IV.

TECHNICAL BASIS FOR THE PROPOSED SCM

To ensure that the proposed SCM is technologically and commercially feasible, we considered the following: 1) the results of our comprehensive survey of architectural coatings; 2) information from coating manufacturers, resins suppliers, and other industry groups; 3) the results of durability and performance testing in several coating categories; 4) the existing VOC limits for architectural coatings; and 5) the results of our technical analyses of all the coating categories proposed in the SCM (see Chapter VI). Based on our technical analyses, we have concluded that the overall performance of the reformulated products in each category will be similar to the performance of their higher VOC counterparts. However, we will conduct technology reviews for the proposed VOC limits that are lower than current limits prior to their effective dates.

A. SALES DATA FROM ARB SURVEY

To determine the extent that current coating products already comply with the proposed VOC limits, staff reviewed sales data from the ARB's 1998 Architectural Coatings Survey. In particular, the percent of marketshare by coatings already in compliance, and the number of complying products in each category were reviewed. Table IV-1 contains these data.

It should be noted that although "swimming pool repair and maintenance coatings" shows a zero complying marketshare, this coating category has only existed to allow chlorinated rubber technology coatings to phase out over time, as evidenced by several district rules having a 340 g/l limit for this category already. The proposed limit of 340 g/l still allows the existing epoxy technology coatings to remain, which are included in the "swimming pool coatings" category. Epoxy coatings can be used to repair epoxy coatings, so there will be repair and maintenance coatings available. Although marked "PD" (protected data) in Table IV-1 due to less than three companies reporting, "swimming pool coatings" have a relatively high complying marketshare.

Similarly, "quick-dry enamels", although marked "PD" in Table IV-1, have a low complying marketshare; however, many complying coatings in the "non-flats - high gloss" category can meet this coating need. As discussed in Chapter VI, we recommend districts eliminate the "swimming pool repair and maintenance" and the "quick-dry enamel" categories (as well as the quick-dry primer, sealer, and undercoater category) over time.

For each SCM category, the technical assessment discusses the specific sales data in Chapter VI of this staff report.

B. INFORMATION FROM COATING MANUFACTURERS, RESIN SUPPLIERS, AND OTHER INDUSTRY GROUPS

As part of our technical assessment of currently available coatings, we reviewed available information from industry, including coating manufacturers, resin suppliers, industry groups, trade groups, and trade journals. The information for each SCM category characterized the complying and non-complying coatings, including features such as recommended coating uses, types of resins and formulations, VOC levels, coating application and surface preparation requirements, expected performance characteristics, and issues associated with each category. For non-complying coatings, we gathered information on the types of technology available to achieve compliance.

For non-complying coatings, we identified several technologies that may be options to achieve lower VOC contents. These options, available singly or in combination, are briefly described below. Discussions of compliance options by coating category are included in Chapter VI, under the subsections entitled "Proposed VOC Limit and Basis for Recommendation."

1. Change to High Solids Formulations

The VOC content of traditional solvent-based formulations may be lowered by increasing the solids content and thus decreasing the solvent content. Generally, the resin needs to be modified, by decreasing its molecular weight, to avoid higher viscosity, which would otherwise impair the application characteristics of the coating when less solvent is available. Pigment fillers may also be used to increase the solids content. The resin and coating formulations are generally developed to achieve higher solids content while, at the same time, retaining many of the desirable performance characteristics of the traditional coating.

2. Solvent Substitution with Exempt Solvents

The VOC content of solvent-based formulations may be decreased by substituting appropriate amounts of exempt solvents to replace traditional solvents. The exempt solvent to be used should have similar solvent characteristics as the traditional solvent (or combination of solvents) used, to minimize changes to the coating application and performance characteristics. Exempt solvents such as Oxsol 100® (parachlorobenzotrifluoride) or acetone are available for reformulation.

3. Use of Reactive Diluents

For some solvent-based, two-component formulations, the use of reactive diluents may decrease the VOC content. Reactive diluents initially act as solvents and then form part of the coating, instead of evaporating away, thus reducing VOC emissions.

4. Change From Solvent-Based To Water-Based Formulations

When a solvent-based formulation is well above the VOC limit, changing to a water-based formulation may be a practical option. Currently, there are solvent-based and water-based versions of several types of basic formulations, such as acrylic, epoxy, and polyurethane formulations. The manufacturers of some of the newer, water-based, low VOC coatings believe that the performance characteristics of the new coatings are comparable to that of the traditional, solvent-based, high-VOC coatings. Coatings may also be reformulated by changing the resin type and formulation altogether. For example, a current alkyd formulation (solvent-based) may be changed to an acrylic formulation (water-based) or to a low VOC, two-component epoxy or polyurethane formulation, depending on the performance characteristics needed.

The current alkyd coatings are essentially all solvent-based, high VOC formulations. There are indications that new technologies are emerging for water-based alkyds that may meet the proposed VOC limits in the SCM.

5. Change to Hybrid Resin Systems

Changing current high-VOC formulations, such as alkyds, by developing new hybrid resins may be an option to lower VOC contents. This option may be desirable since hybrid resins and formulations may provide new or enhanced performance characteristics, and thus may provide more types of formulations and flexibility for the coating users.

6. Decrease Level of Coalescent Solvents and/or Glycols

For non-complying water-based formulations, the coalescent solvents and freeze/thaw additives (glycols) are generally the main sources of VOCs. To lower the VOC content, the resins may need to be modified to enable lower amounts of coalescent solvents and/or glycols to be used.

Overall, the staff made an effort wherever possible to ensure that multiple reformulation options are available for products to comply with the proposed VOC limits. Multiple reformulation options allow flexibility in the formulation of compliant coatings, ensuring that effective, reliable, and cost-effective coatings will be brought to the marketplace. The proposed limits were developed at VOC levels that staff determined could be met without the increased use of Toxic Air Contaminants or ozone-depleting compounds.

C. TEST RESULTS

We also reviewed available test results comparing the application and durability performance characteristics of certain low and high VOC coatings. The tests include results from the Harlan Associates Study and the National Technical Systems (NTS) Study.

1. Harlan Associates Study

In February 1995, the ARB published the results of performance testing of architectural coatings by Harlan Associates, Inc. The purpose of the study was to determine the physical properties and performance of representative products in eight coating categories. A total of 110 coating products, purchased during late 1993 and throughout 1994, were tested in the following categories:

- Industrial Maintenance Primers and Topcoats
- High-Temperature Industrial Maintenance Coatings
- Lacquers
- Varnishes
- Non-flats (including Quick-Dry Enamels)
- Primers/Sealers (including Quick-Dry Primers/Sealers)
- Sanding Sealers
- Waterproofing Sealers (Wood and Concrete)

While the raw data from this study were published in 1995, an analysis of the overall comparison of the coatings' test performance was not published. In developing the proposed SCM, ARB and district staffs analyzed and summarized the raw data. This performance study, although somewhat dated, is used to supplement the newer NTS study.

2. NTS Study

In support of the 1999 amendments to its architectural coatings rule (Rule 1113), the South Coast AQMD contracted with NTS to test performance characteristics of six significant architectural coating categories. The ARB staff has participated on the contract's technical advisory committee, which was established to oversee contractor selection, coating selection, testing protocol development, and analysis of results. Most of the members in the technical advisory committee are from the coating industry. The study was initiated in May 1998, and an interim report was released in April 1999. ARB staff analyzed the data from the laboratory portion of the NTS Study, and the results of the study are an important part of our technical assessment of these eight coating categories. ARB's analysis is found in Appendix E. In addition to the laboratory results, accelerated exposure, real time exposure, and application characteristics studies are continuing. ARB staff are continuing to track these portions of the NTS study, and we will include any results in our future technology assessments.

The purpose of the NTS study was to test the application and durability performance of very low-VOC, low-VOC, and just-compliant coatings for the following six coating categories:

- Industrial Maintenance Coatings
- Non-flat Coatings
- Primers, Sealers, and Undercoaters
- Quick-Dry Enamels
- Quick-Dry Primers, Sealers, and Undercoaters

- Waterproofing Sealers

Results from the Harlan Associates Study and the NTS Study are discussed in the technical assessment for these categories (See Chapter VI). Overall, the complying coatings performed similarly to the non-complying coatings.

D. EXISTING REGULATORY LIMITS

We also considered the regulatory limits currently in effect in the air pollution control and air quality management districts (air districts) in California, and the national limits promulgated in the U.S. EPA's rule. In particular, we considered the regulatory limits adopted by the South Coast AQMD on May 14, 1999, and the South Coast AQMD's technical assessment associated with those limits. Because of the lead efforts taken by the South Coast AQMD, their interim limits served as the starting points in developing many of the limits in the SCM, with differences as discussed in the technical assessment for each of the SCM categories (see Chapter VI). One notable difference is that the South Coast AQMD rule includes certain final limits to be effective during the 2005-2008 time frame, while the SCM includes only near term limits, to be effective during the 2003-2004 time frame.

The national limits apply as minimal requirements. In most cases, the SCM included limits more stringent than the national limits, because of the greater need for VOC emission reductions in California compared to other parts of the nation, or because the SCM limits have been in effect for many years already in many California districts.

The districts with adopted architectural coatings rules (other than the South Coast AQMD) are anticipated to be updating their rules. Also, other districts that are nonattainment for the State or federal ozone or PM_{10} standards may decide to adopt architectural coatings rules. The purpose of this SCM is to serve as a model rule for these districts. Our technical assessment considers the current common district limits by category, and the extent of changes if the SCM limits are to be implemented by the districts. Some of the current district limits are based on the ARB's 1989 SCM for architectural coatings, the predecessor document to this proposed SCM.

E. COMMENTS RECEIVED

As described above, we received comments and considered VOC limits suggested by coating manufacturers, air districts, other government agencies, other industry groups, and trade groups. Various workshops and meetings were held, and many revisions to the draft SCM have been made. This coordinated effort was an important approach for developing the VOC limits, compliance dates, category definitions, and related wording as currently proposed in the SCM.

Table IV-1 lists the proposed VOC limits for each coating category, the emission reductions, and the number and marketshare of coatings that currently comply with the proposed limits. The total emission reductions from the proposed limits is about 10 tons per day (excluding the South Coast AQMD). The variation in complying marketshare reflects the fact

that each limit is developed independently, based on individual technical assessments and on the available reformulation options.

Table IV-2 summarizes the emission reductions that will be realized in the non-South Coast AQMD portion of the State from the few National Rule limits that are more stringent than most current district rules. These emission reductions cannot be claimed as being due to the proposed SCM, but can be claimed by districts toward their SIP commitments, assuming a district did not take credit for the National Rule in their applicable SIP. See also Chapter VI category discussions.

Table IV-1
Summary of Complying Products

Coating Category	Proposed VOC Limit (g/l)	Number of Complying Products/ Total[1]	VOC Emission Reduction (TPD) and Percent Reduction	Complying Marketshare[2] (%)
Flat Coatings	100	1,097/2,355	1.39/17	48.5
Non-flat Coatings				
- Low Gloss	150	472/851	0.11/6	75.7
- Medium Gloss	150	805/2139	1.06/16	57.3
- High Gloss	250	333/796	0/0	79.5
Specialty Coatings:				
Antenna Coatings	530	None reported	0/0	~100[3]
Antifouling Coatings	400	PD	0/0	100
Bituminous Roof Coatings	300	110/151	0/0	98
Bituminous Roof Primers	350	Not surveyed	0/0	Unknown[4]
Bond Breakers	350	PD	0/0	PD
Clear Wood Coatings				
- Clear Brushing Lacquers	680	Not surveyed	0/0	Unknown[4]
- Lacquers (including lacquer sanding sealers)	550	138/403	1.03/41	13.8
- Sanding Sealers (other than lacquer sanding sealers)	350	5/31	0/0	4.5
- Varnishes			0/0	
- Clear	350	146/341		47.6
- Semitransparent	350	28/90		51.5
Concrete Curing Compounds	350	36/47	0/0	95.1
Dry Fog Coatings	400	46/51	0/0	96.9
Faux Finishing Coatings	350	Not surveyed	0/0	~100[3]
Fire-Resistive Coatings	350	Not Surveyed	0/0	Unknown[4]
Fire-Retardant Coatings				
- Clear	650	PD	0/0	100
- Opaque	350	53/57	0/0	99.8
Floor Coatings	250	373/578	0/0	84.8

Table IV-1 (continued)
Summary of Complying Products

Coating Category	Proposed VOC Limit (g/l)	Number of Complying Products/ Total[1]	VOC Emission Reduction (TPD) and Percent Reduction	Complying Marketshare[2] (%)
Flow Coatings	420	None reported	0/0	~100[3]
Form-Release Compounds	250	PD/13	0/0	PD
Graphic Arts Coatings (sign paints)	500	18/108	0/0	81.2
High-Temperature Coatings	420	54/93	0/0	52.5
Industrial Maintenance Coatings[5]	250	941/2,759	2.95/38	28.0
Low Solids Coatings	120	PD	0/0	PD
Magnesite Cement Coatings	450	PD/5	0/0	PD
Mastic Texture Coatings	300	56/56	0/0	100
Metallic Pigmented Coatings	500	98/125	0/0	98.3
Multi-Color Coatings	250	13/22	0.01/29	65.8
Pre-Treatment Wash Primers	420	PD/30	0/0	PD
Primers, Sealers, and Undercoaters	200	445/891	0.64/14	73.6
Quick-Dry Enamels[6]	250	PD/154	0.99/44	PD
Quick-Dry Primers, Sealers, and Undercoaters[7]	200	19/150	1.00/31	34.6
Roof Coatings	250	125/174	0/0	97.4
Rust Preventative Coatings[8]	400	16/25	0/0	63.5
Shellacs - Clear - Opaque	 730 550	 2/2 10/10	 0/0 0/0	 100 100
Specialty Primers, Sealers, and Undercoaters	350	Not surveyed	0/0	Unknown[4]
Stains	250	337/1323	0.64/17	52.8
Swimming Pool Coatings	340	PD/18	0/0	PD
Swimming Pool Repair and Maintenance Coatings[9]	340	0/6	0.03/70	0
Temperature-Indicator Safety Coatings	550	Not Surveyed	0/0	High[3]
Traffic Marking Coatings	150	107/161	0/0	53.4
Waterproofing Sealers - Concrete/Masonry - Wood	 400 250	 Not surveyed[10] Not surveyed[10]	0.39/36	 95.2[10] 12.8[10]
Wood Preservatives Below Ground - Clear - Semitransparent - Opaque	 350 350 350 350	 PD 16/20 20/25 PD	 0/0 0/0 0/0 0/0	 PD 94.7 74.1 PD

1. Information based on ARB's 1998 Architectural Coatings Survey.
2. Information based on ARB's 1998 Architectural Coatings Survey. Complying marketshare is based on sales volumes reported in survey.
3. Complying marketshare estimated (not based on ARB survey).
4. Complying marketshare unknown, but estimated to be significant because many district rules currently have the same VOC limit specified in the SCM.
5. A 340 g/l limit is available by a petition process in coastal regions north of Point Sur. However, data reflects all industrial maintenance coatings at 250 g/l.
6. There may be additional coatings in the "non-flat-high gloss" category that meet the definition of "quick-dry enamel."
7. There may be additional coatings in the "primer, sealer, and undercoater" category that meet the definition of "quick-dry primer, sealer, and undercoater."
8. These include products specifically listed as rust preventative in the ARB study.
9. Although the survey shows a zero complying marketshare, several district rules currently specify a 340 g/l VOC limit for swimming pool repair and maintenance coatings. In addition, "swimming pool repair and maintenance coatings" are a specific technology that has been signaled to be phased out for the past ten years (as evidenced by district rules). Current 340 g/l swimming pool coatings will meet this need.
10. Waterproofing sealers were surveyed in the ARB's 1998 Architectural Coatings Survey, but the survey did not distinguish between products for wood and concrete. The complying marketshares are based on all waterproofing sealers.

PD = Protected data, less than three companies reporting.

Table IV-2
VOC Emission Reductions Credited to U.S. EPA's National Rule

Coating Category	VOC Emission Reductions (excluding South Coast AQMD) (tons/day)
Quick-dry Primers, Sealers, and Undercoaters	0.27
Roof Coatings	0.01
Rust Preventatives	0.01
Traffic Coatings	0.36
Total	**0.65**