal Explored, But Abandoned, the Option of Seeking Competitive Advantage by Using the 5/14 Project Results Internally.

760. After the May 14, 1990 presentation to the Executive Committee, Unocal looked at multiple paths to gain a competitive advantage from the 5/14 Project, including a commercial path and patenting path. (Miller, Tr. 1353).
761. To gain a competitive advantage through the patenting path, Unocal went through its legal department to seek a patent based on the 5/14 Project. (Miller, Tr. 1354-1355).
762. After management reviewed the preliminary data and model from the 5/14 Project, Dr. Miller immediately suggested that Unocal explore using the 5/14 Project to “see if

Unocal can produce low-emissions” gasolines. (CX 175). This was the commercial path. (Miller, Tr. 1373).

763. To gain a commercial advantage from the 5/14 project, Unocal pursued each of these paths in parallel. (Miller, Tr. 1355).
764. There were different people involved in the commercial and patenting paths. (Miller, Tr. 1370-1371). But Unocal employees involved in the commercial path had interest in and followed the patent path. (Miller, Tr. 1371). For instance, the Fuels Issues Team, including Mr. Lamb and Mr. Mandlekar, discussed the patenting path. (Miller, Tr. 1371).

1. Unocal Explored the Possibility of Introducing an “Interim RFG” in the Marketplace.

a. Unocal Management Initially Decided Not to Publicize the 5/14 Research While it Considered the “Interim RFG” Option.

765. Denny Lamb’s handwritten notes on an internal Unocal document (CX 172) reflect that Mr. Stegemeier made a decision at the May 14, 1990 Executive Committee meeting to keep the 5/14 Project secret. (Lamb, Tr. 2180-2181; CX 172 at 001).
766. Even within the company itself, Unocal limited the number of people who knew about the 5/14 Project. (Miller, Tr. 1361-1362). “Unocal was careful internally and externally as to who they disclosed” information about the 5/14 Project. (Miller, Tr. 1362-1363).
767. Unocal made an effort to keep the patent activity related to the 5/14 Project limited to its law department and the inventors and away from other people at Unocal. (Miller, Tr. 1365).
768. Unocal also limited who within Unocal knew about the patent application filed from the 5/14 Project. (Miller, Tr. 1365).
769. Unocal’s Chief Patent Counsel, Mr. Wirzbicki, knew that one reason not to disclose a pending patent is that it could invite another company to file an interference at the Patent Office. An interference is a procedure to determine who was the first inventor of a particular invention that can occur when two people get to the Patent Office at about the same time, with the same invention, and they are both asking for a patent on it. (Wirzbicki, Tr. 954-955).
770. Nevertheless, while Mr. Wirzbicki was prosecuting the ‘393 patent, he thought it was “highly doubtful” that another person would file an interference. (Wirzbicki, Tr. 955).
771. Part of the reason that Mr. Wirzbicki was not concerned about the prospect of interference in prosecuting the ‘393 patent was because he believed at the time that “Dr.

- Jessup and Dr. Croudace's invention was very unusual." (Wirzbicki, Tr. 955-956).
772. The other part of the reason that Mr. Wirzbicki was not worried about the prospect of an interference was that he believed "Drs. Jessup and Croudace had found seven or eight properties that affected gasoline emissions, and which ways to adjust them," and that "the odds of there being an interference when you've got that many properties was very slim." (Wirzbicki, Tr. 955-956).
773. In October 1990, Unocal management wanted to preserve all opportunities to obtain a competitive advantage from the 5/14 research findings. In an October 2, 1990 internal Unocal memorandum, Denny Lamb stated: "If 5/14 provides a cleaner more cost effective product than any specified formula and equal emissions provisions are workable, Unocal would have at least two compliance options (i.e., The specified formula or the 5/14 formula) and an opportunity for competitive advantage." (CX 194 at 003).
774. In an October 2, 1990 internal Unocal memorandum, Denny Lamb expressed the concern that: "If Unocal is successful in convincing regulators that 5/14 is correct it could become the specified formula and Unocal would just have one option and no opportunity for competitive advantage." (CX 194 at 003).
775. In an October 2, 1990 internal Unocal memorandum, Denny Lamb urged the company to maintain secrecy of the 5/14 research project in order to see how events unfolded in order maximize the potential for competitive advantage. Lamb advocated to higher level management: "Maintain secrecy of 5/14 findings until air quality benefits and cost effectiveness are assured and appropriate opportunities for certification or substitution are determined." (CX 194 at 003).
776. Unocal explored the option of applying the results of the 5/14 project to produce an early version of RFG at its Los Angeles refinery. Unocal considered producing an "Interim RFG" that might give it a competitive advantage in the marketplace and compete with other interim products. (CX 229; CX 231).
777. Unocal management started consideration of the interim reformulated gasoline strategy by May 1990. (CX 177 (presentation dated May 23, 1990); CX 178 (FIT memo dated May 24, 1990); CX 181 at 002-003).
778. At a May 23, 1990 staff meeting, Mr. Beach directed Unocal employees to explore an "interim" gasoline strategy for "'all' California" to be implemented prior to any mandated reformulated gasoline. (CX 178 at 001; Miller, Tr. 1375-1376).
779. In November, 1990, Roger Beach had instructed members of the Fuels Issues Team to develop a premium interim reformulated gasoline to be introduced in Southern California in early 1991. (CX 208).

780. Unocal's efforts to create and market an interim RFG were in response to the fact that other companies had introduced cleaner-burning gasolines prior to the implementation of CARB's Phase 2 regulations. (Kulakowski, Tr. 4410). Chief among those companies was ARCO with its EC-1 product. (Kulakowski, Tr. 4410).
781. Unocal scientists and inventors and Unocal management knew prior to its presentation to CARB in June 1991 that Unocal had a competitive advantage over its competitors with respect to producing gasolines that had low olefins and low T50. (CX 220). Management was informed that one of the advantages of using the 5/14 research results to influence CARB would be to achieve a competitive edge in the area of olefin reductions. In an internal memorandum dated December 11, 1990, Unocal scientists and inventors Drs. Jessup and Croudace stated: "Unocal could push other companies into olefin reductions which Unocal would not have to do. This will give us a competitive edge by making our competitor's product more costly." (CX 210 at 004; Jessup, Tr. 1216). At the time, Unocal had one refinery that produced no olefins and one that did not produce many; thus, Unocal was already able to produce low-olefin gasoline. (Jessup, Tr. 1216-1217).
782. In an internal Unocal memo dated January 15, 1991, the scientists and inventors informed Unocal management that "Unocal, on average, produces a regular unleaded gasoline with a significantly lower 50% distillation point and olefin content than our competitors." (CX 220 at 001). In this memo, the scientists and inventors also emphasized that T50 was a driver of exhaust emissions. This memo discussed the fact that Chevron Premium superior to Unocal premium gasoline because of lower T50: "The Chevron Premium gains its advantage in HC and CO emissions because the 50% distillation point is significantly lower than the other products." (CX 220 at 001).
783. In 1991, Unocal considered using the advertising claim "Unique Patent Pending Gasolines" for the interim RFG that Unocal sought to develop using the 5/14 Project. (CX 157; Miller, Tr. 1416-1417).
784. In a February 1991 memorandum to Mr. Beach, Dr. Miller indicated that Unocal's marketing department was considering three claims for Unocal's interim RFG. (CX 228; Miller, Tr. 1417; Beach, Tr. 1683). The first of these potential claims was "Pending patent product." (CX 228; Miller, Tr. 1417). Dr. Miller also communicated this potential marketing claim to Mr. Lipman, Dr. Alley, Dr. Jessup, and Dr. Croudace. (CX 228).
785. High level Unocal management participated in the consideration of whether to market an interim RFG. (CX 229 (Memo to Roger Beach, dated February 25, 1991 re: "Interim RFG Strategy); CX 231; CX 1639).
786. In February 1991, Roger Beach participated in discussions concerning an interim RFG strategy. (CX 229 (J.M. Monroe to Beach, February 25, 1991 memo: "Per our discussion

of February 19, 1991 a tentative strategy and timing of an interim reformulated gasoline has been developed. The attached summarizes this strategy.”)). Roger Beach received a memo that detailed the interim RFG strategy which contemplated the introduction of a product in late spring or early summer 1991 with a marketing claim of “patent pending.” (CX 229 at 002). Unocal considered bringing an interim RFG on the market in Southern California by May 1, 1991. (CX 215 at 003). This memo was copied to Denny Lamb and Wayne Miller. (CX 229 at 001).

787. In March 1991, Denny Lamb made a presentation directly to the Executive Committee and Richard Stegemeier, Unocal’s CEO and Chairman of the Board, concerning the interim RFG strategy. (CX 231; CX 1639 (Presentation slides to Executive Committee on interim RFG strategy; “EC Presentation March 1991); Lamb, Tr. 2121).
788. During an informal presentation made by members of Unocal’s Science and Technology Division to the company’s Executive Committee on March 5th, 1991, Stegemeier inquired into the feasibility of using Unocal’s 5/14 emissions results to develop a gasoline fuel with M85 equivalence similar to ARCO’s EC-X. (CX 231 at 001).

**b. Unocal Management Concluded in May 1991 That the
“Interim RFG” Product Could Not Be Successfully Marketed.**

789. As of April 1991, Unocal continued to explore the merits of producing and marketing of an interim RFG. (CX 235 (memo re: market study about consumer price sensitivities)).
790. In April 1991, Unocal developed an internal cost study for its interim RFG project. (CX 237 at 001; Miller, Tr. 1389).
791. Unocal put a lot of work into its interim RFG project, which was an attempt to use the 5/14 Project to commercialize a product. (Miller, Tr. 1389-1391). Approximately 50 Unocal employees worked on the effort. (Miller, Tr. 1390). Dr. Miller and others at Unocal expended a lot of time on the effort. (Miller, Tr. 1390).
792. Unocal never marketed an interim RFG because market research determined that doing so would have been unprofitable. (Beach, Tr. 1683-1684, Kulakowski, Tr. 4410).
793. With regard to its proposed interim RFG product, Unocal determined that Unocal users were only willing to pay 2 cents per gallon more for the product than for conventional gasoline. (CX 235 at 001).
794. In the early 1990's, Unocal had pretax profits of one to two cents per gallon. (Beach, Tr. 1684-1686).
795. By May 1991, the interim RFG project was “put on the shelf.” (CX 3054 at 002-003; Miller, Tr. 1391-1392). Lamb informed the Fuels Issues Team on May 17, 1991 that the

interim RFG project had been placed “on the shelf.” (CX 3054 at 002-003). Someone higher than Mr. Lamb in Unocal made the decision. (Lamb, Tr. 2146). Mr. Lamb informed the Fuels Issues Team that the “ongoing use for 5/14” research results would be in connection with a “CARB consultation/presentation to influence regs.” This is the only ongoing use of the 5/14 research results discussed at the May 17, 1991 Fuels Issues Team meeting. (CX 3054 at 003; Lamb, Tr. 2145-2147).

796. Ultimately, Mr. Beach made the decision to “kill” the interim RFG project. (Lamb, Tr. 1977).
797. Other than the potential patents, after Unocal abandoned its interim RFG project, there was no value to the 5/14 Project from a business perspective. (Kulakowski, Tr. 4411).
798. Prior to Unocal’s June 20, 1991 presentation to CARB, Unocal had decided to abandon its efforts to use the 5/14 emissions results in manufacturing and marketing an “Interim RFG” gasoline product. (CX 3054 at 002-003).
799. With Unocal’s plans for an interim clean gasoline “on the shelf,” Unocal re-evaluated its “ongoing use” of the 5/14 Project research. Unocal elected to use its research for a presentation to influence CARB’s developing Phase 2 rules. (Lamb, Tr. 2147; Kulakowski, Tr. 4414-4416; CX 3054).

2. Unocal Explored Using the 5/14 Project Results to Make Refinery Modifications that Would Enable it to Gain Competitive Advantage By Producing Reformulated Gasoline.

800. Dr. Alley recognized that the 5/14 Project had the goal “to develop a formula, a combination of ingredients that would give minimum pollutants but still retain . . . driveability.” The 5/14 Project also had the purpose of showing formulations that gave minimum pollutants “with the ordinary products from a refinery.” Though originally Unocal did not have the goal to seek a patent for this project, ultimately it did lead to a patent application and patent. (CX 7041 (Alley, Dep. at 19-20, 47)).
801. Mr. Lamb saw in August 1990 the coming regulatory changes as a “significant opportunity in our strategy to gain competitive advantage with cost effective environmental high ground fuels.” (CX 188).
802. In October 1990, Unocal management, specifically Denny Lamb, wanted to maximize the “competitive advantage” resulting from the 5/14 research findings. He saw that combining the 5/14 research with equal emission provisions in any coming regulations would provide Unocal with an opportunity for competitive advantage. (CX 194 at 003).

D. Unocal Engaged in a Strategy of Using Its Emissions Research to Influence Fuels Regulations and the Industry.

803. On or about October 2, 1990, Dennis Lamb sent an internal Unocal memorandum to Roger Beach and Steven Lipman entitled “5/14 Information Strategy.” This internal memorandum discussed the September 17, 1990 meeting and attached a proposed response to questions posed by Richard Stegemeier, Unocal’s CEO and Chairman of the Board. Dennis Lamb transmitted [cc:ed] this memo to other members of Unocal management including S.K. Alley, D.E. D’Zurilla, J.W. Ichord, J.W. Miller, and F.L. Walker. (CX 194).
804. By October 2, 1990 suggestions had been made within Unocal “that the information from 5/14 should be taken immediately upon confirmation to both EPA and CARB in an effort to have the specifications adopted reflect the 5/14 conclusions.” (CX 194 at 002).
805. By October 2, 1990, Mr. Lamb informed Unocal management that “Timing may not allow the opportunity to impact the Clean Air Act or EPA with 5/14,” however, he continued that, “Timing is favorable to influence CARB.” (CX 194 at 003).
806. Mr. Lamb conveyed to Unocal management that “For Unocal, CARB will be the dominating agency.” (CX 194 at 003).
807. In January 1991, the Executive Committee received a briefing on the imminent RFG regulations, what Unocal was going to do to comply with those regulations, and what Unocal could do with its in-house technology, including the 5/14 project results, which was offered as a vehicle for competitive advantage. (CX 217; CX 219). Specific participants at this meeting included Mr. Stegemeier, Mr. Lamb, Dr. Miller, Dr. Jessup, and Dr. Croudace. (CX 220).
808. Efforts were taken to continue to apprise Unocal high-level management of the competitive significance of the 5/14 research project results. The purpose of the January 14, 1991 presentation to Richard Stegemeier, Unocal’s CEO and Chairman of the Board, was to give Stegemeier a “complete perspective” on what the regulations required, Unocal’s refining plans to comply with the regulations, and the “status of the 5/14 project.” Unocal management that prepared for, and participated in, the presentation to Stegemeier included Denny Lamb and Wayne Miller. (CX 217).
809. In early January 1991, Unocal managers Wayne Miller, Arun Mandlekar, and Denny Lamb prepared for a “joint presentation” on January 14, 1991 to Mr. Stegemeier. (CX 217 at 001; Lamb, Tr. 2119; CX 220 (memo confirms meeting took place where 5/14 research results were discussed)). This involved extensive preparation, including the participants reviewing each other’s draft slides. (CX 217 at 001). Handwritten notes dated January 4, 1991, refer to a meeting discussing presentations to be made by Dr. Miller (whose initials are JWM), Denny Lamb, and Mr. Mendlekar. (CX 478 at 001; Miller, Tr. 1386). These notes state “for JWM – go heavy on 50% point,” which refers to

- T50. (CX 478 at 001).
810. The memorandum from Mr. Mandlekar to Dr. Miller discussing the January 14, 1991 presentation to Mr. Stegemeier and draft presentation materials were copied to high level Unocal management, including Mr. Beach and Mr. D’Zurilla. (CX 217; Lamb, Tr. 2119).
811. An internal set of Unocal slides entitled “REFORMULATED GASOLINE (RFG)[:]
RESEARCH OBJECTIVE: USE TECHNOLOGY TO GAIN A COMPETITIVE
ADVANTAGE” (dated January 11, 1991) sets forth ways in which Unocal could use its 5/14 Project. (CX 219; Miller, Tr. 1388). One of the “THREE KEY POINTS OFFERED” in that internal set of Unocal slides was “‘5/14’ results ready to use for competitive advantage.” (CX 219 at 004). Included as one of four “WAYS TO USE ‘5/14’ NOW” was “Influence CARB rules.” (CX 219 at 012; Miller, Tr. 1387-1388).
812. Although he could not recall specifically whether these slides were used in the January 14, 1991 presentation to Mr. Stegemeier, Dr. Miller testified that this set of slides, which he sent to Mr. Mendlekar on January 11, 1991 (the time period during which Dr. Miller, Mr. Mendlekar, and Mr. Lamb were preparing for their joint presentation to Mr. Stegemeier), “were presented more than once” and that he “presented them at times.” (Miller, Tr. 1386-1387).
813. Unocal management, including Dennis Lamb, had direct and informal access to high-level Unocal management, including Mr. Stegemeier, Unocal’s CEO and Chairman of the Board. Unocal employees did not strictly communicate in a rigid manner only to those within their direct chain of authority. (CX 217 (Lamb refers to Stegemeier as “Dick”)).
814. Mr. Stegemeier has a management philosophy that “the best ideas bubble up from the bottom. They don’t come crashing down from the top.” Therefore, he sees that “all members of the company should have input into the way we run the company.” (CX 7065 (Stegemeier, Dep. at 105-106)).
815. Internal Unocal documents prepared for the January 14, 1991 presentation to Unocal’s CEO, Richard Stegemeier, reflect that the overall objective for Unocal’s emissions research was to “Use Technology to Gain a Competitive Advantage.” (CX 219 at 002).
816. Internal Unocal documents prepared for the January 14, 1991 presentation to Unocal’s CEO, Richard Stegemeier, set forth “Three Key Points Offered.” These were that (1) the conclusions from the 10 car test conducted by the Southwest Research Institute (SwRI) confirmed the conclusions presented at May 14, 1990 Executive Committee meeting; (2) that the “5/14 equations apply widely;” and (3) that the “5/14 results ready to use for competitive advantage.” (CX 219 at 004).
817. Unocal management, including Wayne Miller believed that the fact that the “5/14

equations apply widely” meant that Unocal’s emissions research had discovered directional relationships between gasoline properties and exhaust emissions that had general application in the refining of low emissions, reformulated gasoline. (CX 219 at 004).

818. Unocal management, specifically including Wayne Miller, tracked the progress of the Auto/Oil research. (CX 219 at 007-010).
819. Richard Stegemeier took an active role in overseeing the 5/14 Project and, at the January 14, 1991 presentation, requested that the scientists and inventors obtain additional information for him concerning emissions calculations for ARCO gasolines. (CX 220).
820. Mr. Lipman learned from Dr. Alley that Unocal representatives would visit CARB to present results from the 5/14 project. Dr. Alley provided Mr. Lipman with information about what Unocal would disclose to CARB in this meeting set up by Mr. Lamb. (CX 7053 (Lipman, Dep. at 32, 34-35)).
821. In regard to Unocal’s decision to provide the 5/14 information to CARB, Mr. Lipman encouraged Dr. Alley and his team to assist the Refining and Marketing Division in any way they could. Mr. Lipman understood that Mr. Lamb wanted help, and Mr. Lipman “fully supported their efforts.” (CX 7053 (Lipman, Dep. at 37)).
822. Roger Beach, the Senior Vice President of Refining and Marketing, had the authority and responsibility for providing company information to federal and state regulators during the period of the CARB Phase 2 rulemaking. (CX 7065 (Stegemeier, Dep. at 23)).
823. Dr. Alley believed that Mr. Beach “owned the information” from the 5/14 Project, and therefore he looked to Mr. Beach to make the decision about disclosing the information. (CX 7041 (Alley, Dep. at 129, 132)).
824. Stegemeier was aware that Unocal provided CARB information related to Unocal’s 5/14 research project. (CX 7065 (Stegemeier, Dep. at 47-48)).
825. Mr. Stegemeier believed that providing the emissions results from the 5/14 project to CARB or the Environmental Protection Agency was a “good idea,” or he would have objected. (CX 7065 (Stegemeier, Dep. at 79)).
826. Mr. Stegemeier delegated to Mr. Lamb discussing Unocal’s comments on the reformulated gasoline regulations with CARB. (CX 7065 (Stegemeier, Dep. at 62-63); CX 42).

1. Unocal Management Monitored the Patent Prosecution Process.

827. The senior officers of the company were interested in and following the efforts to obtain

patents over the 5/14 Project. (Miller, Tr. 1371). Those senior officers were Mr. Stegemeier (the then-CEO), Mr. Beach (the then-COO), and Mr. Schmale (the then-CFO). (Miller, Tr. 1372).

828. A summary of activities for the Science and Technology Division for July 1992 reports to Mr. Beach, "Unocal received an informal notice from the U.S. Patent & Trademark Office that it would allow claims to Unocal's reformulated gasoline. These claims are broad enough to cover all gasoline fuels to be sold in California under current CARB regulations starting in March 1996." Mr. Lipman, the report's author, relied on the accuracy of this information from Mr. Wirzbicki, the head of the Patent Department. (CX 593 at 003; CX 7053 (Lipman, Dep. at 5-6)).
829. Mr. Beach would have been made aware of the notification from the Patent and Trademark Office when he read the monthly report from Science and Technology in August 1992. (CX 7053 (Lipman, Dep. at 9); CX 593 at 003).
830. Dr. Alley would have received a copy of the summary of activities for the Science and Technology Division for July 1992, in which Mr. Beach was advised that Unocal received an informal notice that the U.S. Patent & Trademark Office would allow claims to Unocal's reformulated gasoline patent. (CX 7053 (Lipman, Dep. at 51); CX 593).
831. Mr. Schmale knew that Unocal had applied for a patent related to reformulated gasoline. (CX 7062 (Schmale, Dep. at 25)).
832. Mr. Lipman recalls that Greg Wirzbicki informed him that he had received notice that the patent was going to be issued to Unocal. (CX 7053 (Lipman, Dep. at 8)).
833. On March 1, 1994, Mr. Wirzbicki sent copies of the issued '393 patent to Mr. Beach, Mr. Schmale, Mr. D'Zurilla, Mr. Lamb, Mr. Economides, Dr. Miller, and Dr. Jessup. (CX 339).
834. Unocal Chairman and CEO Richard Stegemeier congratulated Chief Patent counsel Greg Wirzbicki upon learning of the issuance of Unocal's '393 RFG patent, in line with his practice of congratulating those who got patents "that had any value." (CX 7065 (Stegemeier, Dep. at 89, 112)).

2. Unocal Management Knew that Achievement of a Competitive Advantage Required Influencing Regulations.

835. The scientists sent the December 1990 memorandum advocating influencing regulators in order to obtain substantial licensing to Dr. Miller, Dr. Alley, Mr. Lamb, Mr. Plumbley, and patent counsel. (CX 210 at 002; CX 3005 at 001; Jessup, Tr. 1212-1214, 1218-1219).

836. Dr. Croudace sent the November 1990 memorandum advising that “Unocal’s Advantage from the 5/14 Project will Be Gone in Six Months,” to Mr. Wirzbicki, Unocal’s Chief Patent Counsel, Mr. Lamb, and Dr. Alley. (CX 207).
837. In January 1991, Unocal management believed that one way to use 5/14 for competitive advantage was to “influence CARB rules,” as this alternative was presented [or was considered as an option to present] to Richard Stegemeier, Unocal’s CEO and Chairman of the Board. (CX 219 at 012).

3. Unocal Management Knew That Unocal Could Obtain a “Pot of Gold” From Licensing its Reformulated Gasoline Technology.

838. Dr. Jessup created a 4 foot by 8 foot “pot of gold” poster board (CX 2) for an “in-house poster session.” (Jessup, Tr. 1235). The poster was used to show Unocal management the work that Dr. Jessup was doing in the Science and Technology Division. (Jessup, Tr. 1236). Dr. Jessup stood in front of the poster and used it to explain the 5/14 Project. (Jessup, Tr. 1236). At the time, Dr. Jessup expected that the patent from the 5/14 Project would be of some commercial value. (Jessup, Tr. 1236). The board placed that value at \$.01 per gallon or \$1,000,000,000 per year. (CX 2).
839. On the “pot of gold” poster, Dr. Jessup estimated that Unocal could achieve \$100 million a year from introducing reformulated gasoline in the market and cost saving at its Los Angeles refinery. (Jessup, Tr. 1241-1242; CX 2). But he estimated a \$1 billion per year royalty stream from licensing the patents from the 5/14 Project. (Jessup, Tr. 1242; CX 2). As Dr. Jessup admitted, the \$1 billion number was put on the poster for management to see. (Jessup, Tr. 1242).
840. The “pot of gold” poster recounts the history of the 5/14 Project. (Jessup, Tr. 1237). It includes graphs from the SwRI emissions test data (the ten-car study). (Jessup, Tr. 1237-1238). It includes frequency charts from the one-car tests. (Jessup, Tr. 1238-1239). It also refers to the results of the Unocal program, which were that it defined key fuel properties that reduce regulated tailpipe emissions, developed a series of equations that predict emissions from key fuel physical properties (one the aspects of the invention), and patent pending formulations (referring to the patent-application). (Jessup, Tr. 1240; CX 2).
841. Jessup created the “pot of gold” poster in or about May 1991, prior to the presentation to CARB of the 5/14 Project. Jessup’s notes relating to a draft outline of the presentation to CARB indicates that the proposed presentation to CARB would include some of the same information detailed on the poster. (CX 245).
842. As Dr. Jessup admitted, the “pot of gold” poster board contains bar charts that he later showed to CARB. (Jessup, Tr. 1239, 1285 (stating that CX24 at 44-46 “are the same frequency charts that we looked at yesterday at CX 2”)). He also admitted that the poster

refers to the possibility of Unocal introducing an interim RFG, which was abandoned prior to June 1991. (Jessup, Tr. 1240-1241). Further, a layout of slides that Dr. Jessup created during preparations for the meeting with CARB, states that the CARB presentation should include “results ala poster,” by which Dr. Jessup was referring to the bar charts on the “pot of gold” poster. (CX 245; Jessup, Tr. 1248-1249).

843. Dr. Jessup put the “pot of gold” image on the poster; he “thought it was a nice touch.” (Jessup, Tr. 1242).
844. Dr. Jessup ensured that his manager, Dr. Miller, reviewed the “pot of gold” poster before it was used. (Jessup, Tr. 1243).
845. Dr. Miller participated in the creation of the “pot of gold” poster board. (Miller, Tr. 1425; CX 2). He was involved in setting the \$1 billion figure on that board, which is based on a 1 cent/gallon royalty. (Miller, Tr. 1427; CX 2). Originally, the figure was higher because of a higher cent/gallon royalty. (Miller, Tr. 1428). Working with the inventors, Dr. Miller (their supervisor at the time) reduce the number to make it “more credible.” (Miller, Tr. 1428).
846. The \$1 billion revenue stream depicted on the “pot of gold” poster board was more than 10% of Unocal’s overall revenues in 1990. (Miller, Tr. 1429).
847. Mr. Neil Schmale, one of Unocal’s senior management, examined the “pot of gold” poster and saw the \$1,000,000,000 royalty number. (Jessup, Tr. 1236; CX 2).
848. As of 2003, Mr. Schmale does not recall seeing the Unocal story board poster. However, he testified in his 1996 deposition that he thought he’d seen it “out at the research center, probably as part of a story board on the kinds of things they were doing out there.” In 1996 Mr. Schmale went on to state that the story board looked like that kind of thing he’d seen out at the research center. In 2003, Mr. Schmale acknowledges that his prior testimony, “sounds like the kind of thing I’d say.” (CX 7062 (Schmale, Dep. at 27-28); CX 2).
849. Mr. Schmale was aware of discussions within Unocal about the licensing potential of the reformulated gasoline patent. (CX 7062 (Schmale, Dep. at 69-70)).
850. Mr. Wirzbicki, Unocal’s Chief Patent Counsel also attended the Science and Technology Division open house in which Dr. Jessup and Dr. Croudace had a posterboard with respect to their invention. (Wirzbicki, Tr. 933). Mr. Wirzbicki recalled that the posterboard had a dollar sign and a number on it. (Wirzbicki, Tr. 933-934).
851. At the open house, Drs. Jessup and Croudace called Mr. Wirzbicki’s attention to the posterboard. (Wirzbicki, Tr. 933).

852. Drs. Jessup and Croudace told Mr. Wirzbicki at the open house that Mr. Schmale, a member of the Unocal Executive Committee, had seen the poster board. (Wirzbicki, Tr. 933-934).
853. Although there were a number of other poster boards during the presentation to Mr. Schmale, Dr. Miller could not recall any in his area that displayed a value greater than a million dollars, let alone a billion. (Miller, Tr. 1455).
854. In another presentation (hand dated 5/1/91), Dr. Jessup indicated that potential uses of the 5/14 Project included: "Influence Regulations"; "Increased Market Share For Unocal Gasolines"; "Increased Profits For Unocal Gasolines"; and "License Technology"(which referred to licensing the patents from the 5/14 Project and under which he suggested a 1 cent/gallon royalty). (CX 238 at 18; Jessup, Tr. 1221-1223).
855. In that same 5/1/91 presentation, Dr. Jessup wrote that "5/14 Project Equations are valid and proven" and "Now is the time to publish and to influence CARB." (CX 238 at 020; Jessup, Tr. 1225-1226). He went on to state, "Huge licencing [sic] income potential exists," which Dr. Jessup believed to be true at time. (CX 238 at 020; Jessup, Tr. 1226). A different presentation also dated 5/1/91 contains these same statements. (CX 239 at 008; Jessup, Tr. 1227-1228).
856. When Mr. Beach saw the statement that a "[h]uge licencing [sic] potential exist[s]" for the 5/14 Project, he found it "exceedingly interesting." (Beach, Tr. 1695; CX 239 at 008). Mr. Beach believed that there was a sufficient probability of potential licensing income that it made the prospect "rather interesting." (Beach, Tr. 1695-1696).
857. Though he tried to deny it at trial, prior testimony shows that Mr. Beach understood as of May 1991 that Unocal's patent application represented a potentially huge licensing opportunity. (Beach, Tr. 1696-1697). On cross-examination, Mr. Beach admitted that if the patent issued, it could impact Unocal's profitability. (Beach, Tr. 1698).

4. Unocal Management Knew That Obtaining Competitive Advantage Required Pursuit of a Patent Strategy.

858. Unocal management and employees outside of the Science and Technology division recognized Unocal's reformulated gasoline technology could become a lucrative asset. Unocal internal business documents from 1991 refer to the licensing potential of patents based on the 5/14 Project, as well as using the results to influence CARB and gaining a competitive advantage. (CX 2; CX 238; CX 219; CX 223; CX 239).
859. In 1991, Jessup and Kulakowski had a conversation about the amount of gasoline produced in California during which Jessup commented that "wouldn't it be great if Unocal could get a licensing fee on all that gasoline." (Kulakowski, Tr. 4507-4508).

860. Mr. Schmale has general recollection of discussions about the licensing potential of Unocal's reformulated gasoline patent prior to the patent actually being issued. (CX 7062 (Schmale, Dep. at 32-33)).
861. Mr. Schmale had meetings regarding the possibility of licensing reformulated gasoline. One meeting, in particular, which included Mr. Beach occurred roughly contemporaneous with the issuance of the patent. (CX 7062 (Schmale, Dep. at 70-71)).
862. Mr. Schmale and Mr. Beach advocated to have somebody "go back and make really, really sure to scrub this and make sure we had a good patent" before asking for licensing. Mr. Schmale had concern that "we didn't want to go out and start saying we were going to charge people for something and then discover that this thing . . . wouldn't stand up." (CX 7062 (Schmale, Dep. at 71-72)).
863. Discretion as to the release of the detailed emissions results from the 5/14 project to CARB and other regulatory agencies fell within the delegated authority of Mr. Beach and his team, including Mr. Lamb, working with the Patent Department. (CX 7065 (Stegemeier, Dep. at 82)).